2015 AAPT

Winter Meeting

San Diego, CA

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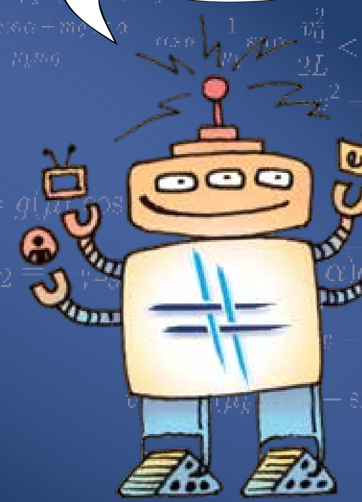

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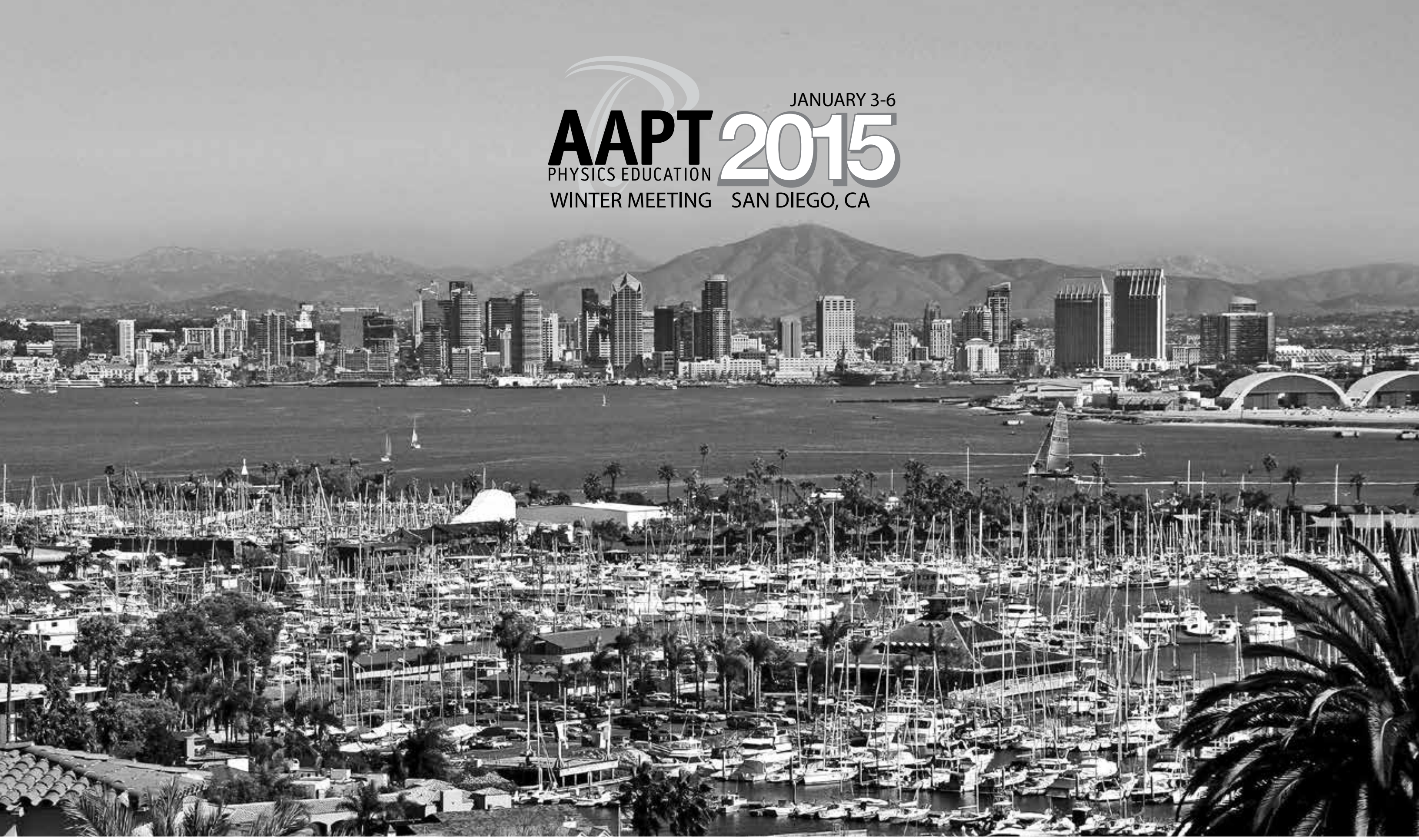

2015 AAPT Winter Meeting

San Diego, CA
January 3–6, 2015

Sheraton San Diego Hotel & Marina

American Association of Physics Teachers
One Physics Ellipse
College Park, MD 20740
301-209-3333
www.aapt.org

Cover photo: courtesy San Diego.org, Joanne DiBona

photos courtesy: Joanne DiBona, sandiego.org

Welcome to San Diego

Welcome to the 2015 AAPT winter meeting in San Diego. Be prepared for workshops for physics, astronomy, and physical science teachers of any level, engaging sessions on a variety of topics, plenary talks, and special events—an exciting and invigorating four days!

History of San Diego

Originally, Native Americans, the Kumeyaays, lived next to the San Diego River and coastal area. The first Europeans to land on the West Coast were represented by Juan Rodriguez Cabrillo of Spain at San Diego Bay in 1542. He claimed the entire area for Spain. In 1602 Sebastián Vizcaíno was sent to map the California coast; he arrived on his ship the San Diego. In 1769, Gaspar de Portolà established the Fort Presidio of San Diego. Also that year, Mission San Diego de Alcalá was founded by Franciscan friars.

San Diego became part of Mexico in 1821 after Mexico won its independence from Spain. The Fort Presidio was gradually abandoned; and the town of San Diego grew up on the level land below the fort. In the year 1838, San Diego had only 100-150 residents and it lost its pueblo status.

The U.S. went to war against Mexico in 1846 and set out to conquer California. The Mexican-American war dragged out til 1848, ending with the Treaty of Guadalupe Hidalgo. The Mexicans tried to keep San Diego as part of Mexico, but eventually, the boarder was agreed on to be "one league" south of San Diego Bay. The state of California was admitted to the union in 1850; the same year San Diego was incorporated as a city.

Two world fairs, the Panama-California Exposition in 1915, and the California Pacific International Exposition in 1935, were held in San Diego's Balboa Park. Many of the Spanish-Baroque style buildings built for these events are still there. San Diego became a major hub of military activity, and the population of the city doubled between 1930 (147,995) to 1950 (333,865).

Education

The following colleges and universities are located in and around San Diego:

Public colleges include: *University of California, San Diego, San Diego State University, San Diego Community College District.* Private colleges include: *University of San Diego, Point Loma Nazarene University, Alliant International University (AIU), National University, California International Business University (CIBU), San Diego Christian College, John Paul the Great Catholic University, California College San Diego, Coleman University, University of Redlands School of Business.*

(courtesy, Wikipedia)

Things to do in San Diego:

◆ **San Diego Zoo:** The San Diego Zoo is one of San Diego's most well-known attractions—famous for its pandas and its pioneering efforts to create cage-less exhibits. Also see Orchid House and botanical gardens. Open daily 9–6. 2920 Zoo Drive • San Diego, CA 92101 • *zoo.sandiegozoo.org/*.

◆ **San Diego Air and Space Museum:** The Air and Space Museum San Diego has exhibits that display aerospace artifacts and aviation memorabilia in addition to flight simulators and 3D/4D movie showings. 2001 Pan American Plaza • San Diego, CA 92101 • *www. sandiegoairandspace.org/*.

◆ **USS Midway Museum:** The USS Midway Museum welcomes visitors to tour the 60 exhibits and 25 restored aircrafts about the famous aircraft carrier. Located in the harbor area, you can also take a Harbor Tour by boat or visit the Maritime Museum there. 910 North Harbor Drive • San Diego, CA 92101 • *www.midway.org/*.

◆ **SeaWorld San Diego:** SeaWorld in San Diego has a roller coaster and you can also watch Shamu's tricks and learn about marine life and conservationism. 500 Sea World Drive • San Diego, CA 92109 • *seaworldparks.com/en/seaworld-sandiego/*.

◆ **Hotel del Coronado and beach:** An iconic beachfront luxury hotel in San Diego; site of "Some Like it Hot" filming and other movies. Opened in 1888, it is one of the few remaining Victorian wooden luxury hotels and is designated a National Historic Landmark. 1500 Orange Ave. • Coronado, CA 92118 • *http://hoteldel.com/*.

◆ **San Diego Museum of Man:** Anthropology museum located in Balboa Park. Find out more about humans. Special exhibits now: "From the Vault Rare Artifacts with Fascinating Stories," "BEERology," "Monsters!" 1350 El Prado • Balboa Park, San Diego, CA 92101; *www.museumofman.org/*.

◆ **Balboa Park:** Famous city park founded in late 1800s, and many buildings are from the 1915 Panama-California Exposition. Includes Old Globe Theater, Model Railroad Museum, Automotive Museum, Japanese Friendship Garden, and Natural History Museum plus the Zoo! 1350 El Prado • Balboa Park, San Diego, CA 92101; *http://www.balboapark.org/*.

(compiled from www.sandiego.org/)

Photo courtesy Hotel del Coronado

Photo courtesy San Diego Zoo

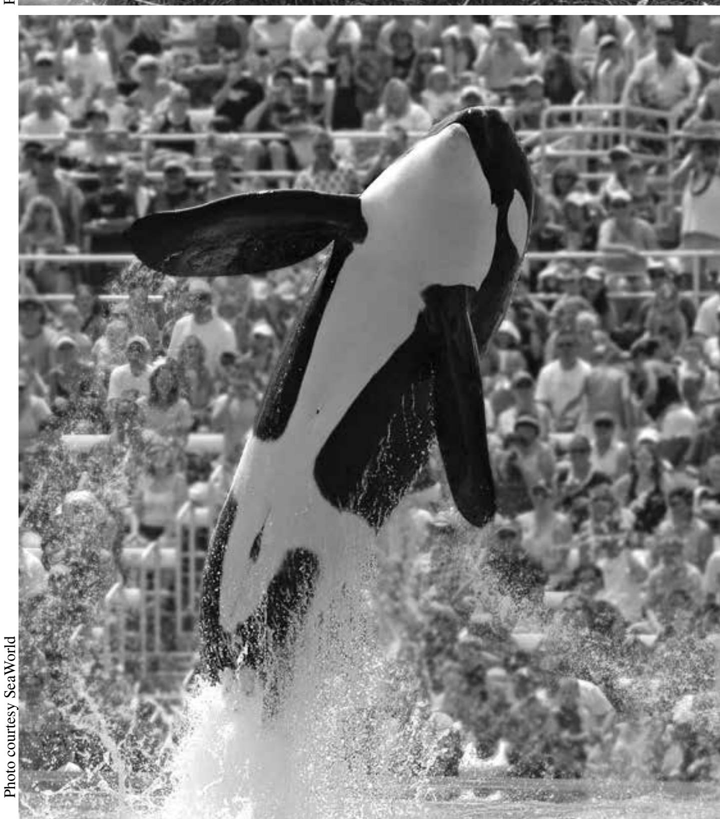

Photo courtesy SeaWorld

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The American Association of Physics Teachers is extremely grateful to the following companies who have generously supported AAPT over the years:

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WebAssign

Special Thanks

AAPT wishes to thank the following persons for their dedication and selfless contributions to the Winter Meeting:

Greg Severn, University of San Diego, for organizing the workshops.

Paper sorters:

Sean Bentley, *Society of Physics Students, College Park, MD*

Andrew Gavrin, *Indiana University–Purdue University Indianapolis*

Jan Mader, *Great Falls High School, Great Falls, MT*

Daryl McPadden, *Florida International University, Miami, FL*

Eleanor Sayre, *Kansas State University. Manhattan, KS*

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Facebook/Twitter at Meeting

We will be posting updates to Facebook and Twitter prior to and during the meeting to keep you in the know! Participate in the conversation on Twitter by following us at **twitter.com/AAPTHQ** or search the hashtag **#aaptwm15**. We will also be posting any changes to the schedule, cancellations, and other announcements during the meeting via both Twitter and Facebook. Visit our Pinterest page for suggestions of places to go and things to do in Orlando. We look forward to connecting with you!

Facebook: facebook.com/AAPTHQ
Twitter: twitter.com/AAPTHQ
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Contacts:

Meeting Registration Desk: 240-247-7001

AAPT Programs & Conferences Dept:
301-209-3340; programs@aapt.org

Tiffany Hayes, Director, Programs & Conferences

Cerena Cantrell, Associate Director, Programs & Conferences

Janet Lane, Programs Administrator

Pearl Watson, Meetings Logistics & Registration Coordinator

American Association of Physics Teachers
One Physics Ellipse
College Park, MD 20740-3845
301-209-3340, fax: 301-209-0845
programs@aapt.org, www.aapt.org

First time at an AAPT meeting?

Welcome to the 2015 AAPT Winter Meeting in San Diego! Everyone at AAPT hopes you fulfill all the goals you have for attending this meeting. To help you plan your meeting activities, the following information and suggestions have been developed.

- Being at your first National Meeting can be a lonely experience if you don't know anyone. AAPT members are friendly people, so do not hesitate to introduce yourself to others in sessions and in the hallways. It is fun and rewarding to establish a network of other physics teachers with whom you can talk and share experiences. This is especially true during lunch and dinner.
- Area Committee meetings are not only for members of the committee, but also for friends of the committee. You are welcome to attend any Area Committee meeting. You should be able to find one or two committees that match your interests. Their meeting times are listed on page 14 in this guide. Area Committee meetings are often relatively small and are a great place to meet other people with interests similar to yours.
- Be sure to attend the First Timers' Gathering from **7–8 a.m. Sunday in Seabreeze 1-2**. It is a wonderful way to learn more about the meeting and about AAPT.
- Awards and other plenary sessions have distinguished speakers and are especially recommended. Invited speakers are experts in their fields and will have half an hour or more to discuss their subjects in some depth. Posters will be up all day and presenters will be available during the times indicated in the schedule. Contributed papers summarize work the presenters have been doing. You are encouraged to talk to presenters at the poster sessions or after the contributed paper sessions to gain more information about topics of interest to you. Informal discussion among those interested in the announced topic typically will follow a panel presentation, and Topical Discussions are entirely devoted to such discussions.
- Be sure to make time to visit the exhibits in the Exhibit Hall in Harbor Island Ballroom. This is a great place to learn what textbooks and equipment are available in physics education.

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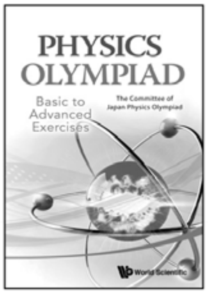

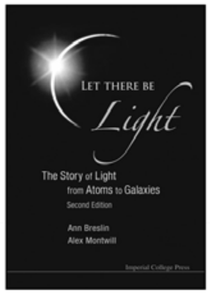

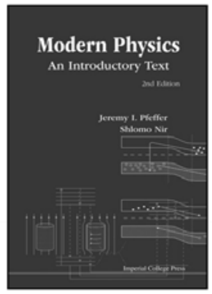

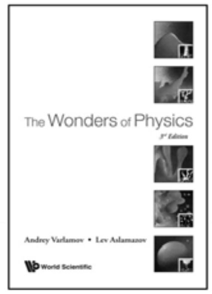

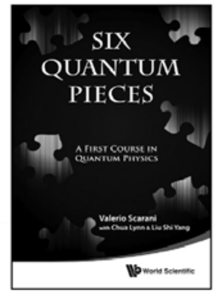

INTERNATIONAL YOUNG PHYSICISTS' TOURNAMENT
Problems & Solutions 2012 – 2013
edited by **Sihui Wang** & **Wenli Gao** *(Nanjing University)*

This book is based on the solutions of 2012 and 2013 IYPT problems. Many of the articles include modification, extension to existing models in references, or derivation and computation based on fundamental physics, and are not confined to the models and methods in present literatures.

268pp **Dec 2014**
978-981-4630-83-2(pbk) **US$38** **£25**

PHYSICS OLYMPIAD — BASIC TO ADVANCED EXERCISES
by **The Committee of Japan Physics Olympiad**

This book contains some of the problems and solutions in the past domestic theoretical and experimental competitions in Japan for the International Physics Olympiad. Through the exercises, we aim at introducing the appeal and interest of modern physics to high-school students.

380pp **Mar 2014**
978-981-4556-67-5(pbk) **US$48** **£32**

LET THERE BE LIGHT (2nd Edition)
The Story of Light from Atoms to Galaxies
by **Ann Breslin** & **Alex Montwill**
(University College Dublin)

"Compared to the first edition, the mathematics demands have been reduced, and the last chapter has been expanded to include the potential detection of the Higgs boson in 2012. Historical interludes continue to be distinct from the main development, and the illustrations provide charming entertainment. The revisions make the main text, already instructive and well developed, more accessible and engaging to general audiences."
CHOICE

552pp **Apr 2013**
978-1-84816-758-2 **US$138** **£91**
978-1-84816-759-9(pbk) **US$52** **£34**

MODERN PHYSICS (2nd Edition)
An Introductory Text
by **Jeremy I Pfeffer** & **Shlomo Nir**
(Hebrew University of Jerusalem)

This second edition preserves the unique blend of readability, scientific rigour and authenticity that made its predecessor so indispensible a text for non-physics science majors. As in the first edition, it sets out to present 20th century physics in a form accessible and useful to students of the life sciences, medicine, agricultural, earth and environmental sciences. It is also valuable as a first reader and source text for students majoring in the physical sciences and engineering. Two new chapters have been added, one on Einstein's elucidation of Brownian Motion and the second on Quantum Electrodynamics.

676pp **Feb 2013**
978-1-84816-878-7 **US$148** **£98**
978-1-84816-879-4(pbk) **US$78** **£51**

THE WONDERS OF PHYSICS (3rd Edition)
by **Andrey Varlamov** *(Italian National Research Council)* &
Lev Aslamazov *(Moscow Technological University)*

"This is an informal, charming, and idiosyncratic book with a strongly personal choice of topics. Overall, a well-written, engaging text covering both nonstandard and appropriate subjects."
CHOICE

328pp **Apr 2012**
978-981-4374-15-6 **US$68** **£45**

SIX QUANTUM PIECES
A First Course in Quantum Physics
by **Valerio Scarani** *(NUS, Singapore)*, **Lynn Chua** &
Shi Yang Liu *(NUS High School of Mathematics and Science)*

This book is an original first approach to quantum physics, the core of modern physics. It combines the competence of a well-known researcher in quantum information science and the freshness in style of two high school students.

160pp **Sep 2010**
978-981-4327-53-4 **US$51** **£34**
978-981-4327-54-1(pbk) **US$25** **£17**

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www.worldscientific.com

Bus Schedule for AAPT Workshops

Saturday, January 3

Buses departing Sheraton to Univ. of SD

- 7:15 a.m.
- 7:25 a.m.
- 12:20 p.m.

Buses departing Univ. of SD, returning to Sheraton

- 12:15 p.m.
- 1:00 p.m.
- 5:15 p.m.
- 5:30 p.m.

Sunday, January 4

Buses departing Sheraton to Univ. of SD

- 7:15 a.m.
- 7:25 a.m.

Buses departing Univ. of SD, returning to Sheraton

- 12:15 p.m.
- 12:40 p.m.

**T02, T03, T05 and W35 will be held at the Sheraton Hotel and Marina;
all other workshops will take place at the University of San Diego.**

Sheraton San Diego Hotel and Marina
1380 Harbor Island Drive
San Diego, CA 92101

University of San Diego
5998 Alcalá Park
San Diego, CA 92110

SEES Program for area students!

Meeting-at-a-Glance

Meeting-at-a-Glance includes sessions, workshops, committee meetings and other events, including luncheons, Exhibit Hall hours and snacks, plenary sessions, and receptions. All rooms will be in the Sheraton Hotel, San Diego. Workshops on Saturday and Sunday will be at University of San Diego. The building at the university is the Shiley Center for Science and Technology (SCST) (Tutorials will be held at the hotel.)

FRIDAY, January 2

4–7 p.m.		**REGISTRATION**	**Grande Foyer**
4:30–5:30 p.m.		Finance Committee	Marina 1
5:45–6:45 p.m.		New Executive Board Orientation	Seabreeze 1-2
7–10 p.m.		Executive Board I	Seabreeze 1-2

SATURDAY, January 3

7 a.m.–4 p.m.		**REGISTRATION**	**Grande Foyer**
8–10 a.m.		Meetings Committee	Marina 3
8–10 a.m.		Publications Committee	Marina 4
		(WORKSHOPS W01-W34 ARE AT UNIV. OF SAN DIEGO, bus schedule, p. 8)	
8 a.m.–12 p.m.	W01	Workshop on Digital Spectroscopy	SCST 290
8 a.m.–12 p.m.	W02	Creating Interactive Web Simulations Using HTML5 and Javascript	SCST 233
8 a.m.–12 p.m.	W04	Beginning Arduino	SCST 252
8 a.m.–12 p.m.	W05	Phenomenon-based Learning: Fun, Hands-on, Cooperative Learning	SCST 235
8 a.m.–12 p.m.	W07	Teaching Physics for the First Time	SCST 230
8 a.m.–12 p.m.	W08	Writing in the Sciences	SCST 231
8 a.m.–12 p.m.	W10	An Introduction to Scientific Computing with Python and iPython Notebooks	SCST 133
8 a.m.–5 p.m.	W12	Inquiry-based Labs for AP Physics	SCST 229
8 a.m.–5 p.m.	W13	Research-based Alternatives to Traditional Physics Problems	SCST 129
10 a.m.–3 p.m.		San Diego Zoo Tour	offsite
10:15 a.m.–4:45 p.m.		Executive Board II	Seabreeze 1-2
11:30 a.m.–2:30 p.m.		Resource Letters Committee	Marina 4
1–5 p.m.	W14	Modeling in College Physics	SCST 230
1–5 p.m.	W15	Implementing Engineering Design in YOUR Classroom	SCST 233
1–5 p.m.	W17	STEM Grant Writing	SCST 231
1–5 p.m.	W21	Intersection of Physics and Biology: Activities and Materials	SCST 235
1–5 p.m.	W23	Fun & Engaging Physics Labs	SCST 232
1–5 p.m.	W24	Engaging TYC students in Astronomical Inquiry	SCST 130
1–5 p.m.	W25	Creating Affectively Positive Online Learning Environments	SCST 252
1–5 p.m.		USS Carrier Midway Museum Trip	offsite
3–4:30 p.m.		Nominating Committee I (Closed)	Marina 3
5:30–7 p.m.		ALPhA Committee	Marina 3
5:30–8 p.m.		Area Chairs Orientation & Programs I	Nautilus 4
5:30–8 p.m.		Section Representatives and Officers	Nautilus 1
7:30–9 p.m.		**REGISTRATION**	**Grande Foyer**
8–10 p.m.		SPS Undergraduate Research and Outreach Poster Session	Harbor Island Ballroom
8–10 p.m.		Exhibit Hall Opens / Opening Reception	Harbor Island Ballroom

SUNDAY, January 4

		School Spirit Day – wear a t-shirt or hat representing your school	
7 a.m.–4 p.m.		**REGISTRATION**	**Grande Foyer**
7–8 a.m.		First Timers' Gathering	Seabreeze 1-2
7:30–9 a.m.		Review Board	Marina 1
8–9 a.m.		Physics Bowl Advisory Committee	Marina 3
8 a.m.–12 p.m.	W27	Metacognition and Reasoning in Physics	SCST 233
8 a.m.–12 p.m.	W28	Astronomy and Physics Simulations for Computers and Tablets	SCST 292
8 a.m.–12 p.m.	W30	Making Good Physics Videos	SCST 252
8 a.m.–12 p.m.	W31	Low Cost, In Home Labs	SCST 290
8 a.m.–12 p.m.	W32	Writing Learning Objectives	SCST 231
8 a.m.–12 p.m.	W33	Simple DC Labs	SCST 229
8 a.m.–12 p.m.	W34	New RTP and ILD Tools and Curricula: Video Analysis, Clickers and E&M Labs	SCST 235
8 a.m.–12 p.m.	W35	Creating Physics Simulations for Smartphones, Tablet Devices & Computers in HTML5	Executive 3B
8 a.m.–3 p.m.		Physics of Scuba	Bay Tower Pool
9–10 a.m.		Venture/Bauder Committees	Marina 4
9–10 a.m.		Committee on Governance Structure	Marina 2

9–11 a.m.	T02	Building and Funding Outreach Programs	Executive 1
9–11 a.m.	T03	Electrostatics from Gilbert to Volta	Executive 2A
9–11 a.m.	T05	Using Elements of History and Philosophy of Physics in Teaching	Executive 3A
9 a.m.–12 p.m.		Special Workshop for Section Representatives	Executive 2B
10 a.m.–12 p.m.		Bringing the New Physics Teachers Workshop to San Diego High School Teachers	Grande Ballroom B
10 a.m.–5 p.m.		**Exhibit Hall Open**	Harbor Island Ballroom
10–10:30 a.m.		Exhibit Hall Morning Break (10:15 a.m. Kindle Fire Raffle Drawing)	Harbor Island Ballroom
10–11 a.m.		Spouse/Guest Gathering	Harbor's Edge rest.
10–10:40 a.m.	AB	PER: Evaluating Instructional Strategies	Nautilus Hall 5
10 a.m.–12 p.m.	AA	SPS Undergraduate Research and Outreach	Nautilus Hall 1
10 a.m.–12 p.m.	AC	Best Practices in Educational Technology	Nautilus Hall 2
10:30 a.m.–12 p.m.	AD	Understanding the Redesigned AP Physics 1 and 2 Courses and Exams	Nautilus Hall 3
11 a.m.–12 p.m.	AE	30 Demos in 60 Minutes	Nautilus Hall 4
11 a.m.-12 p.m.	CW01	Create Your New Year's Teaching Resolution: Cengage Learning	Marina 6
12–1 p.m.	CW02	Enrich your Physics Course with WebAssign Additional Resources	Spinnaker 1-2
12–1 p.m.	CW05	The New Fourth Edition of Matter & Interactions	Executive 4
12:30–2 p.m.		Committee on the Interests of Senior Physicists	Marina 1
12:30–2 p.m.		Committee on Physics in Undergraduate Education	Marina 3
12:30–2 p.m.		Committee on Teacher Preparation	Marina 4
12:30–2 p.m.		Committee on Women in Physics	Marina 2
12:30–2 p.m.		High School Physics Teachers Luncheon	Seabreeze 1-2
12:30–2 p.m.		Early Career Professional Speed Networking	Grande Ballroom A
2–2:50 p.m.	BB	Recruitment and Retention	Nautilus Hall 2
2–3 p.m.	BE	Powerful, Simple, Collaborative Graphing with Plot.ly	Executive 2A/2B
2–3:10 p.m.	BD	Decreasing Stereotype Threat in Discourse and Assessment	Nautilus Hall 3
2–3:10 p.m.	BG	Department Lab Assessment	Executive 3A/3B
2–3:10 p.m.	BH	PER: Student Engagement and Metacognition	Nautilus Hall 5
2–3:30 p.m.	BA	The Higgs and My Classroom	Nautilus Hall 1
2–3:30 p.m.	BC	How to Publish an Article	Grande Ballroom B
2–3:40 p.m.	BF	Exemplary Ways to Prepare Elementary School Teachers to Meet the NGSS Challenge	Nautilus Hall 4
3:30–4 p.m.		**Exhibit Hall** Afternoon Break (3:45 p.m. AmEx Gift Card Drawing)	Harbor Island Ballroom
4–5:30 p.m.	CA	Challenges with Sea-based Naval Operations & Unmanned Aerial System Integration	Nautilus Hall 1
4–5:30 p.m.	CB	Report from International Conference on Women in Physics	Executive 3A/3B
4–5:30 p.m.	CF	Development of Perception of Extraterrestrial Life	Nautilus Hall 5
4–5:30 p.m.	CG	Beyond the MOOCs: The Impact of Open Online Courses	Executive 2A/2B
4–5:40 p.m.	CD	Technology-Enhanced Teaching Environments	Nautilus Hall 3
4–6 p.m.	CC	Teaching Math Methods in the Upper Level UG Physics	Nautilus Hall 2
4–6 p.m.	CE	K-12 PER	Nautilus Hall 4
4–6 p.m.	CH	Improving Pedagogy in Pre High School Education	Grande Ballroom B
6–7 p.m.		Meet-up for Early Career & First Timers	Tapatini restaurant
6–7:30 p.m.		Committee on History & Philosophy in Physics	Marina 3
6–7:30 p.m.		Committee on Laboratories	Marina 4
6–7:30 p.m.		Committee on Physics in High Schools	Nautilus Hall 1
6–7:30 p.m.		Committee on Physics in Two-Year Colleges	Marina 2
6–7:30 p.m.		Committee on Research in Physics Education (RiPE)	Nautilus Hall 5
6–7:30 p.m.		SPS Undergraduate Awards Reception	Seabreeze 1-2
6–7:30 p.m.	TOP01	Physics & Society Topical Discussion	Nautilus Hall 3
6–7:30 p.m.	TOP02	iOS and Android App Show	Executive 2A/2B
6–7:30 p.m.	TOP05	Topical Discussion: The Joint Task Force on Undergraduate Physics Programs	Executive 3A/3B
7:30–8:30 p.m.	**Plenary**	Adrian Bejan	Grande Ballroom C
8:30–9:15 p.m.		Book signing for Adrian Bejan	Grande Ballroom C
8:30–9 p.m.		General Membership Meeting	Grande Ballroom C
8:45–10 p.m.		High School Share-a-thon	Nautilus Hall 5
9–10:30 p.m.		AAPT Council Meeting	Grande Ballroom C

MONDAY, January 5

7 a.m.–5 p.m.	**REGISTRATION**	**Grande Foyer**
7–8 a.m.	Two-Year College Breakfast	Spinnaker 1-2
7–8 a.m.	AAPT Fun Run/Walk	offsite
7:30–9 a.m.	Awards Committee (Closed)	Marina 4
7:30–10 a.m.	Investment Advisory Committee	Marina 3

8–9:30 a.m.	PST1	Poster Session 1	Grande Ballroom A
8–9:30 a.m.	TOP03	History and Philosophy of Physics Topical Discussion	Nautilus Hall 3
8–9:30 a.m.	TOP04	Graduate Student Topical Discussion	Nautilus Hall 4
9:30–11 a.m.	**Awards**	Melba Newell Phillips Medal – Tom O'Kuma; SPS Chapter Advisor Award	Grande Ballroom C
10 a.m.–4 p.m.		**Exhibit Hall Open**	Harbor Island Ballroom
10:30–11 a.m.		**Exhibit Hall Break** (10:45 a.m. Fitbit Wristband Drawing)	Harbor Island Ballroom
11 a.m.–12 p.m.	DC	Historical Incidents Useful for Teaching Physics	Nautilus Hall 2
11 a.m.–12 p.m.	DF	Interactive Lecture Demonstrations–What's New? ILDs Using Clickers & Video Analysis	Nautilus Hall 5
11 a.m.–12 p.m.	DJ	Recruiting and Retaining Underrepresented Physics Teachers	Spinnaker 1-2
11 a.m.–12:10 p.m.	DD	Single Photon Detectors	Nautilus Hall 3
11 a.m.–12:20 p.m.	DA	Using Social Networking to Enhance Your Physics Class	Nautilus Hall 1
11 a.m.–12:30 p.m.	DG	Writing in Physics	Seabreeze 1-2
11 a.m.–12:30 p.m.	DH	Panel of Support and Information for Graduate Students	Executive 2A/2B
11 a.m.–12:30 p.m.	DI	Updates and Resources for Introductory Physics for Life Sciences	Executive 3A/3B
11 a.m.–12:30 p.m.	DB	Physics Outreach at Science Festivals	Executive 1
11 a.m.–12:40 p.m.	DE	Mentoring Newly Graduated Teachers to Improve Retention	Nautilus Hall 4
12:30–1:30 p.m.	CW03	Expert TA: Closing the Gap between Homework and Test Scores	Marina 6
12:30–1:30 p.m.		Multicultural Luncheon	Harbor's Edge restaurant
12:30–2 p.m.		Committee on Educational Technologies	Marina 1
12:30–2 p.m.		Committee on Graduate Education in Physics	Marina 3
12:30–2 p.m.		Committee on Diversity in Physics	Marina 4
12:30–2 p.m.		Committee on Science Education for the Public	Marina 2
12:30–2:30 p.m.	CW04	CourseWeaver: Easy Authoring of Computer-Graded Homework	Nautilus Hall 1
2–3 p.m.		**Plenary:** Eugene G. Arthurs	Grande Ballroom C
3–3:30 p.m.		**Afternoon Break in Exhibit Hall** (3:15 p.m. IPad Mini drawing)	Harbor Island Ballroom
3:30–4:10 p.m.	EI	Remote Labs	Grande Ballroom B
3:30–4:40 p.m.	EH	Research Experiences for Teachers (RET)	Spinnaker 1-2
3:30–5 p.m.	EA	Career Pathways - Mentoring Undergraduates	Nautilus Hall 4
3:30–5:10 p.m.	EB	Evaluation of Teachers and Professors	Nautilus Hall 1
3:30–5:30 p.m.	EC	International Networks for Action Research in Physics Education	Nautilus Hall 2
3:30–5:30 p.m.	ED	Project Learning Labs for Undergraduate Innovation and Entrepreneurship in Physics	Nautilus Hall 3
3:30–5:30 p.m.	EE	Teaching Sustainability in Non-major Courses	Executive 3A/3B
3:30–5:30 p.m.	EF	Informal Science Education	Executive 2A/2B
3:30–5:30 p.m.	EG	PER in the Professional Preparation of Teachers	Nautilus Hall 5
4:30–5 p.m.	EJ	Upper Division Undergraduate	Grande Ballroom B
4:30–5 p.m.		Great Book Giveaway	Harbor Island Foyer
5:30–6:30 p.m.		Member and Benefits Committee	Marina 4
5:30–6:30 p.m.		Committee on SI Units and Metric Education	Marina 1
5:30–7 p.m.		Committee on Apparatus	Executive 3A/3B
5:30–7 p.m.		Committee on International Physics Education	Seabreeze 1-2
5:30–7 p.m.		Committee on Physics in Pre-High School Education	Marina 3
5:30–7 p.m.		Committee on Professional Concerns	Marina 6
5:30–7 p.m.		Committee on Space Science and Astronomy	Marina 2
5:30–7 p.m.		PERLOC (Closed)	Executive 2A/2B
6–7:30 p.m.		AIP Gemant Award Presentation: Sean Carroll	Fleet Center
7–8 p.m.	FE	MOOCs as Outreach, Moving towards MOOO	Nautilus Hall 5
7–8 p.m.	FA	Introductory Courses	Nautilus Hall 1
7–8:10 p.m.	FB	Biophysics Labs Beyond the First Year	Nautilus Hall 2
7–8:30 p.m.	FC	Video Update – Advanced Video Techniques	Nautilus Hall 3
7–8:30 p.m.	FD	Recruiting & Facilitating Alternative Certification of Teachers	Nautilus Hall 4
8:30–10 p.m.		PTRA Oversight Committee	Marina 2
8:30–10 p.m.		Poster Session 2	Grande Ballroom A

TUESDAY, January 6

7–8:30 a.m.		Programs Committee II	Spinnaker 1-2
7–8 a.m.		Outdoor Yoga	Bayview Lawn
7–8:30 a.m.		PERTG Town Hall Meeting	Grande Ballroom C
8 a.m.–3 p.m.		**REGISTRATION**	Grande Foyer
8:30–9:10 a.m.	GG	Development of Perception of Extraterrestrial Life II	Executive 2A/2B
8:30–9:20 a.m.	GH	Updates and Resources for Introductory Physics for Life Science II	Executive 3A/3B 8:30–10
a.m.	GB	Mentoring Graduate Students for Careers Outside of Academia	Nautilus Hall 2
8:30–10:10 a.m.	GF	Effective Practices in Educational Technology	Harbor Island 1
8:30–10:20 a.m.	GE	Teaching Advanced and Honors Students	Nautilus Hall 5
8:30–10:30 a.m.	GA	Disentangling Student Reasoning From Conceptual Understanding	Nautilus Hall 1

8:30–10:30 a.m.	GC	Assessing Pedagogical Content Knowledge (PCK) for Teaching K-12 Physics	Nautilus Hall 3
8:30–10:30 a.m.	GD	Undergraduate Research	Nautilus Hall 4
9 a.m.–12 p.m.		SEES (Students to Experience Engineering and Science)	Harbor Island Ballroom
10:30 a.m.–12 p.m.	**Awards**	Oersted Medal: Karl Mamola, DSCs, Presidential transfer	Grande Ballroom C
12:30–1:10 p.m.	HC	Science and Society	Nautilus Hall 3
12:30–1:10 p.m.	HG	High School	Executive 3A/3B
12:30–1:40 p.m.	HD	PER: Examining Content Understanding and Reasoning	Nautilus Hall 4
12:30–1:50 p.m.	HA	TYC Partnerships	Nautilus Hall 1
12:30–2 p.m.	HB	Stories from the Leading Edge of Astronomy	Nautilus Hall 2
12:30–2 p.m.	HE	Endangered Physics Teacher Preparation Programs	Harbor Island 1
12:30–2 p.m.	HF	Writing in Physics II	Executive 2A/2B
2–3:30 p.m.		AAPT Symposium on Physics Education and Public Policy	Grande Ballroom C
3–5 p.m.		Nominating Committee II (Closed)	Marina 2
3:30–4:30 p.m.	IA	Post-deadline Abstracts (Paper)	Nautilus Hall 1
3:30–4 p.m.	IB	Post-deadline Abstracts II (Paper)	Nautilus Hall 2
3:30–4 p.m.	IC	An Introduction to Physical Sciences Education Advocacy	Grande Ballroom C
3:30–5 p.m.		Post-deadline Poster Session	Grande Ballroom A
4:30–5:30 p.m.		Executive Board III	Seabreeze 1-2

Tuesday, January 6: **5:30–9:30 p.m. Gaslamp Quarter Shuttle Service**

A shuttle will run between the Sheraton Hotel (pick-up at the end of the Sheraton driveway on Harbor Drive) and the Gaslamp Quarter (Gaslamp pick-up/drop-off location is at 4th and G Street) every 20-30 minutes.

Special Events at 2015 AAPT Winter Meeting

Saturday, January 3

▶ **San Diego Zoo Trip**
10 a.m–3 p.m. Saturday offsite

Considered one of America's best, the San Diego Zoo is a must-see in Southern California. Spend the day monkeying around in this tropical oasis as you visit amazing habitats for animals such as gorillas, tigers, sun bears, flamingos, mandrills, polar bears, birds of paradise, giant tortoises, leopards and more. Price includes round trip transportation, zoo admission along with scheduled shows, guided bus tour and Skyride. *Fee: $65 Child: $56*

▶ **USS Carrier Midway Trip**
10 a.m.–3 p.m. Saturday offsite

Since 2004, the USS Carrier Midway is docked in San Diego Harbor about 2.5 miles away from the AAPT conference hotel. With many narrations provided by Midway sailors and pilots who lived and worked on the carrier, the self-guided audio tour moves from the engine room to the bridge through 60 exhibits, including 29 restored aircraft. On the flight deck, one can see the constraints and mechanisms for launching and recovering aircraft. *Fee: $40 Child: $56*

▶ **Grand Opening of Exhibit Hall and Opening Reception** **Harbor Island Ballroom**
8–10 p.m. Saturday

Sunday, January 4

▶ **First Timers' Gathering**
7–8 a.m. Sunday
Seabreeze 1-2

Are you new to an AAPT National Meeting? If so, this is the best time to learn about AAPT and the Winter Meeting, as well as meet fellow attendees. AAPT leadership will be represented to discuss ways to get more involved with AAPT. You are also welcome to participate in any of AAPT's Area Committee meetings.

▶ **The Physics of Scuba**
8 a.m.–3 p.m. Sunday
Bay Tower pool / Fairbanks B (Bay Tower)

▶ **Spouse/Guest Gathering**
10–11 a.m. Sunday
Harbor's Edge restaurant

▶ **H.S. Physics Teachers Day Luncheon**
12:30–2 p.m. Sunday
Seabreeze 1-2

Special luncheon for high school teachers attending conference for the first time. Open to all. *Ticket required. Fee: $47*

▶ **Early Career Professionals Speed Networking Event**
12:30–2 p.m. Sunday
Grande Ballroom A

Speed-networking provides the opportunity to discuss career goals and challenges with a new contact for five minutes, exchange information, and then move on to the next person.

▶ **Exhibit Hall Kindle Drawing**
– 10:15 a.m. Sunday

▶ **Exhibit Hall $100 AmEx Card Drawing**
– 3:45 p.m. Sunday

Purchase tickets at Registration. You must be present to win!

Monday, January 6

▶ **Two-Year College Breakfast**
7–8 a.m. Monday
Spinnaker 1-2

Pre-register and enjoy your time and breakfast with like-minded attendees. *Fee: $30*

▶ **AAPT Fun Run / Walk**
7–8 a.m. Monday

Join us for the 6th Annual AAPT Fun Run/Walk *Fee: $20*

▶ **Multicultural Luncheon**
12:30–1:30 p.m. Monday
Harbor's Edge restaurant

Increase awareness and understanding while sharing and celebrating unique perspectives. *Ticket required. Fee: $47*

▶ **Exhibit Hall Fitbit Wristband Drawing**
– 10:45 a.m. Monday

▶ **Exhibit Hall IPad Mini Drawing**
– 3:15 p.m. Monday

Purchase tickets at Registration. You must be present to win!

▶ **Great Book Giveaway**
4:30–5 p.m. Monday
Harbor Island Foyer

Get your raffle ticket from the AAPT booth and attend this popular event to claim your book.

Tuesday, January 6

▶ **Outdoor Yoga**
7–8 a.m. Tuesday fee: $10
Bayview Lawn

Committee Meetings

All interested attendees are invited and encouraged to attend the Committee meetings with asterisks (*).

Friday, January 2

Finance Committee	4:30– 5:30 p.m.	Marina 1
New Executive Board Orientation	5:45–6:45 p.m.	Seabreeze 1-2
Executive Board 1	7–10 p.m.	Seabreeze 1-2

Saturday, January 3

Meetings Committee	8–10 a.m.	Marina 3
Publications Committee	8–10 a.m.	Marina 4
Resource Letters Committee	11:30 a.m.–2:30 p.m.	Marina 4
Executive Board II	10:15 a.m.–4:45 p.m.	Seabreeze 1-2
Nominating Committee I (Closed)	3–4:30 p.m.	Marina 3
ALPhA Committee	5:30-7 p.m.	Marina 3
Area Chairs Orientation and Programs I	5:30–8 p.m.	Nautilus Hall 4
Section Representative and Officers	5:30–8 p.m.	Nautilus Hall 1

Sunday, January 4

Review Board	7:30–9 a.m.	Marina 1
Physics Bowl Advisory Committee	8–9 a.m.	Marina 3
Governance Structure Committee	9–10 a.m.	Marina 2
Venture/Bauder Fund Committees	9–10 a.m.	Marina 4
Undergraduate Physics Education*	12:30–2 p.m.	Marina 3
Interests of Senior Physicists*	12:30–2 p.m.	Marina 1
Teacher Preparation*	12:30–2 p.m.	Marina 4
Women in Physics*	12:30–2 p.m.	Marina 2
History and Philosophy of Physics*	6–7:30 p.m.	Marina 3
Laboratories*	6–7:30 p.m.	Marina 4
Physics in High Schools*	6–7:30 p.m.	Nautilus Hall 1
Physics in Two-Year Colleges*	6–7:30 p.m.	Marina 2
Research in Physics Education*	6–7:30 p.m.	Nautilus Hall 5
AAPT Council Meeting	9–10:30 p.m.	Ballroom C

Monday, January 5

Awards Committee (closed)	7:30–9 a.m.	Marina 4
Investment Advisory Committee	7:30–10 a.m.	Marina 3
Educational Technologies*	12:30–2 p.m.	Marina 1
Graduate Education in Physics*	12:30–2 p.m.	Marina 3
Diversity in Physics*	12:30–2 p.m.	Marina 4
Science Education of the Public*	12:30–2 p.m.	Marina 2
Member and Benefits Committee	5:30–6:30 p.m.	Marina 4
Apparatus*	5:30–7 p.m.	Executive 3A/3B
International Physics Education*	5:30–7 p.m.	Seabreeze 1-2
Pre-High School Education*	5:30–7 p.m.	Marina 3
Professional Concerns*	5:30–7 p.m.	Marina 6
Space Science and Astronomy*	5:30–7 p.m.	Marina 2
SI Units and Metric Education*	5:30–6:30 p.m.	Marina 1
PERLOC (closed)	5:30–7 p.m.	Executive 2A/2B
PTRA Oversight Committee	8:30–10 p.m.	Marina 2

Tuesday, January 6

Programs Committee II	7–8:30 a.m.	Spinnaker 1-2
PERTG Town Hall Meeting	7:30–8:30 a.m.	Ballroom C
Nominating Committee II (Closed)	3–5 p.m.	Marina 2

Oersted Medal

Karl C. Mamola
Appalachian State University (emeritus)
Department of Physics

AAPT, TPT and me

Tuesday, January 6
10:30 a.m.–12 p.m.

Grande Ballroom C

Karl C. Mamola has been named as the 2015 recipient of the prestigious Oersted Medal, in recognition of his significant contributions to physics education through his roles as editor of *The Physics Teacher* and as mentor for students, prospective authors, column editors, reviewers, and others.

Mamola earned his BS in physics in 1963 at the Stony Brook University, his MS in physics in 1965 at Florida State University, and his PhD in physics in 1973 at Dartmouth College.

In 1963 Mamola began his career as Instructor of Physics at Appalachian State University. His responsibilities grew as he was promoted, first to Assistant Professor, then to Associate Professor, Chair of the Department of Physics & Astronomy (1977) and Professor (1978). He served as Department Chair for 21 years, and was the recipient of a number of teaching and service awards.

Throughout his career, Mamola has touched a multitude of lives, as a physics teacher, a prolific author, a presenter at national and local meetings, as editor of the "Apparatus for Teaching Physics" column in *The Physics Teacher*, and as editor of *The Physics Teacher,* AAPT's signature publication. He consistently produced an extraordinary publication with content accessible to and usable by physics teachers at all levels.

He has always served AAPT well at the section and national levels. As an active member of the Executive Board, he was also supportive of the national officers and took an active role in working on new Association initiatives. He gave freely of his time, using his leadership and writing skills in service to the physics teaching community. Mamola's involvement in AAPT in a wide range of capacities has made it a better organization and its members more effective educators. His contributions to physics and physics teaching continue to have an outstanding and widespread impact on the teaching of physics.

Remarking on his selection for the Oersted Medal, Mamola said, "For nearly 50 years AAPT has played a critical role in my professional life. I am grateful to everyone in the physics teaching community who has supported, inspired, and befriended me throughout the years. I'm delighted and honored to have been selected as the recipient of the 2015 Oersted medal."

The Oersted Medal is named for Hans Christian Oersted (1777-1851), a Danish physicist who, in the course of creating a demonstration for teaching his class, discovered that electric currents caused a magnetic field. This was a crucial step in establishing the theory of electromagnetism, so important in building modern technology and modern physics. The award was established by AAPT in 1936.

Melba Newell Phillips Medal

Thomas L. O'Kuma
Lee College
Physics Department

Growing with AAPT

Monday, January 5
9:30–11 a.m.

Grande Ballroom C

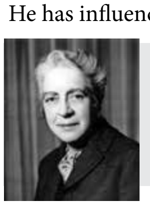
The Melba Newell Phillips Medal has been awarded to **Thomas L. O'Kuma**, Physics Faculty, Lee College, Baytown, TX, in recognition of his creative leadership and dedicated service that have resulted in exceptional contributions within AAPT.

O'Kuma received both his BS degree in physics and mathematics from Louisiana Tech University, Ruston, LA, and his MS in physics (research field, statistical mechanics). He did additional graduate work in physics and mathematics at the University of Florida and the University of Houston Clear Lake.

A Life Member of AAPT, O'Kuma has served in numerous roles for AAPT, including the role of AAPT President. He has served on 13 AAPT committees, including the Two Year College Committee, Nominating Committee (chair in 2007), the Executive Officer Search Committee, the TPT Editor Search Committee (chair in 2000), AAPT Council (chair in 1999), and numerous review committees and area committees. Most recently he completed a term as the chair of the Meetings Committee. The parameters for the committee were being refined and its future was not clear. Tom led AAPT through the transition from meetings for a smaller organization to the recognition that the current size requires considerable coordination to manage the logistics of a campus meeting. The success of the recent summer meetings in Philadelphia and Minneapolis and the success of the new format for the winter meeting has its origin in the work O'Kuma did with the Meetings Committee.

The Texas Section has benefited from his leadership as well. O'Kuma has provided professional development workshops at essentially every one of twice-yearly meetings. He has served in all of the Section officer roles, including Section Representative to AAPT, and is currently organizing the Texas Section spring meeting, highlighting the contributions of under-represented members of the community.

He has been a driving force for enhancing the educational opportunities for students in K-12 and the two-year colleges, presenting at the New Faculty Experience for Two Year College Faculty and serving on the steering committee for TYC21 Project, as Principal Investigator of the SPIN-UP/TYC Project. As a PI of multiple grants, his focus has always been on the teaching aspect of physics and the research behind effective teaching strategies. He has co-authored several books based on PER. O'Kuma served as a rural PTRA site coordinator for nearly 10 years and worked side by side with the PTRAs leading the sessions. He has influenced and mentored thousands of teachers in Texas and across the United States.

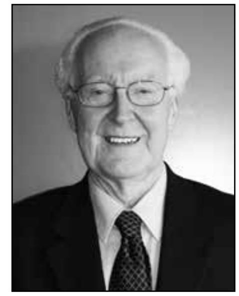


The Melba Newell Phillips Medal is presented to AAPT leaders who, like Melba Newell Phillips after whom the medal is named, have provided creative leadership and dedicated service that resulted in exceptional contributions to AAPT. The recipient, who must be an AAPT member, delivers an address at the AAPT Meeting at which the medal is presented and receives a monetary award, the Melba Newell Phillips Medal, an Award Certificate, and travel expenses to the meeting.The medal is presented only occasionally.

Homer L. Dodge Citations for Distinguished Service to AAPT

Tuesday, January 6 • 10:30 a.m.–12 p.m. • Grande Ballroom C

David Cook



David Cook

David Cook retired Professor of Physics and Philetus E. Sawyer Professor of Science, Lawrence University, served as AAPT Vice President (2008), President-Elect (2009), President (2010), and Past President (2011). Currently, he chairs the AAPT Meetings Committee. Cook earned his BS in physics at Rensselaer. Both his AM and PhD in physics were earned at Harvard. While serving on the Physics faculty at Lawrence University, Appleton, WI, he taught nearly every undergraduate physics course. His focus, however, was on computation in the upper-level curriculum. He served several terms as Physics Department Chair. His AAPT service includes more than four decades of meeting attendance, leadership on at least eight committees, and representing AAPT on the AIP Governing Board. While serving on the AAPT Executive Board, he generated detailed manuals for members of the presidential chain, and he took on the task of formatting and indexing the 250-page Executive Board Handbook compiled over several years by the Governance Review Committee. Another enduring legacy of his service is PAC Tools. Cook was the impetus and leader of the advisory group that worked with staff to develop AAPT's online program for planning meetings from abstract submission through the paper sort, to export into the final meeting program.

Andrew D. Gavrin

Andrew D. Gavrin

Andrew Gavrin, Associate Professor and Chair of the Physics Department at Indiana University-Purdue University Indianapolis (IUPUI), is currently serving as AAPT Chair of the Committee on Physics in Undergraduate Education, as a member of the Undergraduate Curriculum Task Force, and as a member of the Programs Committee. He earned his BS in physics at the Massachusetts Institute of Technology. Both his MA and PhD in physics were earned at Johns Hopkins University. His research interests are in Physics Education and Magnetic Materials. His AAPT service includes Committee on Educational Technologies (2005-2006), Nominating Committee (2008), Advisory Committee for Photo Contest (2009-present) and Video Contest (2009-2010), Special Projects and Philanthropy Committee (2012-2014), and the Committee on Instructional Media (2000-2002). A member since 1997, Gavrin has been a fixture at AAPT meetings for almost 20 years. During that time he has given numerous presentations. His committee service has given him the opportunity to organize numerous sessions contributing to the overall quality of the meetings.

Elizabeth C. (Tommi) Holsenbeck

Tommi Holsenbeck

Tommi Holsenbeck, Physics Specialist for Alabama Science In Motion, Alabama State University Region, 2006-2014, is recognized for her work with PTRA and the AAPT High School Physics Photo Contest. Holsenbeck earned her BS at Auburn University and her Certification in Comprehensive Science from the University of Alabama. She began working as a high school physics teacher in 1997 at Jefferson Davis High School in Montgomery, AL. Joining AAPT during her first year teaching, she was mentored by members in the Alabama Section. Additionally, she accepted opportunities to develop as a teacher through PTRA, PTRA for Rural Workshop at Auburn University 2005-2007, PRISMS (Physics Resources and Instructional Strategies to Motivate Students)–Trainer 1988-1993, C3P (Comprehensive Conceptual Curriculum in Physics)–Trainer 1996-1999, Labnet (TERC)–Mentor 1990-1994, ASPIRE (Alabama Supercomputer Program to Inspire Computational Research in Education) where she was Regional Coordinator 1995-2002, and PS4ET (Physical Science for Elementary Teachers) Trainer, funded by Alabama Commission on Higher Education Eisenhower Grant, 1992-1995. Her service to AAPT includes Secretary/Treasurer of the Alabama Section 2007-2015, Coordinator of the High School Physics Photo Contest 2011-2015, Chair of the Committee on Physics in High Schools 2013-2015, Friend of the Committee on Educational Technologies, and Friend of the Pre-High School Committee.

Elisha Huggins

Elisha Huggins

Elisha Huggins was an early pioneer in the use of computers as physics instructional tools. He has authored a number of introductory physics textbooks including *Physics 2000* which promotes the teaching of special relativity in the first week of an introductory physics course. Professor Huggins is also the developer of the award-winning software program MacScope which allows a computer to be used as a powerful storage oscilloscope. He has demonstrated the features of MacScope, as well as Physics 2000, in commercial workshops at numerous national AAPT meetings helping physics teachers make modern physics a part of introductory physics courses. Huggins has taught Physics at Dartmouth College since 1961. He was an undergraduate at MIT and got his PhD at Caltech. His PhD thesis was under Richard Feynman, where he found a number of terms representing the lack of uniqueness of energy momentum tensors. The scalar field term, which now plays a major role in conformally invariant field theories, was named the "Huggins term" by Murray Gell-Mann. His AAPT service includes contributions to *American Journal of Physics* and *The Physics Teacher*, commercial workshops at Summer and Winter meetings where he presented his innovative teaching ideas, and Sustaining Membership in the Association since 2000. He currently serves as a member of the editorial board of *The Physics Teacher.*

The Homer L. Dodge Citation for Distinguished Service to AAPT was established in 1953, was renamed in 2012 to recognize the foundational service and contributions of Homer Levi Dodge, AAPT's first president. The Homer L. Dodge Citation for Distinguished Service to AAPT recognizes AAPT members for their exceptional contributions to the association at the national, section, or local level.

SYMPOSIUM on Physics Education

AAPT Symposium on Physics Education and Public Policy

Tuesday, January 6 • 2–3:30 p.m. • Grande Ballroom C

Policymakers formulate decisions everyday that impact curriculum, standards, funding, and many other aspects of physics education at all levels. AAPT works with a number of partners to keep policymakers informed on the views of physics educators and to suggest appropriate policy options within the Association's sphere of influence. This session brings together individuals who play pivotal roles in helping to shape policies and who provide information to policymakers. We hope to provide a look at the process of policy making as well as actions you might make to contribute to decisions about policies affecting physics and STEM education.

This Symposium is being partially sponsored by funds contributed to the Memorial Fund in memory of Mario Iona. Iona, a long-standing and dedicated AAPT member, was the first Chair of the Section Representatives and served on the AAPT Executive Board, was a column editor in *The Physics Teacher*, presenter at many national AAPT meetings, recipient of the Robert A. Millikan Award in 1986, and relentless champion of correct diagrams and language in textbooks. Contributions to the Memorial Fund provide support for many AAPT programs such as the Symposium.

Facilitator: *Noah Finkelstein, Professor of Physics at University of Colorado at Boulder*

Speakers:

Shirley Malcom

Shirley Malcom, *Education and Human Resources Programs, AAAS*

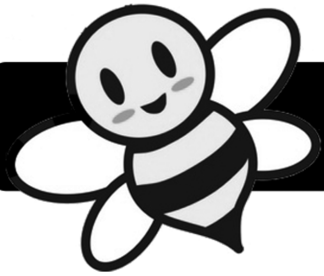
Shirley Malcom is head of Education and Human Resources Programs at AAAS. She works to improve the quality and increase access to education and careers in STEM fields as well as to enhance public science literacy. Dr. Malcom is a trustee of Caltech and a regent of Morgan State University, and a member of the SUNY Research Council. She is a former member of the National Science Board, the policymaking body of the National Science Foundation, and served on President Clinton's Committee of Advisors on Science and Technology. Malcom , a native of Birmingham, Alabama, received her PhD in ecology from The Pennsylvania State University, masters in zoology from UCLA and bachelor's with distinction in zoology from the University of Washington. She holds 16 honorary degrees.

Malcom serves on the boards of the Heinz Endowments, Public Agenda, the National Math-Science Initiative and Digital Promise. Internationally, she is a leader in efforts to improve access of girls and women to education and careers in science and engineering and to increase use of S&T to empower women and address problems they face in their daily lives, serving as co-chair of the Gender Advisory Board of the UN Commission on S&T for Development and Gender InSITE, a global campaign to deploy S&T to help improve the lives and status of girls and women. In 2003, Dr. Malcom received the Public Welfare Medal of the National Academy of Sciences, the highest award given by the Academy.

Lee Zia

Lee L. Zia, *Deputy Division Director, National Science Foundation, Arlington, VA 22230; lzia@nsf.gov*

Lee Zia is the Deputy Division Director for DUE. He served as the Lead Program Director for the NSF National Science, Mathematics, Engineering, and Technology Education Digital Library (NSDL) Program from its inception in FY 2000 to its sunsetting in FY 2010. He served as a "rotator" in the NSF Division of Undergraduate Education during calendar years 1995 and 1996 while on leave from the Department of Mathematics at the University of New Hampshire. Zia rejoined the NSF as a permanent staff member in the fall of 1999. From November 2008 to December 2009, he served as a Commerce Science and Technology Fellow in the Office of Senator John D. Rockefeller IV. Most recently he served as the Lead Program Director for the STEM Talent Expansion Program (STEP). Zia holds degrees in mathematics from the University of North Carolina (BS) and the University of Michigan (MS), and applied mathematics from Brown University (PhD).



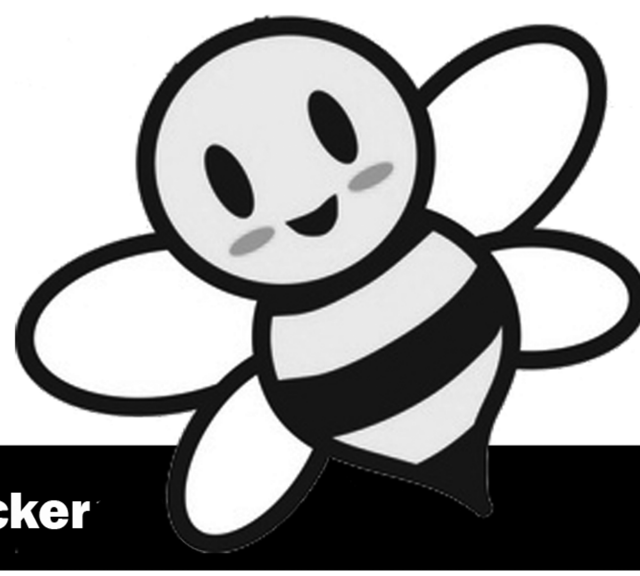
AAPT Welcomes First Time Attendees

Come and check out the latest buzz and meet other newbies at the “Bee Hive” aka the First Timers’ Gathering on **Sunday, January 4 from 7:00 - 8:00 AM.**

This is the best time to learn about AAPT and the Winter Meeting, as well as meet fellow attendees. AAPT leadership will be represented to discuss ways to get more involved with AAPT. You are also welcome to participate in any of AAPT's Area Committee meetings.

Not sure who's new?
Rest assured you'll be able to easily spot other FTAs (First Time Attendees), from the "newbie/bee" stickers on their badges. Make sure to grab one at the registration desk or the AAPT booth!

Calling all AAPT Veterans!
While we have put a lot of work into these new initiatives for our first timers, we still need your help as an AAPT Meeting veteran! The best way for you to help is simply to connect. If you see a first timer, say hello! Introduce them to some of your contacts. Not only will you be helping the first timers, but you'll be building your own network and quite possibly making a great new friend!



“Bee” on the lookout for this sticker

Evolution, Life and Sustainability, as Physics

— What the Constructal Law is, and how it gives us a new worldview,

by Adrian Bejan

Sunday, January 4 • 7:30–8:30 p.m. • Grande Ballroom C

Adrian Bejan
Duke University

Adrian Bejan, J.A. Jones Professor of Mechanical Engineering at Duke University, received all his degrees from M.I.T.: BS (1971, Honors Course), MS (1972, Honors Course) and PhD (1975). His research is in thermodynamics, applied physics, and the constructal law of design and evolution in nature, animate and inanimate. Since 2001 he is ranked by ISI among the 100 most-cited authors in all of engineering (all fields, all countries, living or deceased). He is the author of 28 books and 600 peer-refereed journal articles. His h index on ISI is 54. Professor Bejan was awarded 17 honorary doctorates from universities in 11 countries, for example the Swiss Federal Institute of Technology (ETH Zurich), the University of Rome I "La Sapienza", and INSA Lyon. He received numerous international awards for thermal sciences.

Dr. Bejan will be available to sign copies of his book from 8:30-9:15 p.m.
Design in Nature: How the Constructal Law Governs Evolution in Biology, Physics, Technology, and Social Organization

How Light Has Changed Our Lives,

by Eugene G, Arthurs , SPIE CEO

Monday, January 5 • 2–3 p.m. • Grande Ballroom C

Eugene G. Arthurs
SPIE CEO

Eugene G. Arthurs joined SPIE staff as Executive Director in November 1999. Prior to this he was President and CEO of Cleveland Crystals Inc. (CCI) He joined CCI, a closely held company, in 1997 and after reorganizing the company he marketed and sold it at the end of 1998. In 1980 he joined Quantronix Corporation in New York, leading laser applications development and then managing its business for the semiconductor equipment market. From 1983 to 1997, Eugene was with Oriel Corporation in Connecticut, initially as Vice President of Technology and Marketing and from 1991, as President. Oriel, originally a privately held corporation, was acquired by a venture capital company in 1987. He changed the business of Oriel to emphasize systems and instruments and in 1996 ThermoElectron Corp. acquired an increasingly profitable Oriel. Eugene became involved in Thermo's growth-by-acquisition activities. During his time at Oriel, he played an active role on the Boards of Oriel Scientific Ltd., (London, UK), LOT Oriel GmBH, (Darmstadt, Germany) and he was a founder of Andor Technology Ltd. (Belfast, N. Ireland) a company initially owned mostly by Oriel.

Eugene received his BSc (1st class honours) in 1972 in Physics, and his PhD in 1975 in Applied Physics from Queens University Belfast, N. Ireland. His PhD research was in generation and measurement of tunable ultrashort pulses. In 1973, he taught the MSc class in optoelectronics at Queens while continuing his research. He then moved to Imperial College in London where he conducted U.S. Air Force sponsored research on lasers.

AIP Gemant Award – presented to Sean Carroll

Monday, January 5 • 6–7:30 p.m. Fleet Center (offsite)
Pick up a bus ticket at registration for this event

Sean Carroll
California Institute of Technology

Sean Carroll is a physicist at the California Institute of Technology. Raised in Yardley, PA, he received his PhD in 1993 from Harvard University, and has worked at MIT, the Institute for Theoretical Physics at UC Santa Barbara, and the University of Chicago. His research focuses on theoretical physics and cosmology, especially the origin and constituents of the universe. He has contributed to models of interactions between dark matter, dark energy, and ordinary matter; alternative theories of gravity; violations of fundamental symmetries; and the arrow of time. Carroll is the author of *The Particle at the End of the Universe, From Eternity to Here: The Quest for the Ultimate Theory of Time*, and the textbook *Spacetime and Geometry: An Introduction to General Relativity*. He has been awarded fellowships by the Sloan Foundation, Packard Foundation, and the American Physical Society. He frequently consults for film and television, and has been featured on television shows such as "The Colbert Report", PBS's "Nova" and "Through the Wormhole" with Morgan Freeman.

About the Gemant Award

The Andrew Gemant Award is given to one individual by the AIP Governing Board each year, based on the recommendation of an outside selection committee, for significant contributions to the cultural, artistic or humanistic dimension of physics. For more information, see: http://www.aip.org/aip/awards-and-prizes/gemant

Free Commercial Workshops

CW01: Create Your New Year's Teaching Resolution: Engaging and Motivating Students in Introductory Physics

Location: Marina 6
Date: Sunday, January 4
Time: 11 a.m.–12 p.m.
Sponsor: Cengage Learning

Leader: Deborah Katz

Join Debora Katz, Physics Professor at the United States Naval Academy, for this interactive session on implementing new and creative teaching techniques to motivate and engage students to succeed in Introductory Physics. We will identify student challenges, explore pedagogical possibilities to address those challenges, and find practical ways to implement new teaching techniques. The goal of the session is for you to walk away with a New Year's teaching resolution to implement in your classroom this year. Dr. Debora Katz is the author of a groundbreaking calculus-based physics program, Physics for Scientists and Engineers: Foundations and Connections, published by Cengage Learning. The author's one-of-a-kind case study approach enables students to connect mathematical formalism and physics concepts in a modern, interactive way. By leveraging physics education research (PER) best practices and her extensive classroom experience, Dr. Katz addresses the areas students struggle with the most: linking physics to the real world, overcoming common preconceptions, and connecting mathematical formalism to physics concepts. How Dr. Katz deals with these challenges—with case studies, student dialogues, and detailed two-column examples—distinguishes this text from any other on the market and will assist you in taking your students "beyond the quantitative."

CW02: Enrich Your Physics Course with WebAssign Additional Resources

Location: Spinnaker 1-2
Date: Sunday, January 4
Time: 12–1 p.m.
Sponsor: WebAssign

Leader: Matt Kohlmyer

Since 1997, WebAssign has been the online homework and assessment system of choice for introductory physics lecture courses. Many veteran instructors already know that WebAssign supports over 150 introductory physics textbooks with precoded, assignable questions and advanced learning tools. WebAssign offers even more great resources for physics instruction, many of which can be adopted to supplement publisher offerings for no additional charge. In this presentation, we will focus on the wide array of WebAssign resources you can use to enrich your physics course. These include original question collections with feedback, solutions, and tutorials paired to some of the most popular textbooks; direct measurement videos that help students connect physics to real-world scenarios; conceptual question collections authored by experienced educators and designed around physics education research principles; and lab options that give you a complete low-cost, high-quality course solution. We'll show you how to add any or all of these resources to your WebAssign course. This workshop is intended for current WebAssign users, but newcomers are welcome to join.

CW03: Expert TA: Closing the Gap between Homework and Test Scores

Location: Marina 6
Date: Monday, January 5
Time: 12:30–1:30 p.m.
Sponsor: Expert TA

Leader: Jeremy Morton

The delta between students' homework grades and test scores is a concern we share with you. In order to study this, Expert TA entered into the arena of "Big Data" with our new Analytics tool. We used this to do an intense analysis of data from 125 classes from the 2013-2014 AY. Individual course reports are provided to instructors and we internally facilitated a cross-reference of all reports. We identify that major factors causing these gaps are: access to immediate and meaningful feedback, practice on symbolic questions, and a minimized ability to find problem solutions online. Knowing this, we have worked to develop the largest available library of "symbolic" questions and we use Analytics to data mine every incorrect answer submitted, in order to continually improve our feedback for these questions. We have also put in place very effective strategies to guard our problem solutions. The ultimate goal is to keep students focused on the physics; and then as they are working problems to provide them with meaningful, Socratic feedback that helps resolve misconceptions. Please join us and learn how other instructors are using this resource to reduce cost to students, increase academic integrity, and improve overall outcomes.

CW04: CourseWeaver: Easy Authoring of Computer-Graded Homework

Location: Nautilus Hall I
Date: Monday, January 5
Time: 12:30–2:30 p.m.
Sponsor: CourseWeaver

Leaders: Gerd Kortemeyer, Wolfgang Bauer

If you want to assign computer-graded homework in your teaching, here is your chance to learn how to do it. This session will guide you to create your own homework problems and will also show you how to use problems and problem sets created by others. Working with easy-to-understand examples and templates, you will able to accomplish this even if you have only minimal or no programming experience.

CW05: The New Fourth Edition of Matter & Interactions

Location: Executive 4
Date: Sunday, January 4
Time: 12–1 p.m.
Sponsor: Wiley & Sons

Leaders: Ruth Chabay and Bruce Sherwood

Matter & Interactions is a calculus-based introductory physics textbook. It features a contemporary perspective, with emphasis on a small set of fundamental principles instead of a large number of special-case formulas, on the atomic nature of matter and macro-micro connections, with a strong emphasis on constructing models of real-world phenomena. It includes an accessible, serious introduction to computational modeling. It has proven to work well with students with average preparation as well as with honors and majors students.

The new fourth edition includes major improvements based on further experience with the curriculum, including significantly more explicit instruction on computational modeling. This workshop will provide participants the opportunity to learn more about this curriculum in general and about the new aspects of the fourth edition.

SHARED BOOK EXHIBIT

JANUARY 3-6 AAPT 2015 PHYSICS EDUCATION WINTER MEETING SAN DIEGO, CA

Take a look at the books exhibited from the following publishers at Booth #605 in the Exhibit Hall!

Bitingduck Press

1. Nadeau, Cohen, *Sauerwine: Truly Tricky Graduate Physics Problems (With Solutions)*

Ergopedia, Inc.

1. Tom Hsu, PhD, Manos Chaniotakis, PhD, Michael Pahre, PhD, *Essential Physics, Second Edition*

Knopf Doubleday Academic Services

1. Adrian Bejan and J. Peder Zane, *Design in Nature: How the Constructal Law Governs Evolution in Biology, Physics, Technology, and Social Organizations*
2. Michio Kaku, *Physics of the Future: How Science Will Shape Human Destiny and Our Daily Lives by the Year 2100*
3. John Barrow, *The Constants of Nature: The Numbers That Encode the Deepest Secrets of the Universe*

Princeton University Press

1. Charles D. Bailyn, *What Does a Black Hole Look Like?*
2. Albert Einstein, *The Meaning of Relativity*
3. Richard P. Feynman, *QED: The Strange Theory of Light and Matter*
4. Katherine Freese, *The Cosmic Cocktail*
5. Martin Gardner, *Undiluted Hocus-Pocus: The Autobiography of Martin Gardner*
6. G. Polya, *How to Solve It*
7. Quinn/Nir, *The Mystery of the Missing Antimatter*
8. Stone, *Einstein and the Quantum*
9. Mark Strikman, et al., *Applications of Modern Physics in Medicine*

Turner Publishing

1. Dinah L. Moshe, *Astronomy, A Self Teaching Guide (Eighth Edition)*

World Scientific

1. Sihui Wang & Wenli Gao, *International Young Physicists' Tournament 2012-2013 Problems and Solutions*
2. The Committee of Japan Physics Olympiad, *Physics Olympiad – Basic to Advanced Exercises*
3. Ann Breslin and Alex Montwill, *Let There Be Light – The Story of Light From Atoms to Galaxies*
4. Jeremy I. Pfeffer and Shlomo Nir, *Modern Physics – An Introductory Text (Second Edition)*
5. Andrey Varlamov & Lev Aslamazov, *The Wonders of Physics (Third Edition)*
6. Valerio Scarani w/Chua Lynn & Liu Shi Yang, *Six Quantum Pieces – A First Course in Quantum Physics*

CRC Press / Taylor & Francis Group

1. S. Rajasekar & R. Velusamy, *Quantum Mechanics: An Introduction*
2. Titus A. Beu, *Introduction to Numerical Programming*
3. Iulian Ionita, *Condensed Matter Optical Spectroscopy*
4. Robert Ehrlich, *Renewable Energy*
5. Linda S. Hirst, *Fundamentals of Soft Matter Science*
6. Andrew Rex, *Commonly Asked Questions in Physics*

AAPT Journals

Booth #304
One Physics Ellipse
College Park, MD 20740
301-209-3300
mgardner@aapt.org
www.aapt.org

Drop by for information on how you can become part of the AAPT Publications program. Learn why you should submit articles for publication, consider becoming a reviewer, and make sure your physics department subscribes to *American Journal of Physics* and *The Physics Teacher*. It is rumored that it may be possible to catch up with journal editors and other members of the Publications Committee during your visit. If you are an online-only member, you'll get a chance to see the print copies and reconsider your choice. If you aren't yet an AAPT member, we will do our best to help you decide which option is best for you.

American Association of Physics Teachers

Booths #300,302
One Physics Ellipse
College Park, MD 20740
301-209-3300
rriddle@aapt.org
www.aapt.org

Welcome to San Diego! Join us at the AAPT booth and spin the wheel for your chance to win awesome prizes! We will have a large selection of educational resources available to meet the needs of everyone from students to faculty. Pick up information on some of AAPT's leading programs such as PTRA, eMentoring, and the U.S. Physics Team. Learn about some of our engaging online physics demos and lessons from ComPADRE. Check out the latest and greatest items from The Physics Store catalog including publications, AAPT-branded merchandise, and a limited collection of member-only items. Items will be available for purchase at the booth at a significant savings. Lastly, do not forget to pick up your ticket for the Great Book Giveaway!

American Institute of Physics

Booth #605
One Physics Ellipse
College Park, MD 20740
301-209-3100
jbebee@aip.org
www.aip.org

AIP has been sending *Physics Today* magazine to AAPT members for more than 60 years. Come by the booth to learn about other AIP benefits to which you're entitled, including career resources like employment statistics, Society of Physics Students and an online job board.

American Physical Society

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College Park, MD 20740
301-209-3206
thompson@aps.org
www.aps.org

The American Physical Society's Public Outreach Department aims to bring the excitement of physics to all. Stop by to grab our new retro poster series, your copy of Spectra's Quantum leap or hear more about www.physicscentral.com. We will also be demoing our new comic book app as well as SpectraSnapp for android.

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Cengage Learning is a leading educational content, software and services company for the K12, higher education, professional and library markets with operations in more than 20 countries around the world. The company provides superior content, personalized services and course-driven digital solutions that accelerate student engagement and transform the learning experience. For more information on Cengage Learning please visit www.cengage.com.

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Cambridge, MA 02138
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eleanor@ergopedia.com
www.egopedia.com

Essential Physics, from Ergopedia, is a high school STEM physics program that includes an extraordinary e-Book, matching print textbook, and a coordinated set of powerful, wirelessly-connected lab equipment. Essential Physics interactivity makes rigorous physics concepts accessible to all levels. Ergopedia also offers a full suite of physics equipment modules, suitable for high school and middle school.

Expert TA

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Tulsa, OK 74119
877-572-0734
main@theexpertta.com
www.theexpertta.com

The Expert TA is an online homework and tutorial system for introductory physics courses. Expert TA's proprietary math engine performs partial credit grading of the most complex problems. It analyzes the steps used to solve equations, identifies detailed mistakes and deducts the appropriate points. This method allows instructors to accurately evaluate the mastery of student knowledge and provides students with consistent grading and quality feedback on their work. Stop by Booth 303 for a demonstration.

Jablotron Alarms a.s.

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JABLOTRON introduces MX-10 Digital Particle Camera - a state-of-the-art educational toolkit for demonstrating radiation and analyzing radioactive sources. The control and display software Pixelman© offers interfaces for advanced particle experts as well as teachers and students. Sets of school lab experiments included. Based on Timepix chip created in CERN.

NASA

Booth #603
NASA Headquarters
300 E Street SW
Washington, DC 20024-3210
rebecca.e.vieyra@nasa.gov

In celebration of the centennial of the National Advisory Committee for Aeronautics (precursor to NASA), NASA Aeronautics is currently developing modules for teaching about aeronautics within the context of standard introductory physics coursework. These modules are founded on aeronautics teaching ideas from publications in The Physics Teacher, contextual examples from current NASA Aeronautics research, and many of the principles associated with the inquiry-based Modeling Method of Instruction. Beta-versions of the modules will be available in-print and online, and example activities and experiments will be displayed for interaction by attendees. Leading this effort is AAPT member, Rebecca Vieyra, who is serving as an Albert Einstein Distinguished Educator Fellow at NASA's Aeronautics Research Mission Directorate at HQ in Washington, DC. For more information, and/or to volunteer as a reviewer for the aeronautics materials, please contact Rebecca Vieyra at rebecca.elizabeth.vieyra@gmail.com

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Optical Society of America

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202-416-1985
sschermer@osa.org
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The Optical Society (OSA) is the leading professional society in optics and photonics, home to accomplished science, engineering, and business leaders from all over the world. Through world-renowned publications, meetings, and membership programs, OSA provides quality information and inspiring interactions that power achievements in the science of light. Visit the OSA booth to learn more.
Stop by the OSA booth and pick up your complimentary International Year of Light:2015 Education Kit, Light BLOX. Light BLOX provides students 8+ with hands-on activities that introduce them to the science of light. Each kit comes equipped with a guidebook including lesson plans and activities. www.osa.org/iylkit.

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Plot.ly is a free online tool for importing, analyzing, graphing, and sharing data. Plot.ly makes fits for your data, and runs filters, integrations, stats, and custom functions. Editing together is delightful, and so is making and sharing beautiful graphs. Plot.ly also has a popular Chrome App, especially useful for Chromebooks.

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Quantum Design manufactures automated material characterization systems to further the research and education of physics, chemistry, and material science. These systems and associated curricula provide essential tools for engaging students and assisting teachers by providing hands-on instruction and experience using fundamental science principles. The VersaLab is a portable, cryogen-free cryocooler-based material characterization platform. With a temperature range of 50 – 400K, this 3 tesla platform is perfect for accomplishing many types of materials characterization in a limited space. A fully-automated system with a user-friendly interface, the VersaLab utilizes Quantum Design's PPMS platform measurement options.

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Sapling Learning provides content for algebra- and calculus-based introductory physics courses, as well as conceptual physics. In addition to numeric and equation-based questions, conceptual understanding is measured using sorting, labeling, ranking, multiple choice, and multiple select answer types. To learn more, visit http://www2.saplinglearning.com/physics.

Society of Physics Students

Booth #309
One Physics Ellipse
College Park, MD 20740
301-209-3008
lquijada@aip.org
www.spsnational.org

The Society of Physics Students (SPS), along with Sigma Pi Sigma, the national physics honor society, are chapter-based organizations housed within the American Institute of Physics. SPS strives to serve all undergraduate physics students and their mentors with a chapter in nearly every physics program in the country and several international chapters. Sigma Pi Sigma, with over 95,000 historical members, recognizes high achievement among outstanding students and physics professionals. SPS and Sigma Pi Sigma programs demonstrate a long-term commitment to service both within the physics community and throughout society as a whole through outreach and public engagement. Partnerships with AIP member societies introduce SPS student members to the professional culture of physics and convey the importance of participation in a professional society. SPS and Sigma Pi Sigma support scholarships, internships, research awards, physics project awards, outreach/service awards, and a job site for summer and permanent bachelor's level physics opportunities (jobs.spsnational.org).

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The U.S. Environmental Protection Agency's interactive, virtual community of RadTown USA (www.epa.gov/radtown) features content for students and teachers with information about different radiation sources, links to additional information and games and puzzles for students. The redesigned RadTown has Radiation Education Activities (http://www.epa.gov/radtown/educational-materials.html) for middle and high school students (grades 6-12), which includes lesson plans covering radiation basics, sources of radiation, radiation protection, exposure versus contamination, uranium mining methods, radon and more. All educational activities are aligned with the Next Generation Science Standards and the Vocabulary Materials are aligned with the Common Core State Standards.

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W.H. Freeman & Company Publishers works with instructors, authors, and students to enhance the physics teaching and learning experience. We proudly announce the publication of *College Physics*, 1/e (Roger Freedman, Todd Ruskell, Philip Kesten, David Tauck). Come by Booth 305 to learn more about *College Physics*, to hear about the newest features in smartPhysics, and to browse through other market-leading physics and astronomy titles. www.whfreeman.com/physics.

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AAPT PHYSICS EDUCATION

Sunday, January 4, 2015 – Session Schedule

	Nautilus Hall 1	Nautilus Hall 5	Nautilus Hall 2	Nautilus Hall 3	Nautilus Hall 4	Grande Ballroom B	Executive 2A/2B	Executive 3A/3B	Grande Ball-room C
10:00 a.m.	**AA** SPS Undergrad Research and Outreach	**AB** PER: Evaluating Instructional Strategies	**AC** Best Practices in Educational Technology						
10:30 a.m.				**AD** Understanding the Redesigned AP Physics 1 and 2 Courses and Exams					
11:00 a.m.					**AE** 30 Demos in 60 Minutes				
11:30 a.m.									
12:00 p.m.									
2:00 p.m.	**BA** The Higgs and My Classroom	**BH** PER: Student Engagement; Metacognition	**BB** Recruitment and Retention	**BD** Decreasing Stereotype Threat in Discourse	**BF** Exemplary Ways to Prepare Elementary School Teachers to Meet the NGSS Challenge	**BC** Panel – How to Publish an Article	**BE** Collaborative Graphing with Plot.ly	**BG** Department Lab Assessment	
2:30 p.m.									
3:00 p.m.									
3:30 p.m.									
4:00 p.m.	**CA** Challenges with Sea-based Naval Operations	**CF** Development of Perception of Extraterrestrial Life	**CC** Teaching Math Methods in the Upper-Level UG Physics	**CD** Technology-Enhanced Teaching Environments	**CE** K-12 PER	**CH** Improving Pedagogy in Pre High School Education	**CG** Beyond the MOOCs: The Impact of Open Online Courses	**CB** Report from International Conference on Women in Physics	
4:30 p.m.									
5:00 p.m.									
5:30 p.m.									
6:00 p.m.				**TOP01** Physics and Society Topical Discussion			**TOP02** iOS and Android App Show	**TOP05** The Joint Task Force on Undergraduate Physics Programs	
6:30 p.m.									
7:00 p.m.									
7:30 p.m.									**PLENARY 1:** Dr. Adrian Bejan
8:00 p.m.									
8:30 p.m.									

Monday, January 5, 2015– Session Schedule

Poster Session 1, 8 to 9:30 a.m. • Poster Session 2, 8:30 to 10 p.m. (Grande Ballroom A)

	Nautilus Hall 1	Nautilus Hall 5	Nautilus Hall 2	Nautilus Hall 3	Nautilus Hall 4	Grande Ballroom B	Executive 2A/2B	Executive 3A/3B	Executive 1	Spin-naker 1-2	Sea-breeze 1-2	Grande Ballroom C
8:00 a.m.				**TOP03** History and Philosophy of Physics	**TOP04** Graduate Student Topical Discussion							
8:30 a.m.												
9:00 a.m.												
9:30 a.m.												**Melba Newell Phillips Medal:** Tom O'Kuma
10:00 a.m.												
10:30 a.m.												
11:00 a.m.	**DA** Using Social Networking to Enhance Your Physics Class	**DF** Interactive Lecture Dem-onstrations	**DC** Historical Inci-dents Useful for Teaching Physics	**DD** Single Photon Detectors	**DE** Mentoring Newly Gradu-ated Teachers to Improve Retention		**DH** Panel of Support and Information for Graduate Students	**DI** Updates and Resources for Introductory Physics for Life Sciences	**DB** Physics Outreach at Science Festivals	**DJ** Underrepre-sented Phys-ics Teachers	**DG** Writing in Physics	
11:30 a.m.												
12:00 p.m.												
12:30 p.m.												
1:00 p.m.												
2:00 p.m.												**Plenary Eugene G. Arthurs**
2:30 p.m.												
3:00 p.m.												
3:30 p.m.	**EB** Evaluation of Teachers and Professors	**EG** PER in the Professional Preparation of Teachers	**EC** International Networks for Action Research in Physics Education	**ED** Project Learn-ing Labs for Undergradu-ate Innovation and Entrepre-neurship in Physics	**EA** Career Path-ways – Mentor-ing Under-graduates	**EI** Remote Labs	**EF** Informal Science Educa-tion	**EE** Teaching Sustainability in Non-major Courses		**EH** Research Experiences for Teachers (RET)		
4:00 p.m.												
4:30 p.m.						**EJ** U.D.Undergrad						
5:00 p.m.												
5:30 p.m.												
7:00 p.m.	**FA** Introductory Courses	**FE** MOOCs as Outreach	**FB** Biophysics Labs Beyond the First Year	**FC** Video Update – Advanced Video Techniques	**FD** Recruiting & Facilitating Alternative Certification of Teachers							
7:30 p.m.												
8:00 p.m.												
8:30 p.m.												

Tuesday, January 6, 2015– Session Schedule

Poster Session 3, 3 to 4:30 p.m. (Grande Ballroom A)

	Nautilus Hall 1	Nautilus Hall 5	Nautilus Hall 2	Nautilus Hall 3	Nautilus Hall 4	Harbor Island 1	Executive 2A/2B	Executive 3A/3B	Grande Ballroom C
8:30 a.m.	**GA** Disentangling Student Reasoning From Conceptual Understanding	**GE** Teaching Advanced and Honors Students	**GB** Mentoring Graduate Students for Careers Outside of Academia	**GC** Assessing Pedagogical Content Knowledge (PCK) for Teaching K-12 Physics	**GD** Undergraduate Research	**GF** Effective Practices in Educational Technology	**GG** Extrater. Life II	**GH** Introductory Physics for Life Science II	
9:00 a.m.									
9:30 a.m.									
10:00 a.m.									
10:30 a.m.									**Oersted Medal** Karl Mamola **DSCs Presidential transfer**
11:00 a.m.									
11:30 p.m.									
12:00 p.m.									
12:30 p.m.	**HA** TYC Partnerships		**HB** Stories from the Leading Edge of Astronomy	**HC** Sci. & Society	**HD** PER: Examining Content Understanding and Reasoning	**HE** Endangered Physics Teacher Preparation Programs	**HF** Writing in Physics II	**HG** High School	
1:00 p.m.									
1:30 p.m.									
2:00 p.m.									**Symposium on Physics Education and Public Policy**
2:30 p.m.									
3:00 p.m.									
3:30 p.m.	**IA** Post Deadline Papers		**IB** Post Deadline Papers						**IC** Physical Sciences Education Advocacy
4:00 p.m.									
4:30 p.m.									
5:00 p.m.									

Workshops – Saturday, January 3

Transportation between the Sheraton and the University of San Diego will be provided. Sunday morning tutorials (T02, T03, T05) and workshop 35 will be held at the Sheraton Hotel and Marina.

W01: Workshop on Digital Spectroscopy

Sponsor: **Committee on Space Science and Astronomy**
Time: **8 a.m.–12 p.m. Saturday**
Member Price: $65 **Non-Member Price: $90**
Location: SCST 290

Trina Cannon, Gilliam Collegiate Academy 1700 E. Camp Wisdom Road, Dallas TX 75241; cannonb@hpisd.org

New Demonstration Experiments In Spectrum Analysis. In this workshop, master demonstrator James Lincoln instructs on new techniques in performing spectrum analysis experiments with your students that are sure to improve their learning experience. Also, involved are some old classic trusted demos. Learn also how to use the RSPEC Explorer, a new and inexpensive apparatus that makes teaching spectrum clear to all. Participants are encouraged to bring their own laptop computer.

W02: Creating Interactive Web Simulations Using HTML5 and Javascript

Sponsor: **Committee on Educational Technologies**
Time: **8 a.m.–12 p.m. Saturday**
Member Price: $70 **Non-Member Price: $95**
Location: SCST 233

Andrew Duffy, Department of Physics, Boston Univ., 590 Commonwealth Ave., Boston, MA 02215; aduffy@bu.edu

Dan Schroeder

HTML5 and JavaScript have replaced Java and Flash as the leading technology for in-browser software, with the ability to deliver high-performance, graphics-intensive simulations over the web to both personal computers and mobile devices. Participants in this workshop will learn to use this technology to create educational physics simulations that students can run on almost any computer, tablet, or smartphone that can browse the web. The workshop will cover HTML basics, the JavaScript programming language, graphics using the HTML5 canvas element, and essential user-interface controls. Participants should have some prior programming experience (in any language) and must bring their own laptop computers with up-do-date versions of Firefox, Chrome, and a programmer's text editor such as Notepad++ or TextWrangler. Participants are also encouraged to bring ideas for simulations they would like to create.

W04: Beginning Arduino

Sponsor: **Committee on Physics in Two-Year Colleges**
Co-sponsor: **Committee on Educational Technologies**
Time: **8 a.m.–12 p.m. Saturday**
Member Price: $145 **Non-Member Price: $170**
Location: SCST 252

Greg Mulder, Dept. of Physical Sciences, Linn-Benton Community College, 6500 Pacific Blvd. SW, Albany, OR 97321; mulderg@linnbenton.edu

Pat Keefe

Microcontrollers are relatively inexpensive devices that you can program to collect data from a variety of sensors types and control external devices such as motors and actuators. Microcontrollers can be used in a variety of classroom activities and student projects. We will focus our workshop on using an Arduino Microcontroller to construct a mini-underwater vehicle that will seek out to hover at a desired programmed depth. We will also discuss how our students use Arduinos for fun, research, underwater ROVs, and general exploration. An optional pool-test of your mini-underwater vehicle will occur after the workshop at a nearby hotel pool. Note: you get to keep your mini ROV. No previous microcontroller, programming or electronics experience is required. You need to bring your own Windows, Mac, or Linux computer.

W05: Phenomenon-based Learning: Fun, Hands-on, Cooperative Learning

Sponsor: **Committee on Physics in High Schools**
Time: **8 a.m.–12 p.m. Saturday**
Member Price: $99 **Non-Member Price: $124**
Location: SCST 235

Matt Bobrowsky; expert_education@rocketmail.com

"Phenomenon-Based Learning" (PBL) builds knowledge of and interest in physics as a result of observations of real-world phenomena, in this case, some fun gizmos and gadgets. Why PBL? PISA assessments showed that Finnish students were among the top in science proficiency levels. The PBL teaching philosophy combines elements of what's done in Finland with what's known about effective science teaching based on science education research to present science in ways that are both fun and educational. The approach includes elements of progressive inquiry, problem-based learning, collaborative learning, responsive teaching, and hands-on experiments. The idea is to teach broader concepts and useful thinking and performance skills (as with NGSS) rather than asking students to simply memorize facts and formulae. Participants will leave with a copy of the new NSTA book, *Phenomenon-Based Learning: Using Physics Gadgets & Gizmos*, and with one of the physics gizmos that goes with the book.

W07: Teaching Physics for the First Timer

Sponsor: **Committee on Physics in High Schools**
Time: **8 a.m.– 12 p.m. Saturday**
Member Price: $67 **Non-Member Price: $92**
Location: SCST 230

Jan Mader, 2223 5th Ave. SW, Great Falls, MT 59404; jan_mader@gfps.k12.mt.us

Karen Jo Matsler

Teaching Physics for the First Time provides the participants with learning cycles and PER pedagogy that follows the typical first-year physics curriculum. Resolve to make teaching and learning of the physics concepts a "phun" adventure.

W08: Writing in the Sciences

Sponsor: **Committee on Teacher Preparation**
Time: **8 a.m.–12 p.m. Saturday**
Member Price: $70 **Non-Member Price: $95**
Location: SCST 231

Leslie Atkins, 400 W. 1st St., Depts. of Science Education & Physics, Chico, CA 95929-0535; ljatkins@csuchico.edu

Kim Jaxon, Irene Y. Salter

Faculty who teach Physics, Biology and English at California State University, Chico, have collaborated to develop a suite of materials to aid science faculty in improving writing in their science courses. In this workshop, we will familiarize participants with research from the field of composition, and share how findings from composition studies can be used to improve writing instruction in science courses. We will then walk participants through a range of ways in which we embed writing instruction in our courses—from the informal (whiteboards and lab notebooks) to the formal (term papers and exams) -—with examples from our own courses. Participants will receive a set of lesson plans and activities they can use in science courses. Appropriate for high school and college/university instructors, suitable for non-science majors. Funding by NSF # 1140860.

W10: An Introduction to Scientific Computing with Python and iPython Notebooks

Sponsor: Committee on Educational Technologies
Time: 8 a.m.–12 p.m. Saturday
Member Price: $70 **Non-Member Price:** $95
Location: SCST 133

Larry Engelhardt, Francis Marion University, PO Box 100547, Florence, SC 29506 lengelhardt@fmarion.edu

We will show you how to quickly and easily get started using Python to integrate computation into your physics classes. Python is a simple programming language, appropriate for students of any age. (See *Python for Kids* by J. R. Briggs.) It is simple, but also very powerful (like MATLAB), and it is 100% free (unlike MATLAB). We will introduce the Canopy platform, which includes thousands of Python libraries, a built-in debugger, and the "IPython" notebook interface (similar to Mathematica or Maple...but free). Topics covered will span from making nice-looking plots, to solving differential equations (e.g., Newton's laws), to compiling Python codes to make them as fast as C or Fortran. PLEASE BRING A LAPTOP COMPUTER (Windows, Mac, or Linux).

W12: Inquiry-based Labs for AP Physics

Sponsor: Committee on Physics in High Schools
Time: 8 a.m.–5 p.m. Saturday
Member Price: $110 **Non-Member Price:** $135
Location: SCST 229

Martha Lietz, 2659 Hillside Lane, Evanston, IL 60201; marlie@d219.org

Connie Wells

In this workshop, participants will be provided with an introduction of the new AP Physics 1 and 2 Curricula. We will discuss methodology for inquiry-based labs for both courses, and discuss strategies for converting "cook-book" style labs to be more inquiry-based.

W13: Research-based Alternatives to Traditional Physics Problems

Sponsor: Committee on Research in Physics Education
Time: 8 a.m.–5 p.m. Saturday
Member Price: $80 **Non-Member Price:** $105
Location: SCST 129

Kathy Harper, Engineering Education Innovation Center, The Ohio State University, 244 Hitchcock Hall, 2070 Neil Ave., Columbus, OH 43210; harper.217@osu.edu

Thomas M. Foster, David P. Maloney

Accumulating research on problem solving in physics clearly indicates that traditional, end-of-chapter exercises in physics texts are not useful and may actually hinder students' learning of important physics concepts. The research also raises questions about the efficacy of such tasks for helping students develop "problem-solving skills." In light of these results the question is: What alternative tasks can we use to help students develop problem-solving skills and a conceptual understanding? This workshop will review the research and then provide examples of several alternative tasks and their use. Participants will also get practice writing alternative problems in a variety of formats for use in their own classrooms.

W14: Modeling in College Physics

Sponsor: Committee on Physics in Two-Year Colleges
Co-sponsor: Committee on Physics in Undergraduate Education
Time: 1-5 p.m. Saturday
Member Price: $60 **Non-Member Price:** $85
Location: SCST 230

Dwain Desbien, Estrella Mountain Community College, 3000 N Dysart Rd., Avondale, AZ 85392; dwain.desbien@estrellamountain.edu

This workshop will introduce participants to tools used in college-level modeling classes. Participants will also experience Discourse Management, a classroom management strategy developed in conjunction with college modeling but is transferrable to reformed classrooms.

W15: Implementing Engineering Design in YOUR Classroom

Sponsor: Committee on Physics in Pre-High School Education
Time: 1-5 p.m. Saturday
Member Price: $70 **Non-Member Price:** $95
Location: SCST 233

Karen Jo Matsler, 3743 Hollow Creek, Arlington, TX 76001; kmatsler@me.com

TBD

The Next Generation Science Standards (NGSS) have a strong focus on engineering and expect students to understand that engineering is more than tweaking a project or building bridges. It is no longer sufficient for students to demonstrate that they understand core ideas in science, they are also expected to apply the ideas as they engage in science and engineering practices. Come experience a STEM learning cycle that can be used for middle school students or adapted for other grade levels. We will help you untangle science and engineering practices and show how you can break down a complex real-world problem into smaller problems that can be solved through engineering design. You will have a clearer understanding of what engineering design should look like and you will walk away with great ideas of how to help students learn about STEM.

W17: STEM Grant Writing

Sponsor: Committee on Physics in Two-Year Colleges
Co-sponsor: Committee on Professional Concerns
Time: 1-5 p.m. Saturday
Member Price: $135 **Non-Member Price:** $160
Location: SCST 231

Jay Bagley, 310 East Claremont Rd., Philadelphia PA 19120; bagleyjay@yahoo.com

Workshop Goals: Provide guiding principles for two-year colleges and organizations seeking funding. Provide an overview of the grant application and process and share and learn successful grant writing strategies. Know the difference between types of federal funding grants, cooperative agreements, and contracts.

W21: Intersection of Physics and Biology: Activities and Materials

Sponsor: Committee on Laboratories
Co-sponsor: Committee on Physics in Undergraduate Education
Time: 1-5 p.m. Saturday
Member Price: $75 **Non-Member Price:** $100
Location: SCST 235

Nancy Beverly, Mercy College, 55 Broadway, Dobbs Ferry, NY 10522; nbeverly@mcercy.edu

Ralf Widenhorn, James Vesenka, Charles DeLeone, Dawn Meredith

Inspired by last year's Introductory Physics for Life Science Conference or the Gordon Research Conference in Physics Education: The Complex Intersection of Physics and Biology, by having attended or wishing you had? Several groups will share lab activities and curricular materials, to be explored and experienced by workshop participants to enrich their own bio-inspired physics curriculum.

W23: Fun & Engaging Physics Labs

Sponsor: Committee on Teacher Preparation
Co-sponsor: Committee on Physics in High Schools
Time: 1-5 p.m. Saturday
Member Price: $60 **Non-Member Price:** $85
Location: SCST 232

Wendy Adams, University of Northern Colorado, CB 127, Greeley, CO 80639; wendy.adams@unco.edu

Duane Merrell

In this workshop we will share many labs that are suitable for both high school and introductory college physics. The labs are challenging but not too difficult and leave plenty of room for creativity! We have found success by limiting the goals for the labs to: 1). Fun and engaging, 2). Built in student choice, 3). Related to this week's material. The labs are effective at engaging the students in problem solving and conceptual understanding. Merrell used this type of lab as a high school teacher and physics quickly became one of the most popular classes in the school. Adams, inspired by Merrell, has found that her college students no longer rush to leave, and in some cases stay to see how other groups do even after they've turned in their lab write up for the day! This workshop will allow you to try out these labs for yourself.

W24: Engaging TYC Students in Astronomical Inquiry

Sponsor: Committee on Science Education for the Public
Time: 1-5 p.m. Saturday
Member Price: $60 **Non-Member Price:** $85
Location: SCST 130

Tim Slater, CAPER Ctr. for Physics & Astro Educ. Research, 604 S 26th St., Laramie, WY 82070; timslaterwyo@gmail.com

How can we help our introductory astronomy students with little to no science experience to begin to have success at doing science themselves? In order for novice students to effectively design, conduct, report, and defend science observations and experiments, they must be purposefully supported in each step of the scientific process before they are able to successfully pursue scientific questions of their own design. This workshop provides strategies for bringing these two ideas together: an introduction to scaffolding strategies that teach students to fruitfully engage in scientific thinking and designing astronomy investigations by mining online astronomy databases. Participants in this workshop will structure effective student learning experiences using NASA databases. All participants receive copies of classroom-ready teaching materials for guiding students' inquiry in astronomy based on the principles of a backwards faded scaffolding approach, developed by the CAPER Center for Astronomy & Physics Education Research. Bring your laptop.

W25: Creating Affectively Positive Online Learning Environments

Sponsor: Committee on Women in Physics
Time: 1-5 p.m. Saturday
Member Price: $65 **Non-Member Price:** $90
Location: SCST 252

Dedra Demaree, 3520 Prospect St. NW #314, Washington, DC 20057; Dd817@georgetown.edu

Kyle Kuhn

At Georgetown University, we have been assisting faculty with creating online learning modules using Adobe Captivate 7. These modules are being used to supplement learning, to flip classrooms, and to provide real-time feedback to both students and the instructor. We have found that faculty are excellent at explaining the content in their modules but often do not have a clear template for how to address the holistic student experience in the eLearning environment. In this workshop, we will present (and distribute) a Captivate template that users can have as a base for building online learning modules. The workshop will illustrate key design principles for creating self-directed learning modules that are easy for students to navigate. We will walk participants through the different ways that we have included attention to the affective nature of the student experience within the module template, and the theoretical and practical reasons for each module detail.

Workshops – Sunday, January 4

Workshops are held at University of San Diego. (Tutorials at hotel.)

W27: Metacognition and Reasoning in Physics

Sponsor: Committee Research in Physics Education
Time: 8 a.m.-12 p.m. Sunday
Member Price: $60 **Non-Member Price:** $85
Location: SCST 233

MacKenzie Stetzer, University of Maine, Department of Physics, 5709 Bennett Hall, Room 120, Orono ME 04469-5709; mackenzie.stetzer@maine.edu

Andrew Boudreaux, Sara Julin, Mila Kryjevskaia

It is well known that experts consciously monitor their own reasoning and engage in other metacognitive practices when they are confronted with a new challenge, while novices often persist in unproductive approaches. We have been investigating the relationships among student metacognition, conceptual understanding, and qualitative reasoning in introductory and upper-division physics courses. This represents the first phase of a larger effort to develop a flexible suite of metacognitive activities that are tightly linked to specific physics content and that may be incorporated into common learning environments, including lecture, laboratory, and recitation. This workshop will focus on how students' metacognitive practices impact their reasoning in physics, and will also highlight practical and intellectual challenges associated with assessing student metacognition. We will describe some of our emerging methodologies, give participants firsthand experience examining written student work and video data, share some of our preliminary findings, and discuss implications for instruction.

W28: Astronomy and Physics Simulations for Computers and Tablets

Sponsor: Committee on Educational Technologies
Time: 8 a.m.-12 p.m. Sunday
Member Price: $60 **Non-Member Price:** $85
Location: SCST 292

Mario Belloni, Physics Department, Davidson College, Davidson NC, 28036; mabelloni@davidson.edu

Todd Timberlake, Michael Gallis

The Easy Java/JavaScript Simulation (EjsS) Tool enables students and teachers to create Java simulations by providing simplified tools that lower the barriers involved in Java programming. Over 600 EjsS astronomy and physics simulations are freely available on the Open Source Physics (OSP) site (http://www.compadre.org/OSP/). Recently, the EjsS desktop tool has expanded to include the creation of JavaScript simulations that run on both computers and tablets. This workshop begins with exploring the OSP ComPADRE site to find and run JavaScript simulations. Participants will then receive a free EjsS Reader for tablets that automatically connects to ComPADRE and downloads these JavaScript simulations. We will also introduce the EjsS tool (freely available on ComPADRE) and lead participants through creating JavaScript simulations. Participants are encouraged to bring laptops to install and run the EJS desktop tool and tablets to install the Reader.

W30: Making Good Physics Videos

Sponsor: Committee on Apparatus
Co-sponsor: Committee on Educational Technologies
Time: 8 a.m.-12 p.m. Sunday
Member Price: $70 **Non-Member Price:** $95
Location: SCST 252

James Lincoln, 5 Federation Way, Irvine, CA 92660 ; james@physics-videos.net

Flipping the Classroom and the emergence of free online video hosting has led many of us to be asked to make videos of our lessons and demos. In this workshop, you will learn the five methods of video engagement, fast and effective video writing techniques, and beginner/intermediate editing skill competency that will improve your video quality and help get your message across more effectively. Your instructor is master physics teacher and filmmaker James Lincoln who has made over 100 science videos. Tips and ideas for effective and engaging physics demos are also included.

W31: Low Cost, In Home Labs

Sponsor: Committee on Laboratories
Co-sponsor: Committee on Science Education for the Public
Time: 8 a.m.-12 p.m. Sunday
Member Price: $80 **Non-Member Price:** $105
Location: SCST 290

Alex Burr, 695 Stone Canyon Drive Las Cruces, NM 88011; aburr@aol.com

A physics course without experiments is not a physics course. However many general physics instructors in high schools and colleges feel pressured in terms of money and time to neglect this aspect of physics instruction. This workshop will address these problems. The participants will actually do real experiments which do not have to use expensive, sophisticated equipment, and take up valuable class time. These experiments can illustrate advanced experimental concepts and show that if you ask questions of nature, she will answer. Topics mentioned include mechanics, electricity, and optics. They will be done individually and in groups. Participants should bring Apple or Android smart phones or tablets if they have them. Participants will leave with inexpensive apparatus, detailed notes, and a renewed commitment to physics as an experimental science.

W32: Writing Learning Objectives

Sponsor: Committee on Physics in Undergraduate Education
Time: 8 a.m.-12 p.m. Sunday
Member Price: $60 **Non-Member Price:** $85
Location: SCST 231

Juan Burciaga, Department of Physics, Mount Holyoke College, 50 College St., South Hadley, MA 01075; jburciag@mtholyoke.edu

Writing effective learning objectives is a critical first step in designing and preparing a course or a curriculum but most faculty have no formal training in this process. Yet learning objectives describe the goals of the course, outline the limits of the instruction, and define the assessment strategies that will be used. Writing effective learning goals is in essence not simply the first step but represent most of the work in designing a course. The workshop will focus on the basics of writing effective learning objectives and allow participants an opportunity of practicing on developing their own sets of objectives.

W33: Simple DC Labs

Sponsor: Committee on Physics in High Schools
Time: 8 a.m.-12 p.m. Sunday
Member Price: $80 **Non-Member Price:** $105
Location: SCST 229

Ann Brandon, 1544 Edgwood Ave., Chicago Heights, IL 60411; brandon3912@comcast.net

Deborah Lojkutz

Most students come to physics class with no experience in D-C Circuits. This workshop provides an integrated series of activities and labs powered by 9 volt batteries to introduce D-C Circuits. It builds from ‘What is a circuit’ (Sparky) thru Resistors in a Circuit, Voltages in a Circuit, and Currents in a Circuit to Ohm’s Law. It includes problem sheets for in class and homework. Participants will receive an inexpensive digital meter, a breadboard and assorted parts.

W34: New RTP and ILD Tools and Curricula: Video Analysis, Clickers and E&M Labs

Sponsor: Committee on Research in Physics Education
Co-sponsor: Committee on Educational Technologies
Time: 8 a.m.-12 p.m. Sunday
Member Price: $105 **Non-Member Price:** $100
Location: SCST 235

David Sokoloff, Department of Physics, 1274 University of Oregon Eugene, OR 97403-1274; sokoloff@uoregon.edu

Ronald K. Thornton, Priscilla W. Laws

RealTime Physics (RTP) and Interactive Lecture Demonstrations (ILDs) have been available for over 15 years—so what’s new? The 3rd Edition of RTP includes five new labs on basic electricity and magnetism in Module 3 as well a new approach to projectile motion in Module 1. Some of these new labs make use of video analysis. Also new are clicker-based ILDs. This hands-on workshop is designed for those who want to make effective use of active learning with computer-based tools in their introductory courses. These active learning approaches for lectures, labs, and recitations (tutorials) are based on physics education research (PER). The following will be distributed: Modules from the Third Edition of RTP, the ILD book, the Physics with Video Analysis book and CD, and Teaching Physics with the Physics Suite by E.F. Redish.

W35, T02, T03, T05 will be held at the Sheraton.

W35: Creating Physics Simulations for Smartphones, Tablet Devices, and Computers in HTML5

Sponsor: AAPT
Time: 8 a.m.-12 p.m. Sunday
Member Price: $60 **Non-Member Price:** $85
Location: Executive 3B (Sheraton)

Gerd Kortemeyer, Michigan State University

Wolfgang Bauer

HTML5-based simulations have emerged as the new platform-independent leader in interactive web content. This workshop will cover the essential elements of HTML, of JavaScript, and of the HTML5 JavaScript elements. You will learn how to use event-handlers, how to construct a user interface for different devices, and you will learn how to use produce device-independent graphical output via the canvas element in HTML5. You will also learn how to make your HTML5 apps available to your students as well as other teacher. Every workshop attendee will receive a set of working examples of different interactive simulations, which can be used as templates to create other simulations. Basic programming experience is assumed, and workshop attendees are required to bring their own laptop computer with a current version of Internet Explorer, Firefox, Chrome, or Safari.

T02: Building and Funding Outreach Programs

Sponsor: **Committee on Science Education for the Public**
Time: **9-11 a.m. Sunday**
Member Price: $50 **Non-Member Price: $75**
Location: Executive 1

David Sturm, University of Maine, Department of Physics & Astronomy 5709 Bennett Orono, ME 04469-5709; David_Sturm@umit.maine.edu

Rebecca Thompson

This tutorial session discusses the how-to of building and funding Outreach Programming to engage the public, with presentations from the APS Head of Public Outreach Rebecca Thompson; from established University Outreach programs run by PIRA physics resource specialists (led by David Sturm of UMaine and Mainely Physics); and from other members of the Outreach community.

T03: Electrostatics from Gilbert to Volta

Sponsor: **Committee on Physics in High Schools**
Time: **9- 11 a.m. Sunday**
Member Price: $50 **Non-Member Price: $75**
Location: Executive 2A

Bob Morse, 5530 Nevada Ave., NW Washington, DC 20015; ramorse@rcn.com

With inexpensive equipment, students can carry out activities to build a conceptual understanding of electrostatic phenomena. In this short tutorial we will build the equipment and learn to carry out experiments patterned after those from William Gilbert to Alessandro Volta, including charge detection, electric field patterns and electrostatic induction.

T05: Using Elements of History and Philosophy of Physics in Teaching

Sponsor: Committee on History and Philosophy in Physics
Time: 9:00 a.m. - 12:00 p.m. Sunday
Member Price: $115 **Non-Member Price: $140**
Location: Executive 3A

Genrikh Golin; genrikhgolin@yahoo.com

This workshop is designed for those who teach introductory physics at universities, colleges and high schools. Introducing the students to the elements of history and philosophy of science stimulates interest in students, it can be effective means of humanizing education. Studying the process in development of the fundamental physical ideas, the students comprehend more abstract and complicated physical concepts. This hand-on workshop includes the following aspects: Pivotal Ideas in Physics; The Regularities of Physics Development; Classification of Physical Experiments; Methods of Research in Physics (analogy, hypothesis, modeling, thought and real experiments, etc.); The History and Philosophy of Physics as a Component of Teacher Preparation; Biographical Materials in Teaching; Physicists about Physics Education.

Session SPS: SPS Undergraduate Research and Outreach Poster Reception

Location: Grand Island Ballroom
Sponsor: AAPT, SPS
Date: Saturday, January 3
Time: 8–10 p.m.

Presider: Sean Bentley

SPS01: 8-10 p.m. Fabrication of Nanofilm Capacitor for Use in a Portable EKG

Poster – Amiras S. Simeonides, High Point University, Winston-Salem, NC 27104; sasimeonides@gmail.com

Jarrett L. Lancaster, Joseph M. Starobin, Joint School of Nanoscience and Nanoengineering

Methods of fabricating a thin, flexible EKG lead that can be integrated into clothing are investigated. Physical vapor deposition is used to add a thin gold film to a PDMS-coated silicon chip; the fabrication process is refined to create a surface that is sensitive to electric fields caused by cardiac myocytes.

SPS02: 8-10 p.m. Multi-component Chalcogenide Gradient Index Materials Research

Poster – Stephanie H. Pettit, 20 Peartree Place, Sewell, NJ 08080; pettis11@highpoint.edu

Andrew M. Swisher, Alexej V. Pogrebnyakov, Theresa S. Mayer, Pennsylvania State University

Aberrations in lenses obscure images, and correcting these aberrations can be costly and difficult. To work toward a new way to correct aberrations, refractive indices of optical lenses were studied. Using fused silica and silicon wafers with films made of several compositions of Ge2Se3-As2Se3-PbSe (GAPSe), experiments were done to study the effect of the optical properties of these materials when heated. To heat the samples, a rapid thermal annealer (RTA was used at various temperatures. Indices of refraction were measured with an ellipsometer for every sample. Results showed an increase in the sample's refractive index as the annealing temperature increased. These results were verified using TEM images, which showed crystal growth in the samples.

SPS03: 8-10 p.m. Physics in Non-Inertial Reference Frames

Poster – Hallie Stidham, High Point University, High Point, NC 27262; stidhh12@highpoint.edu

Simeon Simeonides, Junjie Liao, High Point University

This project focused on creating classroom-friendly videos of motion in non-inertial reference frames where fictitious forces are required in order to apply Newton's laws. To explore motion in a linearly accelerating frame, we attached a camera to a fan cart which accelerated down a track, and we recorded video of a neighboring fan cart accelerating down a parallel track at a lower rate. To explore motion in a rotating frame, we attached a camera to a rotating turntable and rolled a steel ball across the turntable. We collected data on the ball's motion from one video camera in the rotating reference frame and from a second camera in the lab frame. We analyzed the videos from each experiment using the video analysis software Tracker to determine mathematical models for each force. We created simulations of the motion in each frame in VPython.

SPS04: 8-10 p.m. Using Integral Transforms to Evaluate Sums in Statistical and Quantum Mechanics

Poster – John J. Vastola, University of Central Florida, Orlando, FL 32816; johnvastola@knights.ucf.edu

Costas J. Efthimiou, University of Central Florida

Evaluating sums analytically is a problem that is easy to pose and to give approximate solutions to, but is difficult to exactly solve in general. A method is proposed of evaluating sums using integral transforms that can reproduce many results obtained using other techniques. In particular, representing polynomials as Laplace transform gives some nontrivial exact results. Some applications of the method are demonstrated, and extensions of the method using integral representations of frequently appearing functions are suggested. One useful representation of the gamma function is supplied, and used to provide both well-known and more obscure results. Interestingly, the application of this integral representation to evaluating sums suggests the introduction of a novel integral transform, which itself can be used to evaluate sums. Some physical problems involving the partition functions of statistical mechanics, and some infinite sums appearing in quantum mechanics, are considered.

SPS05: 8-10 p.m. PTRA: The Next Generation

Poster – Caleb Heath, Van Buren High School, Van Buren, AR 72956; caleb.heath@gmail.com

The Physics Teaching Resource Agent Program (PTRA) is an AAPT initiative "to improve the teaching and learning of physics topics in pre-collegiate education for all teachers and students in the United States." The teacher-leaders of the PTRA accomplish this goal by developing and running workshops for other K-12 educators. These workshops particularly benefit elementary and middle school teachers and help them bring physics into their classrooms. The PTRA is well-suited to supply the increased demand for professional development in physics and engineering teaching necessitated by the Next Generation Science Standards. To make the most of this opportunity, the PTRA will need to continue to innovate its workshops. I will showcase current efforts by the program to incorporate links to the NGSS and to develop new engineering/design activities. I will also present proposals for new types of workshops aligned to these purposes.

SPS06: 8-10 p.m. VPython Modeling to Design Artificial Cilia Platform Magnetics

Poster – Jacob T. Brooks, High Point University, High Point, NC 27262-3598; brookj12@highpoint.edu

Briana Fiser, High Point University

Cilia are a biological structure found in a variety of locations in the human body, including the brain, lungs, and kidneys. These cilia oscillate in a metachronal pattern, which causes a traveling wave to propagate through the cilia, moving fluids throughout the body. Improper cilia movement and function can seriously impair health and contribute to a variety of ciliopathies, including primary ciliary dyskinesia (PCD) and nephronophthisis (which causes kidney failure). Additionally, cilia malfunction can affect embryonic development and left-right asymmetry determination in humans. As cilia drive fluids to one side continuously, they initiate asymmetrical development. Both synchronous and metachronal wave patterns in cilia result in fluid flow, and to increase our understanding of the effect of the metachronal wave patterns in cilia result in fluid flow, we are utilizing both a computer simulation and biomimetic cilia system. We hope to investigate cilia beat amplitude and frequency with an array of artificial cilia, where each cilium is a polymer rod with its upper portion surrounded by a magnetic tube. These cilia respond to the magnetic field from a permanent magnet moving above them. To construct a magnetic setup that results in metachronal waves arising in the cilia array, we developed a VPython computer program that simulates changing magnetic fields and in turn, cilia movement in response. The program assumes artificial cilia align with the magnetic field, allowing us to explore a variety of magnet configurations to understand beat patterns before exploring the artificial system experimentally. The program outputs the tilt angle for each cilium, magnet position, and net magnetic field at each cilium location, as well as a 3-D visual model of the system. This output is used to inform our experiment, and results of the simulation and progress in the experimental investigation will both be discussed.

SPS07: 8-10 p.m. Optical Detection Device for Boltzmann Factor Demonstration with Bouncing Balls

Poster – Seong Joon Cho, Department of Physics, MyongJi University Department of Physics, MyongJi University Nam-dong, cheoin-gu Yon-

gin, 449-728 Republic of Korea; ccssjj5290@gmail.com

Jeong Seok Lee, Han Seok Hwang, Jae Wan Kim, Department of Physics, MyongJi University

Si Youn Choi, LIG Nex1

Bouncing balls contained in a rigid box is an ideal apparatus to demonstrate and visualize the exponential form of the Boltzmann factor. It is relatively simple to make and one can easily observe with his/her naked eye that smaller number of balls are at higher vertical position. However, it is not easy to record the exact number and show the exponential dependence as the balls are constantly moving very fast. We present an optical detection device to count the total number of balls passing through a horizontal line in a given time. The device consists of arrays of LEDs and photodiodes, and an electronic counter circuit. The circuit is carefully tuned that it does not miss any event. The apparatus uses only basic electronic components easily obtainable at an electronic shop and can be made by undergraduate students with a basic knowledge of electronics.

SPS08: 8-10 p.m. Nonlinear Ion Trap Dynamics in an Undergraduate Laboratory

Poster – Robert J. Clark, The Citadel, Dept. of Physics, Charleston, SC 29409; rob.clark@citadel.edu

Mark Maurice, Dylan Green, The Citadel

The surface-electrode multipole ion trap is a new type of rf (Paul) trap which creates a highly nonlinear trapping potential near the electric field null. Here, we present details of the design and characterization of such a trap. In particular, we measure upconversion of the oscillation frequency of a single confined charged particle. These experiments point to a new line of research in atomic ion trapping, as well as a relatively straightforward way to combine the subjects of charged particle optics and nonlinear dynamics in an undergraduate laboratory.

SPS09: 8-10 p.m. Experimental Demonstration of the Boltzmann Factor for Undergraduate Laboratory

Poster – Jeong Seok Lee, Department of Physics, MyongJi University Department of Physics, MyongJi University, Nam-dong, cheoin-gu Yongin, 449-728 Republic of Korea; wjdtjr7777@gmail.com

Seong Joon Cho, Han Seok Hwang, Jae Wan Kim, Department of Physics, MyongJi University

Si Youn Choi, LIG Nex1

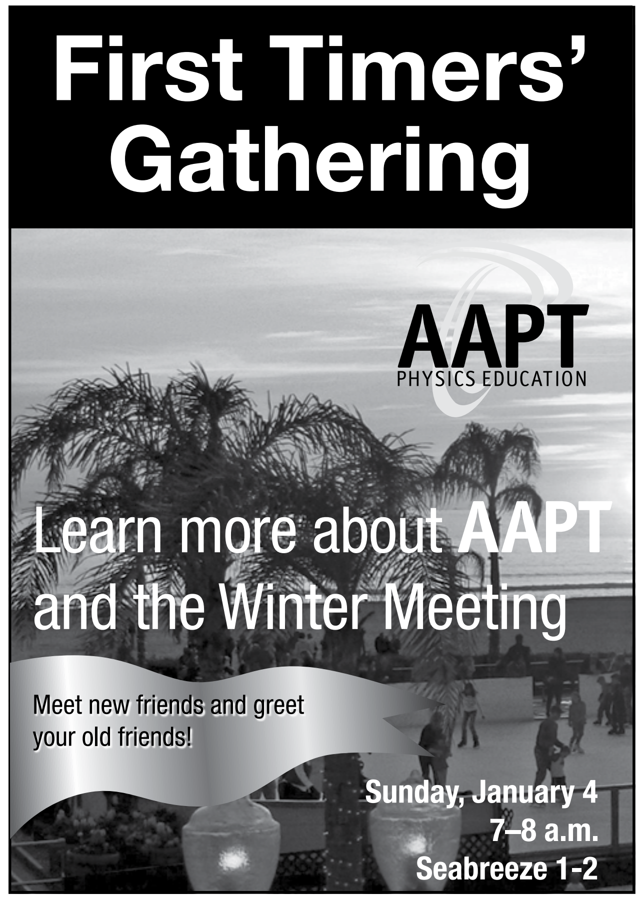
The Boltzmann factor is the basic quantity in statistical and thermodynamic physics. It can be used to understand both classical and quantum mechanical behavior of all systems exchanging energy with their environment. However, the mathematical derivation of the exponential form is not easy and the experimental demonstration is rarely done, even though the Boltzmann factor is a fundamental concept in physics. We present an experiment for the undergraduate laboratory to demonstrate directly and visualize the Boltzmann distribution. Easily available equipment such as plastic balls (BBs), a home audio, an acrylic glass container, and off-the-shelf electronic components, are used. Plastic balls inside a container are excited by an audio speaker and the number of balls bouncing and crossing each height are measured with array of LEDs, photodiodes, and digital counters. The result shows excellent agreement with the theoretical calculation with Boltzmann factor.

SPS10: 8-10 p.m. Magnetic Drag in a Friction Laboratory

Poster – Benjamin A. Catching, California State University Chico, 400 West 1st St., Chico, CA 95928; bcatching@mail.csuchico.edu

Chris A. Gaffney, California State University Chico

Dry frictional forces are commonly investigated in introductory mechanics courses. We propose here an enrichment of such laboratories by measuring the "frictional" drag produced on a magnet sliding down an inclined aluminum ramp. This drag is quite distinct from that produced by the usual type of dry sliding friction. Rather than being characterized by coefficients of kinetic and static friction, we find the drag force to be proportional to the velocity of the magnet. The qualitative differences between dry and magnetic drag opens opportunities for discussion of the deeper conceptual issues, such as: what makes a force a frictional force.



Area Committee of the Year

2014 Winner is the Committee on History & Philosophy in Physics!

The America Association of Physics Teachers has created an "*Area Committee of the Year*" award. The award is based on the yearly reports submitted by Area Committees every fall. Late fall, each Review Board member reads the annual report and each member can then nominate the most active Area Committee (see criteria below). As a group, the Review Committee will decide which Area Committee should receive the "*Area Committee of the Year*" award that year. The award would be announced at the next Programs I meeting and Area Committee members would be recognized with a cake.

Criteria:

- Has the Area Committee gone beyond the standard responsibilities of preparing for the next two national meetings?
- Does it appear that most members of the Area Committee are actively involved in making decisions especially regarding special activities?
- Have or will the activities (beyond meeting preparation) impact AAPT in a substantial way? How?

Sunday, January 4 Highlights

First Timers' Gathering
7–8 a.m.
Seabreeze 1-2

Exhibit Hall Open
10 a.m.–5 p.m.
Harbor Island Ballroom

Exhibit Hall Kindle Fire Drawing
10:15 a.m.
Harbor Island Ballroom

Free Commercial Workshops

CW01: Engaging and Motivating Students in Introductory Physics – Cengage Learning
11 a.m.–12 p.m. – Marina 6

CW02: Enrich your Physics Course with WebAssign Additional Resources
12–1 p.m. – Spinnaker 1-2

CW05: Wiley, The New Fourth Edition of Matter & Interactions
12–1 p.m. – Executive 4

Committees, 12:30–2 p.m.

Interests of Senior Physicists	Marina 1
Undergraduate Education	Marina 3
Teacher Preparation	Marina 4
Women in Physics	Marina 2

Committees, 6–7:30 p.m.

History & Philosophy in Physics	Marina 3
Laboratories	Marina 4
Physics in High Schools	Nautilus Hall 1
Two-Year Colleges	Marina 2
Research in Physics Education	Nautilus Hall 5

High School Teachers Day Luncheon
12:30–2 p.m.
Seabreeze 1-2

Early Career Professional Speed Networking
12:30–2 p.m.
Grande Ballroom A

Exhibit Hall Amex Card Drawing
3:45 p.m.
Harbor Island Ballroom

SPS Undergrad. Awards Reception
6–7 p.m.
Seabreeze 1-2

PLENARY – Adrian Bejan
7:30–8:30 p.m.
Grande Ballroom C
Book Signing to follow!

General Membership Meeting
8:30–9 p.m.
Grande Ballroom C

AAPT Council Meeting
9–10:30 p.m.
Grande Ballroom C

High School Share-a-thon
8:45–10 p.m.
Nautilus Hall 5

Special Session: Workshop for Section Representatives

Location: Executive 2B
Sponsor: AAPT
Date: Sunday, January 4
Time: 9 a.m.–12 p.m.

Leader: Greg Puskar

At the Minneapolis Meeting, attending section reps/officers had a discussion about advocacy and spent time in one-to-one discussion about possible physics advocacy ideas to address issues in their Section. This workshop will follow up on these discussions to craft specific advocacy messages and outreach efforts. You need not have attended this meeting to enroll in this workshop; all are welcome. While we tend to think on a national level and typically only politically when we consider advocacy, it does not need to be limited to those areas. While national efforts are certainly worthy topics, thinking locally or at the state level are equally important. Thinking not just politically but community-based, school district, or state science offices or departments are valid venues as well. We can continue to bemoan the current state of affairs in the physics community or we can begin to act at multiple levels to effect positive change in the broader community's opinions and perceptions of physics.

Bringing the New Physics Teachers Workshop (NPTW) to San Diego High School Teachers

Location: Grande Ballroom B
Sponsor: AAPT
Date: Sunday, January 4
Time: 10 a.m.–12 p.m.

Leaders: William Layton, Cliff Gerstman

For the past three years, workshops specifically directed at new physics teachers have been conducted in the Los Angeles area. These workshops are held on a Saturday three times a year and involve four experienced teachers working with teachers who have fewer than five years of experience teaching physics. Each of the three workshops spend a full day concentrating on topics that the new teachers will most likely encounter in the next few months. There are demonstrations, teaching ideas, and discussions of problems, and each afternoon several labs are conducted to give the participants hands-on experience with the equipment. This session will give a brief view of how the workshops are run, with demonstrations and discussions. Both new and experienced teachers from the San Diego area are strongly encouraged to attend and learn how the NPTW concept can be extended to the San Diego area.

Session AA: SPS Undergraduate Research and Outreach

Location: Nautilus Hall 1
Sponsor: Committee on Physics in Undergraduate Education
Date: Sunday, January 4
Time: 10 a.m.–12 p.m.

Presider: Sean Bentley

AA01: 10-10:30 a.m. Evolution of an Outstanding SPS Chapter

Invited – Logan Hillberry, Colorado School of Mines, Department of Physics, Golden, CO 80401; lhillber@mymail.mines.edu*

Chuck Stone, Colorado School of Mines

Since 2008, Colorado School of Mines' Society of Physics Students (SPS) has blossomed under strong student leadership as it selflessly participates in numerous on-campus and off-campus science outreach programs. The chapter has earned the SPS Outstanding Chapter Award six years in a row, hosted three regional SPS Zone 14 Meetings, won four Marsh White Outreach Awards to promote science in local K-6 schools, and used one Future Faces of Physics Award to travel to two rural secondary schools that serve underprivileged and underrepresented students. Our annual Haunted Physics Lab recently served as a resource for iWonder, a groundbreaking new children's television series that follows teams of adventurous kids as they research and explore the wonderful curiosities of their everyday worlds. This presentation will discuss our chapter leadership and organizational structure that other chapters can emulate to develop successful campus-valued in-reach activities and meaningful outreach efforts.

*Sponsored by Chuck Stone

AA02: 10:30-11 a.m. A Teacher's Guide to African-Americans in Physics and Astronomy

Invited – Simon C. Patane, Vassar College, Box 2179, Poughkeepsie, NY 12604; sipatane@vassar.edu*

Historically, the paradigms that worked to oppress and marginalize African-Americans in society acted similarly within the bounds of science. Very little research fleshing out the struggle of African-Americans in physics, astronomy, and related fields exists and the need to fill this gap drove our research this summer. Supported in part by a Society of Physics Students summer internship at the American Institute of Physics' Center for History of Physics, we researched the experiences of African-American scientists from across a range of physics disciplines, eras, geographical boundaries, and genders. Our work resulted in the creation of a "Teachers Guide to the History of African-Americans in Physics and Astronomy," which includes lessons plans, a bibliography, a trivia card game, and other resources. In this talk, I will explain our research methodology and give an overview of some of the resources we created for use by teachers, students, and outreach professionals.

*Sponsored by Caleb Heath

AA03: 11-11:10 a.m. African-Americans in the Physical Sciences: A Teacher's Guide

Contributed – Jacob Zalkind, Shippensburg University/Society of Physics Students,13 Quail Hill Lane, Downingtown, PA 19335; jakeyjake1231@gmail.com

Simon Patane, Vassar College/Society of Physics Students

Serina Hwang-Jensen, Sharina Haynes, Gregory Good, American Institute of Physics

Physics like any other discipline is a part of history. It has undergone multiple changes and made huge leaps and bounds forward, but is also still a slave to the societal climate and issues pertinent to the various time periods. With this in mind, together with a team of researchers at the Center for the History of Physics at the American Institute of Physics, we did research about the roles that African-Americans have played in the physical sciences, and how their standing has changed in the past 300 years. Once the research was complete, we used the research to generate a set of materials for teachers and students to use in class and integrate this part of the history of physics into a teacher's curriculum to help better tell the stories of these scientists.

AA04: 11:10-11:20 a.m. Light a Spectrum of Utility

Contributed – Kearns Louis-Jean, Xavier University of Louisiana, New Orleans, LA 70125; klouisjean@gmail.com

Mark Sellers, Rhodes College

The Society of Physics Students (SPS) partnered with the National Institute of Standards and Technology (NIST) to create the 2014 SPS Science Outreach Catalyst Kit (SOCK) with a theme titled: "Light A Spectrum of Utility." This resource, aimed at encouraging outreach by SPS chapters around the country, celebrates the International Year of Light (2015) and the International Year of Crystallography (2014) with activities that demonstrate how we use light as a tool. The kits have been tested at the NIST Summer Institute for Middle School Science Teachers. Feedback from the teachers was used to refine the outreach kit. The kits will be sent to 25 SPS chapters who will use the activities and demonstrations in local outreach events. This talk will introduce the 2014 SOCK, highlighting several of the activities and how they are used by SPS chapters to promote physics in outreach to K-12 classrooms.

AA05: 11:20-11:30 a.m. Randolph College's Astronomical Research Ensemble

Contributed – Hartzel E. Gillespie, Randolph College, 503 Darrell Lane, Hurt, VA 24563; hegillespie@randolphcollege.edu*

At small liberal arts colleges, where major astronomical research facilities are often unavailable, it is often difficult to make contributions to modern astronomy. However, using Randolph College's modern observatory along with a research grant from the college, I've been able to perform research on asteroid occultations, stellar spectroscopy, and exoplanet transits. I have observed two positive asteroid occultation events, which happen when an asteroid passes between a star and an observer, blocking the star's light. Preliminary spectroscopy results show that a DSLR camera and a 100 line/mm diffraction grating reveal clear hydrogen Balmer lines in the spectra of type A stars, and further research will attempt to measure rotational velocities of shell stars, primarily of type Be. A DSLR alone is sensitive enough to record the light curves of some exoplanet transits such as the HD189733b transits. *Sponsored by Peter Sheldon

AA06: 11:30-11:40 a.m. Ray-Tracing and Electromagnetic Wave Propagation Web-based Simulators

Contributed – Sarah C. Luciano, Universidad Metropolitana, 1399 Ave. Ana G Mendez - School of Environmental Affairs, San Juan, PR 00926-2602; sluciano93@gmail.com

Smailyn Martinez. Universidad Metropolitana

Two web-based educational tools have been developed to show how light propagates, refracts, and is reflected from different media. The first tool is a ray-tracing application to visually represent the propagation of light as a ray through diverse media. The second tool analytically and graphically studies the behavior of electromagnetic waves as they propagate through space and through an interface between two different media. The animated simulation allows users to manipulate the model parameters and acquire an intuitive understanding of how electromagnetic p- and s-waves propagate in a homogeneous medium and how they are modified as they are refracted and reflected at a material interface. The applications were built using HTML, CSS, and JavaScript libraries for the calculations and simulations. The developed programs address the need to visualize physical phenomena. Some interesting particular cases that are considered are: normal incidence, total internal reflection, absorptive media, and amplifying media.

AA07: 11:40-11:50 a.m. Gaussian Laser Made by LabVIEW

Contributed – Xiayang Zhou Xingangxi, Road No.135 Guangzhou, Guangdong 510275 China; zhouxy25@mail2.sysu.edu.cn

There is a program for LETO to LabVIEW to produce a light shaped by a picture given. However, the program given is only used for a static picture. If we want to do research based on a dynamical beam like Raguel-Gaussian laser, the traditional way would not work. So in my project, I try to revise the program in order to make LETO produce an dynamical beam.

AA08: 11:50 a.m.-12 p.m. AC Circuit Lab for an Introductory Physics Course

Contributed – Cadee Hall, Valencia College, 560 Saddell Bay, Loop Ocoee, FL 34761; chall75@mail.valenciacollege.edu*

Conan Wilson, Valencia College

We will share our experience in designing an AC circuit laboratory experiment for an introductory physics lab at Valencia College. Majority of students enrolled in Physics with Calculus at Valencia College are pre-engineering majors, and knowledge of fundamental concepts related to AC circuits is very important for their success in higher level courses. Currently, there is no AC circuit physics lab offered within physics courses curriculum at Valencia College, therefore we took an initiative to develop one. Design of the experiment, aimed concepts, expected learning outcomes, experimental results and suggested analysis will be presented.

*Sponsored by Irina Struganova

Session AB: PER: Evaluating Instructional Strategies

Location: Nautilus Hall 5
Sponsor: AAPT
Date: Sunday, January 4
Time: 10-10:40 a.m.

Presider: Hunter Close

AB01: 10-10:10 a.m. Assessment and Instructional-Element Analysis in Evidence-based Physics Instruction

Contributed – David E. Meltzer, Arizona State University, Mesa, AZ 85212; david.meltzer@asu.edu

Decades of investigation by hundreds of research and development groups worldwide have yielded an impressive array of curricular and instructional innovations in physics that show evidence of improved student learning. [See, for example, D. E. Meltzer and R. K. Thornton, "Resource Letter ALIP-1: Active-Learning Instruction in Physics," *Am. J. Phys.* **80**, 478-496 (2012).)] In this brief review I will survey the range of assessment instruments and methods that have been used in this work, as well as the extent to which the relative effectiveness of specific elements of the instructional methods has been subjected to analysis.

*Supported in part by NSF DUE #1256333

AB02: 10:10-10:20 a.m. Impacts of Web-based Computer Coaches on Student Attitude and Learning

Contributed – Bijaya Aryal, University of Minnesota, Rochester, MN 55904; baryal@r.umn.edu

We have implemented web-based computer coaches into small classes at University of Minnesota Rochester over the last three years. The varying usage of coaches by individual students outside of class allowed us to categorize them into different user groups. This presentation reports on a comparative study on examining if and how different user groups' attitude toward problem solving changes after the completion of an introductory-level physics course as measured by an attitude survey. The relationship between the use of the coaches and students' conceptual learning measured by a concept test will also be discussed. A consistent tendency has been found correlating the user groups with their course performance and gender. Likewise, time of completion of the coaches seems to correspond with individual student attitudes toward problem solving as well as conceptual learning.

AB03: 10:20-10:30 a.m. Active Reading Documents in Introductory Physics

Contributed – Shawn A. Hilbert, Berry College, Mount Berry, GA 30149-0001; shilbert@berry.edu

A constant struggle for professors is getting students to read the textbook. This year, I piloted a reading companion called an Active Reading Document (ARD). The goal of the ARD is for students to condense the important information from a chapter into one clear, well organized document. The ARD consists of three parts: a visual representation (for example, a concept map) of the content and connections within the chapter, a list of important terms with original definitions, and a set of original connections from within the chapter, to previous chapters, to their own life. This presentation will introduce the concept of an ARD and discuss the successes and failures in a first attempt of implementation into a physics course.

AB04: 10:30-10:40 a.m. Sector Vector: An Interactive Game to Learn Vectors!

Contributed – James G. O´Brien, Wentworth Institute of Technology, Boston, MA 02115-5998; obrienj10@wit.edu

Greg Sirokman, Derek Cascio, Wentworth Institute of Technology

In recent years, science and particularly physics education has been furthered by the use of project-based interactive learning. There is a tremendous amount of evidence that use of these techniques in a college learning environment leads to a deeper appreciation and understanding of fundamental concepts. Since vectors are the basis for any advancement in physics and engineering courses the cornerstone of any physics regimen is a concrete and comprehensive introduction to vectors. Here, we introduce a new turn-based vector game that we have developed to help supplement traditional vector learning practices, which allows students to be creative, work together as a team, and accomplish a goal through the understanding of basic vector concepts. The results of student retention of concepts has increased dramatically, and engagement and time spent in lab have been amazingly increased. The disguise of the lesson and impact of a competitive game environment will be discussed.

Session AC: Best Practices in Educational Technology

Location: Nautilus Hall 2
Sponsor: Committee on Educational Technologies
Date: Sunday, January 4
Time: 10 a.m.–12 p.m.

Presider: Andrew Duffy

AC01: 10-10:30 a.m. On SmartBoards

Invited – Chris Roderick, Dawson College, 3040 Sherbrooke St. W. Westmount, QC H3Z 1A4, Canada; croderick@place.dawsoncollege.qc.ca

Interactive white boards provide extraordinary opportunities for teachers, students (as individuals), and classes (as a whole) to model, practice, document, and engage in physics education. Some of the ways in which a SmartBoard can be used to manifest the process of abstraction, and to facilitate the visualization and manipulation of physical concepts, will be put into practice, live.

AC02: 10:30-11 a.m. Technology to Foster Active Learning

Invited – Manher Jariwala, Boston University, Department of Physics, Boston, MA 02215; manher@bu.edu

Andrew Duffy, Bennett Goldberg, Boston University

Two years ago, Boston University inaugurated its first studio classroom, the latest step in a series of efforts over the last two decades to transform undergraduate STEM education across campus through the effective use of technology. We describe the technological design and implementation of the new flat classroom, which encourages students to work together in class on minds-on and hands-on activities, supported by a cohesive teaching staff of faculty, graduate student Teaching Fellows, and undergraduate Learning Assistants. Moreover we describe how the blend of different technologies allows the teaching staff to better structure and assess the classroom learning experience, thus fostering faculty engagement in the use of evidence-based pedagogical tools as well as enhancing faculty-student interactions. By focusing on supporting the professional development of present as well as future faculty, we seek to reinforce and expand greater campus adoption of best practices in educational technology.

AC03: 11-11:30 a.m. Interactive Video Vignettes: Research-based Online Activities

Invited – Robert B. Teese. Rochester Institute of Technology, 54 Lomb Mem. Drive, Rochester, NY 14623; rbtsps@rit.edu

Priscilla W. Laws, Dickinson College

Kathleen M. Koenig, University of Cincinnati

Interactive Video Vignettes are online presentations that make use of active-learning strategies developed through Physics Education Research. They typically focus on a single topic, are short (5-10 minutes), and use multiple-choice questions, branching and video analysis for interactivity. The LivePhoto Physics Group is creating both a set of exemplary vignettes that are being tested at several institutions and also Vignette Studio software that anyone can use to make their own

vignettes. The project's first workshop on making vignettes was held at the 2014 Summer Meeting of the AAPT. The current status, recent research results, and future directions of the project will be described.
*Supported by NSF grants DUE-1123118 & DUE-1122828.

AC04: 11:30 a.m.-12 p.m. Reimagining Best Practices in Technology-Enhanced Physics Teacher Education

Invited – Marina Milner-Bolotin, The University of British Columbia, Vancouver, BC V6T 1Z4 Canada; marina.milner-bolotin@ubc.ca

Investigating and promoting best practices in teaching and learning have always occupied a prominent place in science education. From Socratic questioning to modern day technology-enhanced pedagogies, such as Peer Instruction, Interactive Lecture Demonstrations, simulation-enhanced pedagogies, educators have been looking for ways to engage students in meaningful science learning. However, frequently technology becomes a fad imposed on teachers, where, the technological tail wags the pedagogical dog. In this presentation I will invite you to re-examine the technology-enhanced pedagogical practices in physics teacher education. We will first question the applicability of the concept of "best pedagogical practice" itself and examine a number of research-informed "best practices" currently implemented in physics teacher education. We will also consider how prospective physics teachers can be engaged in creating their own "best technology-enhanced practices" that suit their views and goals of physics education and help them become the best physics teachers they can be.

Session AD: Understanding the Redesigned AP Physics 1 and 2 Courses and Exams

Location: Nautilus Hall 3
Date: Sunday, January 4
Time: 10:30 a.m.–12 p.m.

Presider: Gay Stewart

AD01: 10:30-11 a.m. Understanding the Redesigned AP Physics 1 Course and Exam

Invited – Connie Wells, Pembroke Hill High School, Physics, Ward Parkway Campus, 5121 State Line Road, Kansas City, MO 64112; cwells@pembrokehill.org

La Tanya Sharpe, The College Board

This talk will present the Curriculum Framework for the redesigned AP Physics 1 course. The newly created labs, teacher support materials, and sample AP Physics 1 exam questions will also be shared and discussed. Instructional strategies for integrating the new learning objectives and fostering deep conceptual understanding will be presented. The characteristics of science inquiry and reasoning skills as they apply to essential physics concepts will also be addressed. The speaker will also discuss and share various instructional methods to assist in making the revised AP Physics 1 course concepts and principles engaging and enduring. The session will conclude with a joint AP Physics 1 and AP Physics 2 question and answer period.

AD02: 11-11:30 a.m. Understanding the Redesigned AP Physics 2 Course and Exam

Invited – Martha Lietz, Niles West High School, Skokie, IL 60077; marlie@d219.org

This talk will present the Curriculum Framework for the redesigned AP Physics 2 course. Newly created labs, teacher support materials, and sample AP Physics 2 exam questions will also be shared and discussed. Instructional strategies for integrating the new learning objectives and fostering deep conceptual understanding will be presented. The characteristics of science inquiry and reasoning skills as they apply to essential physics concepts will also be addressed. The speaker will also discuss and share various instructional methods to assist in making the revised AP Physics 2 course concepts and principles engaging and enduring. The session will conclude with a joint AP Physics 1 and AP Physics 2 question and answer period.

Session AE: 30 Demos in 60 Minutes

Location: Nautilus Hall 4
Sponsor: Committee on Physics in Pre-High School Education
Co-Sponsor: Committee on Physics in High Schools
Date: Sunday, January 4
Time: 11 a.m.–12 p.m.

Presider: Wendy Adams

Come enjoy a fast paced session of great demos!

Speakers:

Duane Merrell, Brigham Young University

Courtney Willis, University of Northern Colorado

The Physics of Scuba

Location: Fairbanks B (Bay Tower) and hotel pool
Sponsor: AAPT
Date: Sunday, January 4
Time: 8 a.m.–3 p.m.

Leaders: Julia Olsen and Dan MacIsaac

Physics of Scuba is a hands-on special event exploring the effects that divers and their equipment are subject to underwater. The classroom portion combines multiple topics such as laws of physics relevant to diving, physical effects of scuba on divers, and physical phenomena of interest to divers in an interactive and engaging format. This event is co-presented by physics and education faculty together with licensed dive instructors. After a morning of classroom activities and instruction, after lunch, your day will culminate with the opportunity for you to get in the water using scuba gear in an afternoon (heated) pool session with dive instructors who will guide your pool experience. If you would like to experience scuba to either enhance your physics instruction or just for fun, this is the event for you. Both the classroom and pool sessions will be held at the Sheraton San Diego Hotel. Bring a swimming suit for pool session.

Session BA: The Higgs and My Classroom

Location: Nautilus Hall 1
Sponsor: Committee on Physics in High Schools
Date: Sunday, January 4
Time: 2–3:30 p.m. (30 minutes discussion time)

Presider: Kenneth Cecire

On July 4, 2012, the world changed with the announcement of the discovery of the Higgs boson at the Large Hadron Collider at CERN. Can we bring the Higgs boson from discovery to the classroom? How might we do it? Tom Jordan and Mike Wadness from QuarkNet will lead off with thought-provoking invited presentations. We will finish with a special discussion with distinguished Fermilab particle physicist Chris Quigg, who will lead us into a discussion of whether we – and our students – should care about the Higgs and what it means for physics. Dr. Quigg, who has long experience with bringing particle physics to people at all levels, will start with a few remarks and is looking forward to a robust conversation with all of us.

BA01: 2-2:30 p.m. Using Particle Physics to Teach About the Nature of Science

Invited – Michael J. Wadness, Medford High School/QuarkNet 489, Medford, MA 02155; mjwadness@verizon.net

For over 20 years national reform documents, including Next Generation Science Standards, have advocated for the explicit instruction of the nature of science (NOS) as a vehicle for achieving science literacy. Unfortunately many teachers struggle with how to best implement meaningful NOS instruction. One possible method is through the context of particle physics research. This talk will demonstrate how some QuarkNet activities that utilize current particle physics research may be used as a context for NOS instruction. Furthermore these activities may also provide a vehicle for connecting the traditional high school curriculum with active physics research.

BA02: 2:30-3 p.m. Teaching and Learning Particle Physics with QuarkNet

Invited – Thomas Jordan, University of Notre Dame, Physics Department, Notre Dame, IN 46556; jordant@fnal.gov

Physics students at all levels should learn about the exciting research currently taking place at universities and laboratories. Students can comprehend much of what transpires in esoteric particle detectors at Fermilab and CERN through the context of fundamental physics tenets such as energy and momentum conservation. Want to learn the mass of the Higgs? Measure the energy and momentum of its decay products and apply what you already know. I will discuss ways to bring this exciting science to your classroom using a Data Portfolio and in masterclasses. The former is a framework of activities that guides students through simple to complex data analysis. The latter is a one-day event that invites high school students to a university campus for activities and interactions with researchers there. These activities are offered by QuarkNet, a collaboration of physicists and physics teachers that has worked since 1999 to help introduce particle physics to high school classes and is supported by the National Science Foundation and the U.S. Department of Energy.

Session BB: Recruitment and Retention

Location: Nautilus Hall 2
Sponsor: Committee on Physics in Undergraduate Education
Date: Sunday, January 4
Time: 2–2:50 p.m.

Presider: Kathleen Falconer

BB01: 2-2:10 P.M. Tripled Our Number of Majors Through Research and Retention Programs*

Contributed – Peter A. Sheldon, Randolph College, Lynchburg, VA 24503; psheldon@randolphcollege.edu

Katrin Schenk, Sarah Lawson, Randolph College

With the help of a National Science Foundation S-STEM grant, we have instituted a recruitment and retention plan to increase the number of physical science majors at Randolph College (total 700 students). While the grant provides scholarships to two cohorts of 12 students, we have exceeded our goal to recruit 24 students each year into the physical sciences, and to retain them at a higher rate than the college as a whole. We have also made research experiences the norm for students starting from the first year. Our historical average was 2.7 physics majors/year, while we now have about 10 each year for the foreseeable future, with an incredible 18% of the current first-year class expressing some interest in physics or engineering. As well as an active recruitment program and early research program, we have a summer transition program, an industry mentor program, enhanced tutoring, and a first-year seminar. This project is supported by the National Science Foundation under Grant No. DUE-1153997. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

*This project is supported by the National Science Foundation under Grant No. DUE-1153997.

BB02: 2:10-2:20 p.m. Ramping up Recruitment in Advance of a New Physics Major

Contributed – Jolene L. Johnson, St. Catherine University, Minneapolis, MN 55411; jljohnsonarmstrong@stkate.edu

Erick Agrimson, Kaye Smith, St. Catherine University

St. Catherine University is launching a new applied physics major in fall 2016. In this talk, I will discuss the ways we are ramping up our recruiting and retention of physics students. These methods include adding a math review at the start of Physics I, adding an Intro to Engineering class, working more closely with advising, starting a freshman seminar for physical science majors, and designing new student spaces in our new building. I will also discuss the challenges we have encountered and our proposed solutions. These challenges include historically poor advising of physical science students, designing a curriculum that appeals to students interested in a wide variety of careers, and the relatively low number of females taking physics in high school.

BB03: 2:20-2:30 p.m. Building a Thriving Undergraduate Physics Program from Scratch

Contributed – Charles De Leone, California State University San Marcos, San Marcos, CA 92096; cdeleone@csusm.edu

Edward Price, California State University San Marcos

At CSU San Marcos, we recently began offering an undergraduate degree in applied physics—our only physics degree program. We graduated our first student in 2009, and currently have over 100 majors in the program. CSUSM, located in north San Diego County, is a Hispanic Serving Institution, and approximately 30% of our applied physics majors are Hispanic. This talk will describe the development of the program, recruiting efforts, and current challenges. We will emphasize the critical features of our success and lessons that generalize to other programs.

BB04: 2:30-2:40 p.m. A Learning Community for Freshman Engineering Students

Contributed – Michael Eads, Northern Illinois University, Department of Physics, DeKalb, IL 60115; meads@niu.edu

Daniel Stange, Northern Illinois University

For the past several years, Northern Illinois University (in DeKalb, IL) has offered a Themed Learning Community (TLC) for freshman engineering majors in their first semester. In this TLC, a group of 24 students are in the same sections of Calculus I and General Physics I. Additional resources are provided by the university and coordination between the calculus and the physics instructor is also encouraged. The calculus and physics for engineers TLC is one of several TLCs offered by the university. Data indicates that student grades and retention rates are better for TLC students compared to comparable students who were not in a TLC. One question that has not yet been studied is whether there are differences in the students' learning of physics in the TLC versus non-TLC sections. A research study is described to begin to address this question and some preliminary data are presented.

BB05: 2:40-2:50 p.m. More Fun Produces More "A" Students

Contributed – Christine M. Carmichael, Woodbury University, Burbank, CA 91510; christine.carmichael@woodbury.edu

In the Physics Lab at Woodbury University, my undergraduates enjoyed the hands-on experiments even more than I expected. "That's the most fun I've had since kindergarten," said the group leader of students at one lab bench. And isn't that our goal? Isn't it our mission to make physics irresistibly fun to engage our students? Given that we are professional physics teachers, who know the Physics content well, and the methodologies of teaching (pedagogy)—we can use traditional assessment methods to validate that the content is genuinely being learned. In my experience: More Fun = More "A"s. Some teaching methods for making introductory physics more fun will be discussed.

Session BC: How to Publish an Article

Location: Grande Ballroom B
Sponsor: Committee on Physics in Two-Year Colleges
Date: Sunday, January 4
Time: 2–3:30 p.m.

Presiders: Dwain Desbien

Panel – Gary White, American Association of Physics Teachers and The George Washington University; gwhite@aapt.org

This panel discussion will discuss the issues and barriers in getting published in *The Physics Teacher*. It is aimed primarily at those who don't typically publish papers (TYC and HS faculty).

Session BD: Decreasing Stereotype Threat in Discourse and Assessment

Location: Nautilus Hall 3
Sponsor: Committee on Women in Physics
Co-Sponsor: Committee on Diversity in Physics
Date: Sunday, January 4
Time: 2–3:10 p.m.

Presider: Jennifer Blue

BD01: 2-2:30 p.m. Stereotype Threat and Female Performance in Secondary Physics Courses

Invited – Gwen Marchand, University of Nevada Las Vegas, 4505s Maryland Pkwy., Las Vegas, NV 89154; Gwen.marchand@unlv.edu

This talk will discuss findings from quasi-experimental, school-based research as to the effects of different aspects of stereotype threat in assessment instructions on secondary student performance in physics. Using this work as a springboard, the presentation will include consideration of situational, personal, and assessment factors that may influence the role of stereotype threat in physics courses, with particular attention to motivational and affective course-related processes and the nature of assessment. Drawing on data collected with secondary physics students, the talk will explore the role that motivational factors may play in females' vulnerability to stereotype threat in physics courses. Ways to facilitate a positive motivational climate both during instruction and assessment in physics courses will be discussed.

BD02: 2:30-3 p.m. Evidence for a Model to Decrease Stereotype Threat in Assessments

Invited – Dedra Demaree, Georgetown University, 1644 21st St. N, Apt. 1, Arlington, VA 22209; dd817@georgetown.edu

Saalih Allie, University of Cape Town

Collaborating with the University of Cape Town, the work discussed in this talk has centered on studying what impacts how a student responds to various wordings of physics question in different contexts. This work has led to the development of a cognitive model for activation of resources and effective use of working memory during problem solving. This talk will share research findings from a few projects where the same physics content was presented, in the same context, but with subtle wording changes that attended to affective factors such as what the audience a student addressed on a written question. These projects include the wording of a lab worksheet, and the words said when giving a clicker question. Our findings indicate that attending to affect changes how students respond, and applying our cognitive model to improve question wording has the potential to positively impact student engagement and performance.

BD03: 3-3:10 p.m. Student-Driven Efforts to Promote Equality in STEM at CSM

Contributed – Libby K. Booton, Colorado School of Mines, Department of Physics, Golden, CO 80401-1843; lbooton@mymail.mines.edu

Kristine E. Callan, Alex Flournoy, Colorado School of Mines

When the Colorado School of Mines (CSM) hosted a CUWiP in 2013, there was a significant number of male attendees, which generated some controversy. However, it also inspired the formation of a new club at CSM: Equality Through Awareness (ETA). ETA's mission is to spread awareness and support for issues faced by underrepresented groups in STEM fields. In addition, ETA serves as an affinity group for the women in physics at Mines. The club's three main components are: weekly student-only discussion groups, guest speakers who are members of underrepresented groups, and a mentoring program for women. This presentation will discuss how the club was formed, its organizational structure, and plans for future growth.

Session BE: Powerful, Simple, Collaborative Graphing with Plot.ly

Location: Executive 2A/2B
Sponsor: Committee on Physics in High Schools
Date: Sunday, January 4
Time: 2–3 p.m.

Presider: Mariah Hamel

Plotly provides a free, online graphing and analytics platform for science. Users can import, analyze, and graph data from Google Drive, Dropbox, or Excel, and collaboratively work from different devices, browsers, and a Chrome App. In this panel, we'll examine the uses for the classroom, including integration with Vernier's state of the art interfaces, sensors, and experiments.

Supported plot types include scatter, line, and bar charts, as well as histograms, heatmaps, 3D plots, and box plots. Plotly supports fits, ANOVA, statistics and spreadsheet formulas, and error bars. Best fit lines in Plotly can be run with many types of regressions: linear, inverse, inverse square, squared, bell curve, and fits to custom functions.

Plotly is free and online for public sharing, provides tutorials and instruction, and is used by researchers at SpaceX, Aerospace Corporation, and NASA.

Speakers:

John Gastineau, Vernier Software

Mariah Hamel, Plot.ly

Matt Sundquist, Plot.ly

Steven J. Maier, Northwestern Oklahoma State University

Session BF: Exemplary Ways to Prepare Elementary School Teachers to Meet the NGSS Challenge

Location: Nautilus Hall 4
Sponsor: Committee on Teacher Preparation
Co-Sponsor: Committee on Physics in Pre-High School Education
Date: Sunday, January 4
Time: 2–3:40 p.m.

Presider: Stamatis Vokos

BF01: 2-2:30 p.m. A Coordinated Approach to the Science Preparation of Elementary School Teachers

Invited – Leslie J. Atkins, Cal State University at Chico, 400 W 1st St., Chico, CA 95929; ljatkins@csuchico.edu

California State University at Chico created a Department of Science Education in the College of Natural Sciences charged with the undergraduate science preparation of future teachers. Faculty in this department have advanced degrees and experience in both science and education; most have K-12 teaching experience. We redesigned the course sequence for future elementary teachers; developed a new majors program for future middle school science teachers, outdoor educators, and museum educators (with 38 majors and growing); and cultivated a cross-disciplinary community of researchers engaged in discipline based education research. This talk will outline our course sequence, including efforts to align courses with the new NGSS.

BF02: 2:30-3 p.m. Preparing Elementary Teachers in Science Through a Multi-Year, Integrated Experience

Invited – Kara E. Gray, Seattle Pacific University, 3307 Third Ave. West, Suite 307, Seattle, WA 98119-1997; grayk5@spu.edu

Lezlie DeWater, Seattle Pacific University

At Seattle Pacific University we prepare future elementary teachers to teach science using a multi-year experience that includes content courses, a methods course, and Learning Assistant (LA) opportunities. Our students begin with a two course sequence that is designed around the NGSS physical science standards and emphasizes topics where research has shown elementary students and teachers tend to struggle. A key objective for these courses is for students to build a model of energy. These courses then prepare students for the science methods course which focuses on strategies for effectively teaching science. Students also have the opportunity to build on the experience by serving as an LA in the content courses. This experience deepens their content knowledge and allows them to build teaching skills. During this talk we will describe the program we have developed for elementary teachers in science and discuss evidence for its effectiveness.

BF03: 3-3:10 p.m. Using NextGen PET to Prepare Elementary Teachers for the NGSS

Contributed – Fred M. Goldberg, San Diego State University CRMSE, 6475 Alvarado Road, Suite 206, San Diego, CA 92120; fgoldberg@mail.sdsu.edu

Steve Robinson, Tennessee Technological University

Ed Price, California State University at San Marcos

Michael McKean, San Diego State University

Danielle B. Harlow, University of California at Santa Barbara

Julie Andrew, University of Colorado at Boulder

The project team who developed PET*, PSET* and LPS* have revised the curricula to make them more flexible for implementation and better aligned with the Next Generation Science Standards' physical science core ideas, the science and engineering practices, and the crosscutting concepts. NextGenPET consists of five separate content modules, each of which includes engineering design activities. There is also a Teaching and Learning module, with activities that embed in the five content modules and help the teachers make explicit connections between the NextGenPET activities, the core ideas, and science and engineering practices of the NGSS, their own learning, and the learning and teaching of children in elementary school. There are two versions of the modules, one for small classes with extensive laboratory work and discussion, and one for large, lecture-style classes. Both versions use the same extensive set of online homework assignments.

**Physics and Everyday Thinking, Physical Science and Everyday Thinking*, and *Learning Physical Science* are all published by It's About Time, Mount Kisco, NY.

BF04: 3:10-3:20 p.m. Engineering in Your World

Contributed – Kaye L. Smith, St. Catherine University, 2004 Randolph Ave., Saint Paul, MN 55105-1789; klsmith2@stkate.edu

Natasha L Yates, St. Catherine University

The National Center for STEM Elementary Education (NCSEE) is located at St. Catherine University in St. Paul, MN. Engineering in Your World is one of three courses that elementary education majors take as part of a specially designed STEM certificate at St. Catherine University; it is co-taught by an engineer and education faculty. This course integrates physics concepts, engineering applications, and a hands-on discovery approach to learning that emphasizes the iterative nature of the engineering design process. Faculty model best practices in teaching STEM, scaffolding the instruction to include guided, connected, and open/full inquiry. Pre-service teachers are actively engaged in learning through assignments in the course that relate both to engineering and education. This presentation will outline the course with examples of topics covered. The results of this work include increased teacher knowledge, greater confidence to address NGSS, and more use of hands-on, inquiry-based pedagogy.

BF05: 3:20-3:30 p.m. You've Got to be Smarter than a 5th Grader!

Contributed – Beverly T. Cannon, Kathlyn Gilliam Collegiate Academy, 6315 Rincon Way, Dallas, TX 75214-2040; cannonb75@gmail.com

With 46 years in the HS classroom, I have begun teaching pre-service elementary teachers for Texas A&M Commerce. With the focus on state standards and NGSS, concepts in physics and chemistry dominate the class materials. No text, printed materials, hands-on labs and very creative uses of technology fill the curriculum. You decide if it is exemplary.

BF06: 3:30-3:40 p.m. Does the Pedagogical Learning Bicycle Promote Transfer?*

Contributed – Claudia Fracchiolla, Kansas State University, 116 Cardwell Hall, Manhattan, KS 66506; fracchiollac@ksu.edu

N. Sanjay Rebello, Kansas State Univrsity

The classical definition of transfer involves the ability of applying what you learned in one context to a different context (Bransford, Brown, Cocking, 2000). More recently, transfer has been defined as the expansive framing learning context (Engel, et. al 2012). For instance, we might facilitate transfer by helping students see the connections between what they are learning in the classroom and their future professional role. The Concepts of Physics (CoP) course at Kansas State University is a physics class for pre-service teachers structured around the pedagogical learning bicycle (PLB). In this instructional model students learn the physics concepts and also learn about how kids think about and learn these same concepts. The PLB model frames students' learning around their future career as teachers. We investigate if the PLB can serve as an instructional model that frames learning in an expansive manner and therefore promotes transfer.

*Supported in part by NSF grant 1140855.

Session BG: Department Lab Assessment

Location: Executive 3A/3B
Sponsor: Committee on Laboratories
Co-Sponsor: Committee on Physics in Undergraduate Education
Date: Sunday, January 4
Time: 2–3:10 p.m.

Presider: Joe Kozminski

BG01: 2-2:30 p.m. Strategies and Goals for Assessment in Lab Courses

Invited – Benjamin Zwickl, Rochester Institute of Technology, 84 Lomb Memorial Dr., Rochester, NY 14623-5603; benjamin.m.zwickl@rit.edu

Assessment has many goals, ranging from promoting student learning in the classroom to evaluating the effectiveness of widely disseminated curricula. Assessment spans scales from individual students learning a single topic to an evaluation of an entire program or department. I will provide a broad overview of assessment opportunities in lab courses and align the discussion with the preliminary laboratory curriculum guidelines developed by the AAPT Committee on Laboratories. In order for these guidelines to have a positive, sustained impact on physics education, they must be coupled with assessment. Using the six broad categories in the guidelines (constructing knowledge, modeling, designing experiments, analyzing and visualizing data, developing technical and practical skills, and communicating physics), I will provide examples of existing assessments and highlight areas for future development. Instructors, laboratory curriculum developers, and education researchers will find examples of interest.

BG02: 2:30-2:40 p.m. Physics Laboratory Performance Assessment at UNC-CH

Contributed – Duane L. Deardorff, The University of North Carolina at Chapel Hill, Campus Box 3255, Chapel Hill, NC 27599-3255; duane.deardorff@unc.edu

In our introductory physics laboratories at UNC-Chapel Hill, we have been administering a lab practicum since 2001. This hands-on lab exam assesses students' ability to make accurate measurements with typical laboratory instruments, analyze and interpret empirical data, evaluate results, analyze measurement errors, and properly communicate findings. Trends in student performance and lessons learned will be shared in this talk. Sample lab exam questions and answers with explanations are provided for students to help them prepare for their exam; these can be found on our department website: www.physics.unc.edu/labs

BG03: 2:40-2:50 p.m. The Laboratory Skill Set in the Calculus-based Sequence

Contributed – Doug Bradley-Hutchison, Sinclair Community College, 444 W. 3rd St., Dayton, OH 45402-1460; douglas.bradley-hutc@sinclair.edu

In this talk we describe the process being employed, and the progress we have made in revising the laboratory sequence for our calculus-based introductory physics sequence. The goal being to develop, in our students, a set of measurable laboratory skills that exists over and above the support for lecture content that the laboratory might provide. Part of the process involves asking faculty, including adjuncts, to articulate their goals and expectations in regard to the laboratory. To better understand our students we are employing formative assessment techniques based on existing labs and other exercises to collect data related to student skill and concept development as they progress through the semester/sequence.

BG04: 2:50-3 p.m. Studying Students' Epistemology and Expectations of Experimental Physics

Contributed – Heather Lewandowski, University of Colorado, CB440 Boulder, CO 80309; lewandoh@colorado.edu

Benjamin Zwickl Rochester Institute of Technology

Noah Finkelstein, Dimitri Dounas-Frazer, University of Colorado

In response to national calls to better align physics laboratory courses with the way physicists engage in research, we have developed an epistemology and expectations survey to assess how students perceive the nature of physics experiments in the contexts of laboratory courses and the professional research laboratory. The Colorado Learning Attitudes about Science Survey for Experimental Physics (E-CLASS) evaluates students' epistemology at the beginning and end of a semester. Students respond to paired questions about how they personally perceive doing experiments in laboratory courses and how they perceive an experimental physicist might respond regarding their research. Also, at the end of the semester, the E-CLASS assesses a third dimension of laboratory instruction, students' reflections on their course's expectations for earning a good grade. By basing survey statements on widely embraced learning goals and common critiques of teaching labs, the E-CLASS serves as an assessment tool for lab courses across the undergraduate curriculum and as a tool for physics education research.

BG05: 3-3:10 p.m. Assessment in Physics Distance Education: Practical Lessons at Athabasca University

Contributed – Farook Al-Shamali, Athabasca University, 16260 - 132 St. Edmonton, AB T6V 1X5, Canada; farooka@athabascau.ca

Martin Connors, Athabasca University

Meaningful and valid assessment of students' learning is at the heart of credit granting institutions, especially for courses delivered at a distance. At Athabasca University, we have extensive experience in teaching online first-year physics courses, most of which include home lab components. Practical experiences and data-driven conclusions demonstrate that online assessment can be conducted effectively in the distance education environment. The turnaround time and quality of feedback on marked assignments and lab reports can be comparable to (if not exceeds) that in conventional classrooms. Blended exam format (multiple-choice and long answer questions) appears suitable for introductory physics courses since it balances exam validity and course administration efficiency. A comprehensive final exam that carries more weight than the midterm appears to be a justified practice.

Session BH: PER: Student Engagement and Metacognition

Location: Nautilus Hall 5
Sponsor: AAPT
Date: Sunday, January 4
Time: 2–3:10 p.m.

Presider: Hunter Close

BH01: 2-2:10 p.m. How Student Research Experiences Shape Perceptions of Scientists

Contributed – Gina M. Quan, University of Maryland, 082 Regents Drive, College Park, MD 20740; gina.m.quan@gmail.com

Many universities have created programs to support undergraduate retention by placing students in research positions. I will present research on first-year undergraduate students' evolving ideas about physics research. Students in the study were part of a research seminar at the University of Maryland in which they worked with research mentors on research projects. Class time was dedicated to teaching research skills and supporting students through emotional hurdles associated with research. In classroom video and interviews, students described ways in which their research experiences were different from their expectations. Students tie an improved sense of competence in research to a better understanding of who does physics and how physics research works.

BH02: 2:10-2:20 p.m. Student Views on the Nature of Disciplines

Contributed – Dyan L. Jones, Mercyhurst University, 501 E 38th St Erie, PA 16546; djones3@mercyhurst.edu

Verna M. Ehret, Lena Surzhko-Harned, Mercyhurst University

At our institution, all freshmen are required to take a multidisciplinary course taught by three faculty members from different departments. Anecdotally, faculty members have long discussed the variations in student perceptions of the disciplines and how they are manifested in this context. This study presents pre- and post-data gathered from one such interdisciplinary class to determine whether there are measurable differences in the way students view natural science, social science, and humanities.

BH03: 2:20-2:30 p.m. Exclusively Visual Analysis of Classroom Group Interactions

Contributed – Laura J. Tucker, Harvard University, 9 Oxford St, McKay 319 Cambridge, MA 02138-3800; ltucker@seas.harvard.edu

Rachel E. Scherr, Seattle Pacific University

Todd Zickler, Eric Mazur, Harvard University

Data that measures group learning are time-consuming to collect and analyze on a large scale. As an initial step toward scaling qualitative classroom observation, our team qualitatively coded classroom video using an established coding scheme with and without its audio. We find that inter-rater reliability is as high when using visual data only "without audio" as when using both visual and audio data to code. Also, inter-rater reliability is high even when comparing use of visual and audio data to visual-only data. We see a small bias that interactions are more often coded as group discussion when visual and audio data are used compared with video-only data. This work establishes that meaningful educational observation can be made through visual information alone. Further, after initial work from qualitative researchers validates the coding scheme in each classroom environment, computer-automated visual coding could drastically increase the breadth of qualitative studies and provide meaningful educational assessment to a large number of classrooms.

BH04: 2:30-2:40 p.m. Using the ITIS to Evaluate Simple Interventions in Introductory Physics

Contributed – Alexandra C. Kopecky, College of DuPage, 425 Fawell Blvd. Glen Ellyn, IL 60137; cthecosmos@gmail.com

Tom Carter, College of DuPage

Jennifer Gimmell, Benet Academy

Recent publications have indicated that there is a link between students' performance and students' beliefs in whether intelligence is fixed or capable of growth. They also argue that these beliefs can be changed by simple interventions. In this talk, we will provide pre- and post-course evaluations of students' beliefs on intelligence using the Implicit Theory of Intelligence Scale (ITIS) for both an experimental and a control class. The experimental class had both a brief written and oral intervention. We will also show correlations between students' beliefs on intelligence and their success in the course.

BH05: 2:40-2:50 p.m. Shifts in Student Views About Metacognition in Calculus-based Physics*

Contributed – Sara Kathrine Julin, Whatcom Community College, 237 West Kellogg Road, Bellingham, WA 98226; sjulin@whatcom.ctc.edu

Andrew Boudreaux, Western Washington University

Student attitudes about learning and understanding physics have been shown to be naïve and remarkably stable, failing to become more expert-like even after instruction informed by PER. This talk describes the efforts of one community college faculty member, already committed to and experienced with student-centered methods, to integrate explicit instruction in metacognition into her teaching of the introductory mechanics course. Students had weekly practice reflecting in writing on changes in their own thinking, supported by frequent full-class discussion in which this type of metacognition was modeled and framed. The sophistication of student attitudes about the role of reflection in their learning was tracked through an end-of-course learning commentary assignment. Preliminary analysis indicates substantial positive changes in attitudes as compared to results from sections of the course in which metacognition was not explicitly taught. The instruction will be briefly described, and data from multiple sections of the course will be shared.

*This work was partially supported by the National Science Foundation under Grant Nos. DUE-1245999, DUE- 1245993, DUE-1245313 and DUE-1245699.

BH06: 2:50-3 p.m. Measuring How Accurately Students Evaluate Changes in their Own Thinking*

Contributed – Andrew Boudreaux, Western Washington University, 516 High St., Bellingham, WA 98225-9164; andrew.boudreaux@wwu.edu

Tija Tippett, Therese Claire, Emily Borda, Western Washington University

Sara Julin, Whatcom Community College

How People Learn summarized decades of research on learning and included metacognition as one of its Three Key Findings. Active self-monitoring characterizes expert learning, and HPL advocates the explicit teaching of monitoring strategies in context. But how accurately can students identify specific changes in their understanding? As part of a collaborative effort at WWU, WCC, NDSU, and U. Maine, we have examined student metacognition using paired questions. This talk presents results from a mechanics question administered at the beginning of instruction in a course for preservice elementary teachers, and again two weeks later toward the end of relevant instruction. The re-assessment included a prompt asking students to describe how their thinking had changed. Researchers coded responses on the initial assessment and re-assessment for content accuracy, and then compared differences in these codes to the students' self-reported descriptions of changes in their thinking.

*This work partially supported by NSF Grant Nos. DUE-1245999, DUE-1245993, DUE-1245313 and DUE-1245699.

BH07: 3-3:10 p.m. Authentic Student Work as a Vehicle for Enhancing Metacognitive Abilities*

Contributed – MacKenzie R. Stetzer, University of Maine, 5709 Bennett Hall, Orono, ME 04469-5709; mackenzie.stetzer@maine.edu

Thanh K. Le, University of Maine

Mila Kryjevskaia ,North Dakota State University

As part of an ongoing project aimed at improving student learning by investigating and supporting student metacognitive abilities in the context of physics, we have been examining the role of metacognition in the kind of qualitative, inferential reasoning emphasized in research-based instructional materials. In particular, we have been using paired question sequences shown to elicit inconsistencies in student reasoning as the basis for a think-aloud interview protocol in which pairs of students collaboratively work through such question sequences. Audio, video, and real-time writing data have been used to identify instances of socially mediated metacognition. This talk will focus on targeted interventions in which student pairs are guided to reflect on multiple samples of authentic student work after the pairs have completed the problems collaboratively. Preliminary findings will be presented.

*This work is supported in part by the National Science Foundation under Grant Nos. DUE-1245313, DUE-1245999, and DUE-0962805.

Session CA: Challenges with Sea-based Naval Operations and UAS

Location: Nautilus Hall 1
Sponsor: Committee on the Interests of Senior Physicists
Co-Sponsor: Committee on Science Education for the Public
Date: Sunday, January 4
Time: 4–5:30 p.m.

Presiders: David M. Cook and Richard Jacob

The invited talks in this session focus on the historical challenges of conducting successful sea-based flight operations, both from aircraft carriers and from air-capable surface combatants. Presentations will highlight the engineering, equipment, and operational strategies involved in meeting those challenges. The session will conclude with an overview of recent experiences in the integration of fixed and rotary wing unmanned aerial systems (UAS) into the sea-based operational environment. Note also the field trip to the USS Carrier Midway Museum scheduled for Saturday afternoon.

CA01: 4-4:30 p.m. The Sea-based Environment – General Description of the Problem

Invited – Robert H. Rutherford, 305 I Ave., Coronado, CA 92118; robert.rutherford@ngc.com

Since the dawn of warfare, naval operations have provided a significant element to the battle space. The power that controls the sea in a combat theater has historically enjoyed an insurmountable advantage and achieved predictable outcomes in regional conflicts. Air capable ships; aircraft carriers that support mainly fixed wing aircraft and smaller surface combatants that support helicopters; provide an additional dimension to sea based combat. This capability doesn't come without challenges however. This session will set the stage for the two sessions that follow. It will describe the operational environment and the corresponding considerations that must be made to effectively operate manned or unmanned aircraft from sea going vessels. This will include an unclassified primer on basic sea based tactics and typical operational flows for both carrier ops and independent surface combatants. The session closes with a summary of the operator training specific and unique to the maritime combat environment.

CA02: 4:30-5 p.m. Aircraft Carrier Equipment Introduction

Invited – Tom Conklin, U.S. Navy, 221 F Ave., Coronado, CA 92118; thomas.r.conklin1@navy.mil

Aircraft carrier operations are often described as precisely controlled chaos. On a flight deck that is 1092 ft long and 257 ft wide, the carrier/air wing team conducts daily flight operations that rival some of the nation's larger airports, and they do it on a moving platform no matter the conditions. In this session we will discuss how aircraft are launched and recovered on the carrier using some new and some not so new technology. As well, we will discuss the tools that aviators have to navigate in and around the carrier environment and land during all-weather operations, and how these have improved over the years.

CA03: 5-5:30 p.m. X-47B U.S. Navy's First Carrier Capable Unmanned Air System (UAS)

Invited – Tighe S. Parmenter, Northrop Grumman Corporation, 845 Leah Ln., Escondido, CA 92029; tighe.parmenter@ngc.com*

This session will examine the technical and operational aspects of the U.S. Navy/Northrop Grumman Unmanned Combat Air System Carrier Demonstration (UCAS-D) program and the X-47B prototype UAS. The presentation will highlight the technical challenges and achievements of the program from concept development through flight test and demonstration at-sea on USS George H.W. Bush (CVN 77) in the summer of 2013. Designed by Northrop Grumman and the U.S. Navy beginning in 2007, the X-47B aircraft achieved the goal of showing that a UAS can integrate seamlessly with and operate from an aircraft carrier during at-sea periods in 2013 and 2014. The presentation will discuss the unique design attributes and flying qualities of the tailless X-47B aircraft the challenges of developing and adapting existing carrier command, control and operating procedures designed for manned aircraft to the standards necessary to support carrier UAS operations.

*Invited by David Cook

Session CB: Report from International Conference on Women in Physics

Location: Executive 3A/3B
Sponsor: Committee on Women in Physics
Co-Sponsor: Committee on International Physics Education
Date: Sunday, January 4
Time: 4–5:30 p.m.

Presider: Monica Plisch

Watch the new "HERstories: Encouraging words from women in physics" video from AAPT and SPS based on interviews with delegates of the 5th International Conference on Women in Physics. Learn about the My STEM Story project (http://mystemstory.wlu.ca/). Hear about what is happening around the world to encourage girls and women to participate in physics. Discuss ways ideas from other countries that might be implemented by AAPT and at your local institution. Come and join us to think about ways to promote women in physics. Partial support provided by NSF #PHY-1419453.

Speakers:

Cherill Spencer, Stanford University

Beth Cunningham, American Association of Physics Teachers

Anne Cox, Collegium of Natural Sciences

Session CC: Teaching Math Methods in the Upper Level UG Physics

Location: Nautilus Hall 2
Sponsor: Committee on Physics in Undergraduate Education
Date: Sunday, January 4
Time: 4–6 p.m.

Presider: Juan Burciaga

CC01: 4-4:30 p.m. Order of Magnitude Physics: The Importance of Non-mathematical Methods

Invited – Sterl Phinney, California Institute of Technology, MS 350-17, Pasadena, CA 91125-0001; esp@tapir.caltech.edu*

Caltech physics graduates are good at calculating resonant EM frequencies of cylindrical cavities, and QED cross-sections. But in 1989, blank stares were the general response to questions like `what's the fundamental vibration frequency of that building?' or `is the heating that's wrecking your experiment from radiation or the lead wires?' So I created a course: "Order-of-Magnitude Physics," offered biennially for the past 25 years. We cover Fermi estimates, dimensional analysis, approximation methods, derive from first principles and fundamental constants all the tabular entries in the AIP handbook (to order of magnitude), and then have fun with everything from nerve cells and Olympic records to weather, bombs and stars. The course is not required by any department, but 1/4 of all Caltech undergraduate and graduate students now take it. Former students teach versions around the world. I discuss the benefits and pitfalls of teaching non-mathematical methods.

CC02: 4:30-5 p.m. Introductory Theoretical Physics: An Activity-based Course

Invited – Robert J. Boyle, Dickinson College, Department of Physics and Astronomy, Tome Hall, Carlisle, PA 17013-2896; robert.james.boyle@mac.com*

The development, evolution and underlying philosophy of Dickinson's course, Introduction to Theoretical Physics, will be discussed. Created with the help of an NSF grant, the course was designed as a project-centered presentation of introductory and intermediate mathematical topics with an "impedance matching" role. Motivating projects and a guided-inquiry approach to mathematics theory would be used to introduce students, who might come to the physics major with a variety of preparations in formal mathematics, to the tools they would need for advanced courses. The challenge in the design of such a course was to introduce these tools without either repeating the applications students would see in those advanced courses, or presenting the mathematics in a purely formal manner divorced from applications. The challenge was met in part by discussing topics that many majors might not otherwise encounter, including some topics in astronomy and astrophysics.

*Sponsored by Juan R. Burciaga

CC03: 5-5:30 p.m. Unpacking Student Challenges in Middle-Division Classical Mechanics/Math Methods

Invited – Marcos Caballero, Michigan State University, 567 Wilson Road, East Lansing, MI 48824-1046; caballero@pa.msu.edu

At the University of Colorado Boulder, we have transformed our middle-division classical mechanics and math methods course using principles of active engagement and learning theory. As part of that work, we are investigating how students use math, and how they connect math with physics. To better understand students' use of math, we developed (through task analysis) an analytical framework that helps to organize and to provide some coherence among the difficulties that students present on written work and in interview settings. Among other contexts, we have used this framework to understand students' use of Taylor series in physics problems. More recently, at Michigan State University, we have begun observing students working in groups while they solve canonical back-of-the-book problems. These in situ observations are leading us to unpack students' in-the-moment reasoning strategies. We are developing theoretical tools to investigate how students solve such problems.

CC04: 5:30-6 p.m. Mathematical Methods in the Paradigms in Physics Curriculum*

Invited – Corinne A. Manogue, Oregon State University, Weniger Hall 301, Corvallis, OR 97331; corinne@physics.oregonstate.edu

David Roundy, Oregon State University

In the Paradigms in Physics program at Oregon State University, we have implemented a unique combination of "just in time" math methods integrated into physics content courses for the early upper-division, combined with a later, separate Mathematical Methods course. This order is exactly the reverse of many other institutions that teach a sophomore level Math Methods course and advanced topics integrated into physics content courses. We will discuss why we made our choice and which content we chose to address in each part. In addition, we will share a number of unique hands-and-bodies-on activities that make esoteric math topics in thermodynamics, quantum mechanics, and E&M more vivid and geometric for the students.

*This material is based on work supported by the National Science Foundation under Grant Nos. 1023120, 1323800. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.

CC05: 4-6 p.m. Kinetic Energy in Galilean and Special Relativity – A Unified Derivation

Poster – Roberto Salgado, Univ. of Wisconsin - La Crosse, Dept of Physics, 1725 State St., La Crosse, WI 54601; rsalgado@uwlax.edu

The expression for the relativistic kinetic energy bears little resemblance to its classical counterpart, as noted by Kleppner and Kolenkow in their mechanics textbook. Using Spacetime Trigonometry,* a unified presentation of Euclidean geometry and Galilean and Minkowskian spacetime geometries, we show that the kinetic energy can be expressed in terms of the Galilean and Minkowskian analogues of a now little-used trigonometric function: the Versed-Sine. Our derivation of the relativistic work-energy theorem becomes much shorter than that of Kleppner and Kolenkow.

*Aspects of Spacetime Trigonometry can be found at http://www.aapt.org/doorway/Posters/SalgadoPoster/SalgadoPoster.htm.

CC06: 4-6 p.m. Teaching Quantum Mechanical Math Using an Elastic Solid Model

Poster – Robert A. Close, Clark College, 1933 Fort Vancouver Way, Vancouver, WA 98663; robert.close@classicalmatter.org

One difficulty in teaching quantum mechanics is that the concept of angular momentum density is not generally understood. This is primarily because the usual treatment of elastic waves in solids assumes infinitesimal rotations. We derive the equation of evolution of classical angular momentum density, which is independent of the choice of origin (and radius vector). Using a simple wave interpretation of Dirac bispinors (yes, simple!), we show that Dirac's equation of evolution for spin angular momentum density is a special case of our more general equation. We derive a Dirac Lagrangian and Hamiltonian and show that they have a familiar interpretation in terms of elastic and kinetic energy. Dynamical momentum and angular momentum operators are equivalent to those of quantum mechanics. Spin and orbital angular momentum are associated with motion of the solid medium and the wave, respectively.

Session CD: Technology-Enhanced Teaching Environments

Location: Nautilus Hall 3
Sponsor: Committee on Educational Technologies
Date: Sunday, January 4
Time: 4–5:40 p.m.

Presider: Jeff Groff

CD01: 4-4:30 p.m. When Form Meets Function – Designing a Next Generation Technology-Rich Collaborative Learning Environment

Invited – Chris Whittaker, Dawson College, 4001 de Maisoneuve West, Montreal, QC H3Z 3G4 Canada; cwhittaker@place.dawsoncollege.qc.ca

Elizabeth S. Charles, Dawson College

Active learning classrooms are still relatively new to colleges and universities across North America. The development and growth in popularity over the last decade of pioneering classroom designs such as SCALE-UP was a natural next-step as the evidence for active learning pedagogies mounted and interest turned to designing classrooms that complemented constructivist and social constructivist educational paradigms. Building on these models of success, we believe that we have taken an important next-step in classroom evolution by integrating Student-Dedicated Interactive Whiteboard (SDIW) technology in a way that enriches collaborative student processes and classroom orchestration. Unlike personal computing devices, SDIWs are shared spaces that allow for the creation and manipulation of dynamic learning artifacts by an entire group of students or class. We will review our classroom design, present results of student surveys as well as preliminary results of a design-experiment to investigate factors that promote or constrain student collaboration and learning.

CD02: 4:30-5 p.m. DALITE: An Asynchronous Peer Instruction Platform

Invited – Nathaniel Lasry, John Abbott College, 128 Finchley Hampstead, QC H3X 3A2; lasry@johnabbott.qc.ca

Elizabeth Charles, Chris Whittaker, Sameer Bhatnagar, Dawson College

Michael Dugdale, John Abbott College

Few student-centered pedagogical approaches have been as widely adopted in higher education as Peer Instruction. Peer Instruction however, is limited to physical classrooms. Can the effectiveness of Peer Instruction be taken outside of classrooms? In this talk we present DALITE, an online pedagogical tool that enables Peer Instruction outside of classrooms by engaging students in conceptual questions and enabling asynchronous peer discussions. DALITE was developed by researchers at Dawson College and John Abbott College (both in Montreal, Canada) and was designed from theoretical principles and models of cognition, learning and instruction. Asynchronous Peer Instruction is of interest to instructors who want their students to discuss concepts with peers either in assignments after class, or before class as in flipped classroom where students engage with the content before coming to class.

CD03: 5-5:10 p.m. Engagement Beyond Clickers

Contributed – Tetyana Antimirova, Ryerson University, 350 Victoria St.,Toronto, ON M5B 2K3 Canada; antimiro@ryerson.ca

Peer collaboration aided by clickers played a great role in turning the traditional introductory lecture-based physics classes into a more interactive and active learning environment. One of the limitations of the traditional clickers is they rely heavily on a multiple choice format. The emergence of new response systems allowing more flexibility in the type of questions that can be delivered. as well as offering additional collaboration capabilities in the classroom and beyond provides new opportunities for engaging the students in science and engineering courses. The "device-less" web-based systems that allow the students to respond via a variety of their own electronic devices (laptops or hand-held) are gaining popularity. We will share our experience in piloting TOPHAT https://tophat.com/ and Learning Catalytics https://learningcatalytics.com/ systems in our undergraduate physics courses.

CD04: 5:10-5:20 p.m. Free Mobile Device Apps for Data Collection and Analysis

Contributed – Rebecca E. Vieyra, Triangle Coalition - Albert Einstein Fellowship, 225 C St. SE, Apt. B, Washington, DC 20003; rebecca.elizabeth.vieyra@gmail.com

Chrystian Vieyra, Vieyrasoft

Mobile devices are loaded with a host of sensors that can be accessed to collect data using free apps, and data can be easily imported into analysis software. Students often have their own devices, and can use them in the classroom, at home, or on field trips. Physics Toolbox apps (http://goo.gl/MRdRvd) were created for the science classroom by the presenter's husband for use with her own students, and their use will be demonstrated. Physics Toolbox apps are available for acceleration, magnetic field strength, light intensity, rotational motion, sound intensity, proximity, ambient pressure, relative humidity, and temperature. Lesson ideas and engineering projects associated with NGSS will be presented. See "Analyzing Forces on Amusement Park Rides with Mobile Devices" (March 2014) in *The Physics Teacher* for the use of apps with amusement park rides. Participants will have the opportunity to request new apps and modifications to existing apps.

CD05: 5:20-5:30 p.m. Going Paperless in a Physics Classroom

Contributed – Shahida Dar, Mohawk Valley Community College, 1236 Hillview Dr., Utica, NY 13501; sdar@mvcc.edu

iPads are increasingly becoming a part of teaching and learning at higher education institutions. Still there aren't many resources available for how to effectively use iPads in a classroom. This session will describe how a physics classroom went paperless when the college issued students iPads.

CD06: 5:30-5:40 p.m. Using Computational Modeling in HS Physics to Enhance Data Analysis

Contributed – Katie Page, Prospect High School, 801 Kensington Rd., Mt. Prospect, IL 60056; katie.page@d214.org

Samuel Hadden, Northwestern University

This session will highlight how high school physics students collected, analyzed, and communicated data using computational modeling and simple coding. Reach for the Stars is an NSF-funded program with support from CIERA and Northwestern University that places STEM graduate student fellows in K-12 science classrooms for the academic year with the goal of enriching their education and strengthening their development as researchers by advancing their communication and teaching skills. The grad fellow worked to bring more inquiry-based teaching methods into the classroom and exposed physics students to his research on Exoplanets and NASA's Kepler Mission. We will demonstrate how concepts of computational thinking and actual computational modeling tools were adapted from the fellow's current research work to my classroom activities connected to the existing physics curriculum. NGSS/ACT alignment and free classroom resources will also be discussed.

Session CE: K-12 PER

Location: Nautilus Hall 4
Sponsor: Committee on Research in Physics Education
Co-Sponsor: Committee on Physics in High Schools
Date: Sunday, January 4
Time: 4–6 p.m.

Presider: Dan Crowe

CE01: 4-4:30 p.m. Student Interactions and Substantive Contributions in Whole Class Consensus Discussions

Invited – Michelle Belleau, University of Colorado, 249 UCB, Boulder, CO 80309 ;shelly.belleau@gmail.com

Mike J. Ross, University of Colorado

The Physics and Everyday Thinking-High School (PET-HS) curriculum is a series of activities in which students build an understanding of physics principles through careful experimentation and whole-class consensus discussions. This learning environment is characterized by shifting the authority for validating science knowledge from the instructor to available laboratory evidence and class consensus. This presentation will focus on these whole-class consensus discussions. The audience will have an opportunity to view and analyze a sample of classroom videos and we will work together to extract the norms and values associated with these consensus discussions. I will then present our coding scheme and a sample of findings from investigating student interactions and substantive contributions. Additionally, I will share how engaging in a practitioner-researcher dual role has affected my teaching and how I view student interactions in whole class discussions.

CE02: 4:30-5 p.m. Characterizing Student Engagement in Consensus Discussions

Invited – Michael Ross, University of Colorado, 249 UCB School of Education, Boulder, CO 80309-0001; michael.j.ross@colorado.edu

Enrique Suarez, Philippe Guegan, Valerie Otero. University of Colorado

The Physics and Everyday Thinking-High School (PET-HS) curriculum was developed to model scientific induction and relies heavily on collaborative discussions to facilitate student sense-making and consensus on the learning targets of the course. This study presents a method for characterizing the participation and substance of student engagement in whole-class discussions. Videos of three sections of a high school physics class using the PET-HS curriculum were analyzed to determine the curricular structures, norms, and teacher and student moves that mediated productive dialogue, including maximizing student-to-student interaction. An interrupted time series design was used to make claims about the impact of teacher moves and classroom structures on the productivity of class discussions. We discuss claims about what classroom structures, norms, and teacher facilitation led to increased student engagement, as well as implications for the design and facilitation of productive classroom discussions.

CE03: 5-5:30 p.m. Physics Teachers' Views on Factors that Influence Urban Physics Participation and Accessibility

Invited – Angela Kelly, Stony Brook University, 106 Roland Ave., South Orange, NJ 07079; angela.kelly@stonybrook.edu

The accessibility of secondary physics in U.S. urban school districts is a complex issue. Many schools do not offer physics, and for those that do, access is often restricted by school policies and priorities that do not promote it. To analyze this problem, the researcher explored urban physics teachers' views on school-based variables that may marginalize traditionally underrepresented students. Teachers from three large urban districts shared perspectives. They believed expanding access could be facilitated with differentiated levels of physics, incorporating mathematical applications with multiple representations, educating students and counselors on the ramifications of not taking physics, grant-funded initiatives, and flexibility with prerequisites and course sequencing. Teachers experienced frustration with standardized testing, lack of curricular autonomy, shifting administrative directives, and top-down reforms that did not incorporate their feedback. Data from this study revealed that physics teacher networks have been a key resource in sharing best practices that may promote physics participation.

CE04: 5:30-5:40 p.m. Effect of Peer Instructions on the Knowledge of Concept in Physics at Swiss High Schools

Contributed – Clemens Wagner, ETHZ, Otto-Stern-Weg 1, Zuerich, ZH 8093 Switzerland; wagnercl@phys.ethz.ch

Andreas Lichtenberger, Andreas Vaterlaus, ETHZ

We have developed a new model of formative assessment in order to foster concept knowledge in physics at the high school level in Switzerland. In our formative assessment approach teaching units include peer instructions using clicker questions. We are investigating the effect of these clicker sessions on the learning progression of high school students concerning physics concepts. Our experimental setting consists of three groups, a control group, with traditional teaching, a frequent testing group, administrating clicker questions as test to students, and the formative assessment group using peer instructions. More than 30 high school teaches are involved in this project and are equally distributed among the three groups. The topic of the teaching units is kinematics, 15 lessons in total, including velocity, acceleration and their vector properties. We are going to present our first results about the effect of these clicker sessions on the concept knowledge in physics.

CE05: 5:40-5:50 p.m. Correlation Between Mathematics and Physics Concepts in Kinematics

Contributed – Andreas Lichtenberger, Swiss Federal Institute of Technology, Otto-Stern-Weg 1, Zurich, 8093 Switzerland; lichtenberger@phys.ethz.ch*

Clemens O. Wagner, Andreas Vaterlaus, Swiss Federal Institute of Technology

We have developed a diagnostic test in kinematics to investigate the student concept knowledge at the high school level. The multiple-choice test consists of 51 kinematics items and nine additional mathematics items. The kinematics items are based on seven basic kinematics concepts we have identified. Conducting a factor analysis with data from 400 students from 20 Swiss high schools we have found that there are two basic mathematical concepts that are crucial for the understanding of kinematics: the concepts of rate and vector (including direction and addition). This result has direct implications for the instruction. It suggests that the mathematical concepts are a prerequisite for learning kinematics. Transferring the mathematical concepts to physical contents and applying them in different contexts might be easier for students than learning physical concepts without a mathematical background. These findings are in line with the results of Bassok & Holyoak (1989) and others.

*Sponsored by Clemens O. Wagner (Swiss Federal Institute of Technology)

CE06: 5:50-6 p.m. Monkeys and Bananas: Middle School Students' Productive Ideas About Energy

Contributed – Benedikt W. Harrer, University of California, Berkeley, 469 Evans Hall, Berkeley, CA 94720; harrer@berkeley.edu

Virginia J. Flood, University of California, Berkeley

We examine middle school students' ideas about energy for progenitors of disciplinary knowledge and practice by using an extension of Hammer and colleagues' resources framework. This elaboration on an established theory allows for the identification of disciplinarily productive resources—i.e., appropriately activated declarative and procedural pieces of knowledge—in individual students' utterances as well as across the interactions of multiple learners engaged in collaborative learning situations. Further, we show how resources that appear in conversational sequences can be evaluated for how they become productive in a situation, based on its outcome. This provides an additional dimension of productiveness beyond disciplinary appropriateness.

Session CF: Development of Perception of Extraterrestrial Life

Location:	Nautilus Hall 5
Sponsor:	Committee on Space Science and Astronomy
Co-Sponsor:	Committee on History and Philosophy in Physics
Date:	Sunday, January 4
Time:	4–5:30 p.m.

Presider: Todd Timberlake

CF01: 4-4:30 p.m. NASA's Kepler Mission and the Search for Habitable Worlds

Invited – William F. Welsh, San Diego State University, 5500 Campanile Drive, San Diego, CA 92182-1221; wwelsh@mail.sdsu.edu

Philip Blanco, Grossmont College

NASA's Kepler telescope has discovered nearly 1000 planets and over 4000 more candidate planets. Its primary goal is to find Earth-like planets suitable for life. The vast majority of planets are not suitable for life (as we know it), but a handful are. But what makes a planet suitable for life? What does "habitable" mean, and how can we determine this? In our talk, we will discuss how Kepler finds planets and summarize the fascinating discoveries made to date. Dr. Welsh will briefly mention his main contribution as a member of the Kepler Science Team, specifically, the discovery of "circumbinary" (Tatooine-like) planets. Dr. Blanco will present some "tools you can use" to engage students by applying simple physics to Kepler's most Earth-like planets. As an example, we shall show how basic gravitation and thermal equilibrium concepts can be combined to estimate conditions on the exoplanet's surface.

CF02: 4:30-5 p.m. The Origin of Life on Earth, and Elsewhere

Invited – Jeffrey Bada, Scripps Institution of Oceangraphy, University of California at San Diego, 8615 Kennel Way, La Jolla, CA 92093-0212; jbada@ucsd.edu

One of the major scientific questions that confronts humanity is whether life exists beyond Earth. It is generally assumed that there are two fundamental requirements for life, as we know it: the presence of liquid water and organic polymers needed to carry out the central biological functions of replication and catalysis. Liquid water would be needed to enable the chemistry involved in the origin of life to take place. Life elsewhere would likely be based on the same types of molecules as on Earth, although these molecules would not necessarily be exactly the same ones as in terrestrial life. The origin and early evolution of life on Earth is thought to have taken place through a series of stages that resulted in the emergence of molecular entities capable of multiplication, heredity, and variation. These simple entities marked the point of the origin of life and evolution, which eventually led to the modern DNA/protein biochemistry. If these processes are common elsewhere, life could be widespread in the Universe. However, as the Russian biochemistry Aleksandr Oparin noted, the evolution of primitive self-replicating entities elsewhere "must differ essentially from the terrestrial animals and plants since it is the environment that forms life." If life does exist elsewhere it would probably not have any resemblance to Earth-based life and would be uniquely suited to the environment of its host planet.

CF03: 5-5:30 p.m. Otherness and Life in the Universe: The Basis for a Wide-ranging Curriculum About Humanity?

Invited – David Brin, 2240 Encinitas Blvd -Suite D-300, Encinitas, CA 92024; davidbrin@sbcglobal.net

We've all seen sci fi dramas about encounters with alien life, but where does fiction meet scientific fact? Are Hollywood scenarios realistic? Or do they give misleading impressions, both plus and minus? No single good or bad scenario for First Contact can be called likely, but any list of plausible or possible risks should be laid on the table and reviewed. Good curricula could turn the concept of "otherness" into a teaching tool of profound potential.

Session CG: Beyond the MOOCs: The Impact of Open Online Courses on Teaching and Education Research

Location: Executive 2A/2B
Sponsor: Committee on Physics in Undergraduate Education
Co-Sponsor: Committee on Research in Physics Educations
Date: Sunday, January 4
Time: 4–5:30 p.m.

Presider: Saif Rayyan

CG01: 4-4:30 p.m. Lessons Learned Implementing Online Education at the University of Arkansas

Invited – John C. Stewart, West Virginia University, White Hall, Morgantown, WV 26501; johns@UARK.EDU

The calculus-based physics sequence at the University of Arkansas-Fayetteville was revised to feature inquiry-based methods as part of the PhysTEC project in 2001. Since this time, the sequence has been a key component to the exceptional growth of the undergraduate physics program and its production of physics teachers. In line with the university system's strategic goals for online education, online lecture sections were added to the sequence in the spring 2013 semester. To improve ease of transfer between university campuses, the University of Arkansas-Fayetteville began offering its first-semester, calculus-based physics class online to other campuses of the University of Arkansas during the fall 2013 semester. This required the production of online laboratories. These laboratories used a mix of simulations and video recording of experiments to replace face-to-face laboratories. Our experiences with taking a very well understood and highly successful course sequence online have been mixed. Some experiences suggest that online options can be an effective replacement of face-to-face options; some experiences suggest that caution is appropriate when considering replacing face-to-face experiences with online options.

CG02: 4:30-5 p.m. A Data-Driven Exploration of MIT MOOCs

Invited – Daniel T. Seaton, Davidson College, 155 South Lexington Ave., Unit 203, Asheville, NC 28801; dseaton@gmail.com

Massive Open Online Courses (MOOCs) provide tremendous opportunities to study the learning behavior of diverse student populations on an unprecedented scale. This talk will be grounded in data gathered from over 30 MIT MOOCs (MITx), where across courses, over 1 million enrollees have generated greater than one terabyte of course-interaction data. Variations in the behavior and backgrounds of participants are abundant, indicating a need to move beyond simple metrics, such as certification rates, in describing participant activity. Analysis of video watching will highlight variation in participant content use, while summaries of enrollee demographics will simultaneously provide backgrounds and offer some explanation of participant video watching behavior. In addition, a reconceptualization of MOOC participants will be offered by highlighting a substantial number of enrolled teachers within the most recent analysis of spring 2014 MIT MOOCs.

CG03: 5-5:30 p.m. Adapting Physics MOOCs to Reality

Invited – Charles H. Holbrow, MIT, 231 Pearl St., Cambridge, MA 02139-4510; cholbrow@mit.edu

To date, most physics MOOCs have resembled traditional university-level physics courses, and, with large production and management teams and high production values, they have been expensive to make. Data show that physics MOOCs are taken not so much by college-age students as by mature, experienced learners. Designers of physics MOOCs have learned from their first efforts, and they are starting to produce physics MOOCs that are less like traditional courses and intended for people who are not college students. I will describe three such MOOCs, two developed at MIT and one proposed for Colgate University. I will also talk about blending online and face-to-face instruction. I will suggest ways for AAPT to help its members create and publish their own online instructional materials.

Session CH: Improving Pedagogy in Pre High School Education

Location: Grande Ballroom B
Sponsor: Committee on Physics in Pre-High School Education
Date: Sunday, January 4
Time: 4–6 p.m.

Presider: Bill Reitz

CH01: 4-4:30 p.m. Improving Pedagogy in Pre-High School Education

Invited – Fred Goldberg, San Diego State University, CRMSE, 6475 Alvarado Road, Ste 206, San Diego, CA 92120; fgoldberg@mail.sdsu.edu

The project team that developed PET*, PSET* and LPS* have revised the curricula to make them more flexible for implementation and better aligned with the Next Generation Science Standards' physical science core ideas, the science and engineering practices, and the crosscutting concepts. NextGenPET consists of five separate content modules and a teaching and learning module, with activities that embed in the content modules. There are two versions of NextGenPET, one for small classes with extensive laboratory work and discussion, and one for large, lecture style classes. Both versions use the same extensive set of online homework activities. In this talk I will focus on one part of the curriculum, describing how it aligns with NGSS and showing classroom video to illustrate that alignment.

**Physics and Everyday Thinking, Physical Science and Everyday Thinking*, and *Learning Physical Science* are all published by It?s About Time, Mount Kisco, NY.

CH02: 4:30-5 p.m. Learning About Teaching and Learning in Next Generation PET

Invited – Danielle B. Harlow, University of California, Santa Barbara, Department of Education, MC 9490, Santa Barbara, CA 93106-9490p dharlow@education.ucsb.edu

The Next Generation Science Standards (NGSS) describe a significant shift in the goals for science instruction. NextGen PET is intended for undergraduate audiences that include pre-service elementary school teachers. Research shows that teacher education, including content instruction, is more effective when it is situated in the practices of teaching. For this reason, we have developed a set of activities that focus on teaching and learning science through the practices of science described in the NGSS. These activities make up the Teaching and Learning (TL) Module. In this talk, I will describe the ways that the activities in the TL Module provide structured opportunities for undergraduates to identify, analyze, and practice teaching that aligns with scientific practices and disciplinary core ideas of the NGSS. I will describe the learning trajectory of these activities and provide examples from specific tasks.

CH03: 5-5:30 p.m. Fun, Research-based Pedagogy with Phenomenon-based Learning

Invited – Matthew Bobrowsky, Delaware State University, 1200 N. DuPont Highway, Dover, DE 19901; expert_education@rocketmail.com

"Phenomenon-Based Learning" (PBL) builds knowledge of and interest in physical science as a result of observations of real-world phenomena, in this case, some fun gizmos and gadgets. Why PBL? PISA assessments showed that Finnish students were among the top in science proficiency levels, and Finland is now seen as a major international leader in education. The PBL teaching philosophy combines elements of what's done in Finland with what's known about effective science teaching based on science education research to present science in ways that are both fun and educational. The approach includes elements of progressive inquiry, project-based learning, collaborative learning, responsive teaching, and hands-on experiments. The idea is to teach broader concepts and useful thinking and performance skills (as with NGSS) rather than asking students to simply memorize facts and formulas. Attendees will get to enter a raffle for free PBL books and gizmos & gadgets!

CH04: 5:30-5:40 p.m. Developing STELLA Format Lesson Plans on Force and Interaction

Contributed – Jeff Howarth, Serrano Middle School, 4725 San Jose St., Montclair, CA 91763; Jeff.Howarth@omsd.net

James Yeh, Serrano Middle School, Montclair, CA

Sara Yeh, Wiltsey Middle School, Ontario, CA

Homeyra Sadaghiani, Cal Poly Pomona

The Noyce Master Teacher program at Cal Poly Pomona is a five-year video-based analysis of professional development program focused on improving Master Teacher science and mathematics pedagogical content knowledge and leadership skills. This program utilizes the Science Teachers Learning from Lesson Analysis (STeLLA), to guide analysis of science teaching through two lenses: Student Thinking, and Content Storyline. The program features lesson plan development using strategies to reveal, support, and challenge student thinking as well as strategies to create a coherent science storyline. The objective is to help deepen understanding of core science concepts, examine how students make sense of those concepts and commonly misunderstand them, analyze and improve teaching and learning, and experience with coaching teachers. As teacher participants, we will share our experience on the process of developing lessons on "Force and Interaction," the implementation, and assessment of those lessons in our eighth-grade classes.

CH05: 5:40-5:50 p.m. Inquiry-Science Institute for the K-8 Classroom

Contributed – Thao Nguyen, Randolph College, 2500 Rivermont Ave., Lynchburg, VA 24503; psheldon@randolphcollege.edu

Hart Gillespie, Shaun Chopp, Peter Sheldon, Peggy Schimmoeller, Randolph College

We continue a study on the influence of hands-on and inquiry instruction (as opposed to traditional lecture and direct instruction) on student achievement and teacher/student attitudes toward science, with the goal of increasing interest in studying science, increasing confidence in communicating science ideas, and increasing student achievement in science and mathematics. We continue creating resources including lesson plans, associated content, and video for hands-on and inquiry-based lessons in the K-8 classroom, and post resources at the project website, tnst.randolphcollege.edu. We held our annual Science Institute for 65 local teachers in June. This professional development opportunity is designed to help teachers implement problem based lessons in the science and mathematics classroom. Data collection includes surveys, student performance measures (SOL end-of-course test scores, science and math grades), and classroom observations. The results of our research show that teachers use more technology after attending the Institute and implement more hands-on activities.

CH06: 5:50–6 p.m. Playing the Game of Science

Contributed – Michael J. Ponnambalam, Sundaranar University 7 - 40 Sannathi St.,, Vadakkankulam Tamil Nadu, TN 627116; michael.ponnambalam@gmail.com

Most of the students at the pre-high school level are too young for serious thinking. They would rather play a game. Turning the 'Teaching of Science' into 'Playing an Interesting Game' grabs and maintains their attention. And the students end up learning science! The author's experience in this connection in Jamaica and Grenada in West Indies will be presented in this talk.

Session TOP01: Physics and Society Topical Discussion

Location: Nautilus 3
Sponsor: Committee on Science Education for the Public
Date: Sunday, January 4
Time: 6–7:30 p.m.

Presider: David Sturm

Session TOP02: iOS and Android App Show

Location: Executive 2A/2B
Sponsor: Committee on Educational Technologies
Date: Sunday, January 4
Time: 6–7:30 p.m.

Presider: Lee Trampleasure

Each presenter will have 5 minutes to present their favorite app. Please sign up with the app you will present in order to guarantee a time slot and ensure we have the proper "dongle" to connect your device to the projector: http://ncnaapt.org/appshow.

Session TOP05: Topical Discussion: The Joint Task Force on Undergraduate Physics Programs

Location: Executive 3A/3B
Sponsor: AAPT
Date: Sunday, January 4
Time: 6–7:30 p.m.

Presider: Robert Hilborn

AAPT and APS have established the Joint Task Force on Undergraduate Physics Programs (J-TUPP) charged with preparing a report that answers the question: What skills and knowledge should the next generation of undergraduate physics degree holders possess to be well prepared for a diverse set of careers? In this topical discussion session, representatives from J-TUPP will give a brief overview of what J-TUPP will do and then open the floor to discussions about questions and issues J-TUPP should address and the kinds of guidelines and recommendations that will be most useful to physics educators as they shape undergraduate physics programs for the decades to come.

2015 Winter Meeting Plenary

Location: Grande Ballroom C
Date: Sunday, January 4
Time: 7:30–8:30 p.m.

Presider: Janelle Bailey

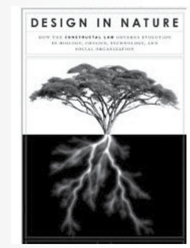
Adrian Bejan

Evolution, Life and Sustainability, as Physics:
What the Constructal Law is, and how it gives us a new worldview,
by Adrian Bejan, Duke University

Why is "sustainability" such a natural urge, in each of us? In this lecture I draw attention to the law of physics of design evolution in nature (the Constructal Law) that provides the scientific basis for sustainability. The human urge is about greater flow access with freedom to change, to evolve. This urge is universal. Design evolution happens, it is natural, animate, inanimate and human made. Evolutionary designs that illustrate this tendency are river basins, vascular tissue, animal locomotion (fliers, runners, swimmers), athletes, power technology evolution, and city and air traffic flow patterns. All the flows needed to sustain human life (food, transportation, heating, cooling, water) are driven by the purposeful consumption of power, and as a consequence the wealth of a country (the GDP) is directly proportional to its annual consumption of fuel. Sustainability comes from greater freedom to change the flow architecture that sustains life, from water and power, to the evolution of science, technology, law and government. Life is flow, and flow leads to better flow over time.

Dr. Bejan will be available from 8:30–9:15 p.m. to sign copies of his book:

"Design in Nature: How the Constructal Law Governs Evolution in Biology, Physics, Technology, and Social Organization"



AAPT Poster Sessions
with Refreshments

Poster Session 1
8–9:30 a.m.
Monday, January 5
Grande Ballroom A

Poster Session 2
8:30–10 p.m.
Monday, January 5
Grande Ballroom A

Post Deadline Posters
3:30–5 p.m.
Tuesday, January 6
Grande Ballroom A

Monday, January 5 Highlights

AAPT Fun Run/Walk
7–8 a.m.
Offsite

AAPT Awards: Melba Newell Phillips Medal presented to Tom O'Kuma and AIP Awards
9:30–11 a.m.
Grande Ballroom C

Exhibit Hall: Fitbit Wristband Raffle Drawing
10:45 a.m.
Harbor Island Ballroom

Multicultural Luncheon
12:30–1:30 p.m.
Harbor's Edge restaurant

Committees, 12:30–2 p.m.

Educational Technologies	Marina 1
Graduate Education in Physics	Marina 3
Diversity in Physics	Marina 4
Science Education for the Public	Marina 2

Free Commercial Workshops
CW03: Expert TA: Closing the Gap between Homework and Test Scores
12:30–1:30 p.m. – Marina 6

CW04: CourseWeaver: Easy Authoring of Computer Graded Homework
12:30–2:30 p.m. – Nautilus Hall 1

PLENARY: Eugene C. Arthurs, SPIE CEO
How Light Has Changed Our Lives
2–3 p.m.
Grande Ballroom C

Exhibit Hall: IPad Mini Raffle Drawing
3:15 p.m.
Harbor Island Ballroom

Exhibit Hall: Great Book Giveaway
4:30–5 p.m.
Harbor Island Foyer

Committees, 5:30–6:30 or 7 p.m.

Apparatus	Executive 3A/3B
International Physics Education	Seabreeze 1-2
Pre-High School Education	Marina 3
Professional Concerns	Marina 6
Space Science and Astronomy	Marina 2
Member and Benefits	Marina 4
SI Units and Metric Education	Marina 1

Poster Session 1

Location: Grande Ballroom A
Sponsor: AAPT
Date: Monday, January 5
Time: 8–9:30 a.m.

Persons with odd-numbered posters will present their posters from 8–8:45 a.m.; even-numbered will present 8:45–9:30 a.m.

Astronomy

PST1A01: 8-8:45 a.m. Learning About the Moon: Results from a First-year Pilot Study*

Poster – Doug Lombardi, Temple University, 1301 Cecil B., Moore Ave., Philadelphia, PA 19122; doug.lombardi@temple.edu

Elliot S. Bickel, Tyron Young, Janelle M. Bailey, Temple University

Students often encounter alternative explanations about a phenomenon. However, inconsistent with scientific practice, students may not be critically evaluative when comparing alternatives. Critical evaluation is the process of weighing connections between evidence and explanations, and we have been developing instructional scaffolds, called model-evidence link (MEL) diagrams, to facilitate critical evaluation about Earth and space science topics. MELs were originally developed by researchers at Rutgers University and we have applied their design to new topics. Our poster focuses on one of these, covering a topic related to our Solar System's evolution: the Moon Formation MEL. In it, students critically evaluate evidence toward either a great impact or capture event in creating Earth's Moon. We will discuss the results of a study revealing how the instructional scaffold impacts student understanding about how our Moon came to be. *The material will be based upon work supported by the NSF under Grant No. DRL-131605. Any opinions, findings, conclusions, or recommendations expressed are those of the authors and do not necessarily reflect the NSF's views.

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PST1A02: 8:45-9:30 a.m. A Detailed Analysis of Emission Lines in Novae

Poster – Glenda Denicolo Suffolk County Community College 533 College Road Selden, NY 11784 USA glenda.denicolo@gmail.com

Emission lines in the spectrum of novae are often heavily blended, even for low dispersion observations, hindering the study of the individual line behavior. We have modeled the optical emisson line spectra of nova KT Eri with using a chi-square minimization routine. Over 30 emission lines were fitted, whereas many were initially confirmed in high-resolution spectra. We have kept a constant line profile (central peak, and broad component when present) for the transitions of the same ion. The intensity of several lines was linked by transition probabilities, and case B recombination ratios. Hydrogen lines were fitted with blue, central and red gaussian components, whereas most other lines were sufficiently well fitted with single gaussians. [O III] and [Ne III] lines had the same broad profile and were modeled with four gaussians each. We study the time-evolution of several lines from day 30 to 100 after maximum for the nova KT Eri. The relation between the onset of the super-soft X-ray emission and evolution of optical spectral lines is also investigated.

Physics Education Research

PST1B01: 8-8:45 a.m. The Item Response Curves of the FMCE and Conceptual Dynamics

Poster – Michi Ishimoto Kochi, University of Technology, Tosayamada-cho Kami-shi, Kochi 782-8502 Japan; ishimoto.michi@kochi-tech.ac.jp

The item response curve (IRC), a simplistic form of item response theory, was introduced as a way to examine items on the Force

Concept Inventory (FCI).[1] The IRC relates the percentage of students at each ability level to each answer choice. This study used the total scores of 1633 students on the Force and Motion Conceptual Evaluation (FMCE) as a proxy for ability level as used on the FCI. A comparison of the IRCs of the pre-instruction test to those of the post-instruction test showed that the total score functioned reasonably as an invariant. The IRCs also showed that some incorrect responses were favored by students with certain ability levels. The results were consistent with the responses indicated in conceptual dynamics by Thornton,[2] which identifies a sequence of intermediate states of concept learning.

1. Gary A. Morris, Nathan Harshman, Lee Branum-Martin, Eric Mazur, Taha Mzoughi, Stephen D. Baker, "An item response curves analysis of the Force Concept Inventory," *Am. J. Phys.* **80**, 825-831 (2012).

2. Ronald K. Thornton, *Conceptual Dynamics," Thinking Physics for Teaching* (Springer), 157-183, 1995.

PST1B02: 8:45-9:30 a.m. A Concept Inventory for Momentum, Energy, and Rotational Dynamics: An Examination of Student Reasoning

Poster – Alex Chediak, California Baptist University, 8432 Magnolia Ave., Riverside, CA 92504; achediak@calbaptist.edu

Kyle Stewart, California Baptist University

For over 20 years, David Hestenes' diagnostic, the Force Concept Inventory (FCI), has been used in college physics courses to gauge student understanding of Newtonian concepts. While the FCI has proven invaluable for this purpose, semester-long physics courses generally cover topics that go beyond the scope of the test. In order to broaden coverage, items addressing energy, momentum, and rotational dynamics have been created to fit seamlessly with the FCI. An Item Response Theory (IRT) analysis of initial results, presented at AAPT 2013 in New Orleans, found that the distractors for the new questions were not optimized. In this poster, we will present the concept inventory and an analysis of free response answers we collected in order to better understand student reasoning. From this analysis, better distractors (and possibly revised test items) will be written.

PST1B05: 8-8:45 a.m. A Taxonomy of Conceptions about Buoyancy

Poster – DJ Wagner, Grove City College, 100 Campus Drive, Grove City, PA 16127; djwagner@gcc.edu

Janice Novacek, Ashley Miller, Grove City College

Numerous studies, dating back at least as far as Piaget, have used buoyancy to probe students' understanding of density. A few studies have instead probed students' understanding of buoyancy in terms of pressure, buoyant force and Archimedes' principle. In this talk, we present an overview of our buoyancy conception taxonomy. Included conceptions were collected both from prior studies involving subjects having a variety of ages, and from our own interviews and assessments given to college students.

PST1B07: 8-8:45 a.m. Do Sinusoidal Graphs of Pressure Variation in Pipes Mislead Students?

Poster – Deva A. O´Neil, Bridgewater College, 402 E College St., Bridgewater, VA 22812; doneil@bridgewater.edu

This study examines whether students are misled by sound wave diagrams that represent pressure variation by a sinusoidal curve inside a pipe. This representation is at odds with the physical reality of sound waves as compression of the medium. After instruction in introductory physics courses about properties of sound waves, students were prompted to identify sound waves as transverse or longitudinal, and to represent the waves pictorially. Exposure to sinusoidal diagrams of pressure variation led a small proportion of students (about 10%) to change their correct answers to responses that were less consistent with the longitudinal nature of sound waves. This effect was observed both in physics majors taking calculus-based physics courses as well as non-majors taking algebra-based physics.

PST1B08: 8:45-9:30 a.m. How Do Verbal and Visual Cueing Affect Student Reasoning?*

Poster – Xian Wu, 116 Cardwell Hall, Manhattan, KS 66506; xian@phys.ksu.edu

Tianlong Zu, Bahar Modir, Lester Loschky, N S. Rebello, Kansas State University

Our previous study shows visual cueing and feedback together can help students solve physics problem decently. In this study, instead of giving students feedback, we were interested in seeing how a verbal hint might help students solve a conceptual physics task. Participants solved four sets of conceptual tasks, each of them containing one initial task, six training tasks, one near transfer task, and one far transfer task. They were asked to use a "think aloud" protocol in solving each task and their spoken answers have been analyzed. Our study explored the relationship between the modality of cueing and students' task-solving performance. This study can shed light on creating effective cueing in computer-based instruction. This research is supported in part by the U.S. National Science Foundation under Grants 1138697 and 1348857. Opinions expressed are those of the authors and not necessarily those of the Foundation. Additional author: John Hutson from Kansas State University.

*This research is supported in part by the U.S. National Science Foundation under Grants 1138697 and 1348857. Opinions expressed are those of the authors and not necessarily those of the Foundation. Additional author: John Hutson from Kansas State University.

PST1B09: 8-8:45 a.m. Self-Explanations Influencing Reasoning on Tasks with Feedback or Visual Cues*

Poster – Elise Agra, Kansas State University, 116 Cardwell Hall, Department of Physics, Manhattan, KS 66506; esgagra@gmail.com

Tianlong Zu, John Hutson, Lester C. Loschky, N. Sanjay Rebello, Kansas State University

Research has demonstrated that visual cues and correctness feedback can influence the kinds of cognitive resources that learners activate on conceptual physics tasks. In this study, we investigate the effect of self-explanations in solving conceptual physics tasks containing a diagram. Students enrolled in an introductory mechanics course were individually interviewed. Using the self-explanation method, students worked through four sets of problems containing a diagram. Each problem set contained an initial problem, six isomorphic training problems, a near transfer problem, and a far transfer problem. The students provided verbal responses to the problems. Students in the cued conditions saw visual cues on the training problems, and students in the feedback conditions were told whether their responses were correct or incorrect. We discuss the influence of self-explanations on students' reasoning resources in the training and transfer problems with respect to the cue and feedback conditions.

*This material is based upon work supported by the National Science Foundation under Grant Nos. 1138697 and 1348857.

PST1B10: 8:45-9:30 a.m. Mapping Student Attitudes and Network Positioning in Introductory Physics

Poster– Adrienne L. Traxler, Wright State University, 3640 Colonel Glenn Hwy., Dayton, OH 45435-0001; adrienne.traxler@wright.edu

Student networks of cooperation and information-sharing in a course form an important but often unmeasured dimension of the learning environment. Physics education researchers have recently begun to explore links between student positions in classroom social networks and various learning outcomes. Here I present a preliminary investigation of the interaction between student attitudes toward physics and their study partner networks in a large introductory physics course. I will investigate the development of the network structure over the semester, and also ask whether students' pre- or post-course attitudes toward science are related to their initial or eventual position in the network.

PST1B11: 8-8:45 a.m. Complex Relationships From a Trivial Math Test

Poster – Thomas Foster, Southern Illinois University, Edwardsville, Dept. of Physics, Edwardsville, IL 62026-1654; tfoster@siue.edu

A two-part math test was given to University Physics students during their first semester of the course. The test had an arithmetic (numbers) portion and an algebraic (symbolic) portion where the solution-steps to the questions on each portion of the test should have been the same (isomorphic). Theoretically, the performance should have been identical on each portion of the test, instead it mattered which test was given first as to how the students would perform. Students given the algebra test first did better on the subsequent arithmetic test. Interpretations surrounding this finding and implication for problem-solving instruction will be discussed.

PST1B12: 8:45-9:30 a.m. Comparing Inquiry Labs to Traditional Labs in Introductory College Physics

Poster – Erin Combs Sutherland, Southern Polytecnic State University, 4206 Rockpoint Dr., Kennesaw, GA 30152-7726; esutherl@spsu.edu

This study investigates the impact of replacing "cookbook" labs with Inquiry labs and using predominantly basic equipment instead of the more complicated and expensive equipment normally used in physics I labs. This study involves three Physics I labs taught by the same professor during the summer of 2013. Two of the classes were taught using the standard lab book and equipment. The third class was taught using the reformatted labs to teach the same physics concepts. We theorized that students would understand the physics behind the labs more clearly if they did not have to spend a large portion of the lab learning to use the equipment and getting it to work correctly. We found that students enjoyed the inquiry labs more and looked forward to the next assignment. Furthermore students spent less time getting the equipment to work which resulted in more time learning the physics concepts.

PST1B13: 8-8:45 a.m. Innovative Experiments for Large-Enrollment General Physics Course

Poster – Kasey Wagoner, Washington University in St. Louis, 1 Brookings Dr. / Campus Box 1105, St. Louis, MO 63130; kwagoner@physics.wustl.edu

Kathryn M. Hynes Washington University in St. Louis

Daniel Flanagan Washington University in St. Louis

We have developed a series of innovative, inquiry-based labs for our large-enrollment, active-learning, introductory physics course. In our talk we outlined the philosophy behind our predict-experiment-assess labs which connect class content to the students' experiences by experimenting with familiar objects (bicycles, Christmas lights, speakers, etc.). Here we show the subjects, learning goals, and experimental procedures for a representative sample of the 18 novel labs we developed for our two-semester introductory physics sequence. We will provide an excerpt of our lab manual for a direct illustration of our approach. Additionally, we will present the extra materials we have developed to help our teaching assistants effectively implement the new labs (rubric, In-Lab guide, wiki, etc.). Finally, we will present feedback which indicates these labs are a significant enhancement to our introductory physics course.

PST1B14: 8:45-9:30 a.m. Investigating Students' Epistemological Changes in Physics Experiments

Poster – Dehui Hu, Rochester Institute of Technology, 1832 Crittenden Road, APT-7, Rochester, NY 14623; dxhsps@rit.edu

Benjamin M. Zwickl, Rochester Institute of Technology

There is a need for tools that assess the growth of students' laboratory skills, attitudes, and expectations across the whole undergraduate curriculum, ranging from introductory labs to research experiences. Building on results from the Colorado Learning Attitudes about Science Survey for Experimental Physics (E-CLASS), we are focusing on students' changes in epistemology across the whole undergraduate curriculum. In summer 2014, we conducted a pilot study to explore students' views about nature of doing physics experiments in lab courses and research. We conducted eight open-ended individual interviews with students enrolled in introductory algebra-based physics courses, calculus-based courses, upper-division physics majors, and graduates students in physics-related disciplines. We identify emergent themes in students' discussions of physics experiments and in the past experiences they use to support their ideas. Results will be used to design refined assessments of students' epistemology and expectations in physics laboratory classes.

PST1B15: 8-8:45 a.m. Investigation of Spin-first Versus Wave-function Approach in Teaching Quantum Mechanics

Poster – Homeyra Sadaghiani, Department of Physics and Astronomy, California State Polytechnic University, Pomona, CA 91768 3801; hrsadaghiani@csupomona.edu

Steven Pollock, University of Colorado, Boulder

We are investigating student learning of quantum mechanics in two different contexts. In one approach, postulates of quantum mechanics are introduced in the context of the wavefunction of a particle in potential wells with continuous bases of position probability densities. The second approach uses the context of Stern-Gerlach experiments with discrete spin bases. We have measured student learning of the core concepts in courses using these approaches with common exam questions and Quantum Mechanics Concept Assessment (QMCA). Preliminary data suggest a small but positive impact on students' scores on topics related to quantum mechanical measurement in the classes taught using the discrete bases in the second approach. Preliminary data also suggest that using the discrete bases approach may shift student focus from computation to more sense making by providing concrete experimental evidence and simplifying the mathematical calculation processes. We will discuss the implications of this study for choices of initial context, the order, and emphasis of content being taught.

PST1B16: 8:45-9:30 a.m. Simulating Nanoscale Magnetism in a Single Domain

Poster – David Sederberg, Purdue University 525 Northwestern Avenue West Lafayette, IN 47907 dsederbe@purdue.edu

High school and even undergraduate students' explanations of magnetic phenomena seldom involve the dynamic alignment of fundamental structural components, their individual contribution to net forces, reversibility, and effects of applied fields. These concepts carry special meaning with respect to the size dependency of ferromagnetic materials at the nanoscale where, as consequence of ambient thermal energy, materials can exhibit zero remanence. In an interactive computer simulation of a single domain ferromagnetic particle, students manipulate three variables: size, applied field, and temperature. Initial piloting in both middle and high school settings suggests that the immediate feedback depicting the magnetic moments of the atoms on the surface of the domain, relative to those comprising the whole, provided a framework with which students could interpret the effect of each of the variables, individually or in concert on overall magnetic moment and remanence. Opportunities are sought for additional field testing of the simulation module.

PST1B17: 8-8:45 a.m. Student Interactions Within an Online Homework Forum in Introductory Physics

Poster – Brandon Kawata, California State University, Long Beach, Department of Physics and Astronomy, Long Beach, CA 90840-0119; bkawata92@gmail.com

James Kisiel, California State University, Long Beach

Student conversations in an online homework forum (Social Homework) for introductory physics were examined to see how students interact in this new type of setting. With the ability to "like" posts and make comments to a discussion (as with Facebook), Social Homework was designed so students in a large lecture hall could participate in small learning groups. Initial analysis of the most liked discussions revealed that most of the posts are related to physics, however, most of these posts were procedural (e.g. Here is the formula we should use) as opposed to conceptual (the net force includes friction). Further research found that most of the contribution within these online discussions came from 1-2 students. Social Homework provides an opportunity for students and instructors to contribute to physics discourse but some modifications may be needed to support a more meaningful learning experience.

PST1B18: 8:45-9:30 a.m. Synergy Between PhysTEC and LA Program Impacts Learning Outcome

Poster – Homeyra R. Sadaghiani, Cal Poly Pomona, 3801 W Temple Ave., Pomona, CA 91768-2557; hrsadaghiani@csupomona.edu

Steve McCauley, Alex Rudolph, Cal Poly Pomona

The Cal Poly Pomona PhysTEC Program utilizes the Learning Assistant program as a mechanism for recruiting and preparing physics and engineering majors for careers in teaching. The Learning Assistant program does not only provide potential future teachers with early teaching experiences, but the program also promotes interactive engagement among students enrolled in the introductory physics courses. We have used pre-/ post-diagnostic test scores to study the impact of the LA program in the Cal Poly Pomona undergraduate physics program. This poster will report preliminary data on student FCI and CSEM gain as well as the LAs own learning gains on topics for which they were Learning Assistants.

PST1B19: 8-8:45 a.m. Teaching Assistant-Student Interactions in Problem Solving: The Issues Framework

Poster – Meghan J. Westlander, North Carolina State University, 3391 Santa Maria Ct., Lafayette, CA 94549; mjwest3@ncsu.edu

Graduate Teaching Assistants (GTAs) have the opportunity to promote an interactive environment in their classrooms through their interactions with students. Research on students' ideas and behaviors within and surrounding those interactions is valuable to obtaining a more complete understanding of how GTAs promote an interactive environment. This research is growing but limited. The Issues Framework was developed to address this area by examining how GTA-student interactions are situated in students' processes during physics problem-solving activities. The framework is focused on the procedural moves students make and physics content they express while working through physics problems. The framework is general in nature with a visually friendly design that makes it a useful tool for consolidating complex data and quickly pattern-matching important pieces of a complex process. I introduce the Issues Framework and show some results of the insight it can provide.

PST1B20: 8:45-9:30 a.m. Access to and Awareness of Undergraduate Research Opportunities at a Large Research University

Poster – Heather Lewandowski, University of Colorado, CB 440 Boulder, CO 80309; lewandoh@colorado.edu

Stephanie S. Hanshaw, University of Colorado

The American Physical Society has recently endorsed a statement that "calls upon the nation's four-year colleges and universities and their physics and astronomy departments to provide or facilitate access to research experiences for all undergraduate physics and astronomy majors." The first step in reaching this goal is to understand, from both the student and faculty member perspective, the awareness of research opportunities and the available access to significant research experiences. We present a study of these issues at a large research university where the number of undergraduate physics majors outnumber the number of faculty by over five to one.

PST1B21: 8-8:45 a.m. Outcomes of an REU Cohort Model in Discipline-based Education Research*

Poster – Warren M. Christensen, North Dakota State University, PO BOX 5474 #105 LLC, East Fargo, ND 58105; Warren.Christensen@ndsu.edu

Jennifer L Momsen, North Dakota State University

Growing up STEM at North Dakota State University is one of the first REU programs in the nation to focus on discipline-based education research (DBER). The goal of our REU is to foster the retention and recruitment of talented students to graduate programs in DBER. Through 10-weeks of immersive research, students build a cohort of like-minded peers and develop as scholars. Results from our first two years indicate participants were deeply engaged, motivated, and committed to their research while on campus. Several participants are matriculating into graduate programs in DBER and nearly all of our remaining participants plan to continue on to graduate programs in STEM. As the program matures, we seek to increase the diversity of our applicants and aim to track these students as they progress in their graduate careers and beyond.

*Funded by NSF DUE #1156974

PST1B23: 8-8:45 a.m. Tutorial Curricula for Advanced High School Physics

Poster – Michael Gearen, Punahou School, Honolulu, HI 1601 Punahou St., Honolulu, HI 96822; mgearen@punahou.edu

Stephen Kaback, The Blake School, Minneapolis, MN

There is a dearth of tutorial materials available for high school physics courses. Mike Gearen, with support from the University of Washington Physics Education Group, has produced two full curricula for AP Physics 1-2, and AP Physics C based exclusively on tutorial instruction. In these courses, students construct knowledge using carefully sequenced series of questions, thought experiments, and problems rooted in research into student learning. This poster will expand on the brief contributed talk by making the complete tutorial curricula available for examination and discussion. Mike Gearen and Steve Kaback will provide more in-depth information on the implementation of these curricula.

PST1B25: 8-8:45 a.m. Previous Ideas About Electricity in Mexican Preschool Boys

Poster – Mario Humberto Ramirez Diaz, CICATA-IPN Av. Legaria 694, Mexico, MEX 11500, México; mramirezd@ipn.mx

Gabriela Nieto Betance, CICATA-IPN

We show previous ideas kids have about electricity, its origin and use. To make this activity, the teacher was trained in a physics workshop built by doctors in physics. As a result, the workshop was elaborated as an indagation cycle, rubrics and the activity was video recorded to analyze. The result of the implementation of indagation cycle, the boys express their previous ideas answering guiding questions like this: "What do some devices often used in regular life have in common?" "Where do you think electricity came from?," and, "What do you want to know about electricity?" In every case, they expressed their own hypothesis orally, in writing, or in cartoon form. Finally, for an end activity, the teacher did a recount of new words learned and their relationship with the environment.

Technologies

PST1C01: 8-8:45 a.m. Developing Interactive Simulations for Touch-Enabled Devices

Poster – Daniel Loranz, Truckee Meadows Community College, 3195 Roxbury Drive, Reno, NV 89523-6204; dloranz@gmail.com

By leveraging the power of modern development environments and accompanying frameworks, an educator with a limited programming background can quickly create simple custom apps for use in his/her classroom. This poster will highlight tools and libraries useful for creating interactive simulations, with an emphasis on creating 2D and 3D interactive animations for iOS devices.

PST1C02: 8:45-9:30 a.m. Two Simulation Tools to Promote Learning in Science

Poster – Pamela A. Maher, University of Nevada, Las Vegas, 718 Lacy

Lane, Las Vegas, NV 89107; maherp@unlv.nevada.edu

Janelle M. Bailey, Temple University

Peter G. Schrader, University of Nevada, Las Vegas

This study examines two simulation tools used in science education to answer the question, "Can simulations promote learning in science"? We compare the affordances of virtual reality headsets (VRH) with affordances offered in a fulldome planetarium. Each tool provides users with an interactive representation of a programmed environment. VRH has the ability to provide users with an interactive experience that conveys spatial relationships. VRH is used on an individual basis and until recently for gaming. The uses of the VRH are relatively unknown in traditional teaching and learning. Fulldome planetarium technology has been in use since the 20th century and offers an environment that affords multiple participants a similar experience. Both tools afford and are constrained by features inherent to their construction. We analyze each tool and its capacity for science content delivery. The research investigates how these tools facilitate development of, access to, and engagement in science concepts.

PST1C04: 8:45-9:30 a.m. LON-CAPA – Online Homework for Increasing Out-of-Class Student Engagement and Learning

Poster – Naresh Sen, California Polytechnic State University (Cal Poly), 1 Grand Avenue, Department of Physics, San Luis Obispo, CA 93407; nsen1343@gmail.com

Physics education research (PER) shows that graded online homework that provides immediate feedback to students dramatically increases out-of-class student engagement and learning. However, commercial online homework systems can be prohibitively expensive. This poster discusses the author's introduction and administration at Cal Poly-SLO of LON-CAPA, an open-source online homework system. LON-CAPA was introduced in fall 2014 for two physics courses instructed by the author for a total of about 80 students. Cal Poly was approved as a new member of the LON-CAPA cluster, and work has begun for on-campus installation and implementation of LON-CAPA for wider student use -- for all sections of introductory physics courses. When fully implemented, student use is expected to be about 5000-7000 students each year for several years. The cost to students is zero, an important factor compared to commercial online homework systems. Administration cost to the physics department is minimal, approximately $600 per year.

PST1C05: 8-8:45 a.m. Survey of Video Creation Technologies

Poster Jeff Stephens Misericordia University 301 Lake Street Dallas, PA 18612 United States jstephen@misericordia.edu

Whether you are interested in flipping your classroom, or not, you may benefit from the ability to create and distribute informative video content to your students. This work presents a survey of technologies including iOS and Android apps, traditional video technologies, and computer software. Each is capable of creating a quality video for student learners. We also offer a comparison of key features for each technology to help users fit their individual needs.

PST1C06: 8:45-9:30 a.m. Approaches to the Online Lab Problem in Physical Science

Poster – Robert D. Collins, University of Alabama in Birmingham, 704 Bailey Brook Circle, Birmingham, AL 35244; robertcollins1776@hotmail.com

L. Rast, D. L. Shealy, J. C. Martin, University of Alabama in Birmingham

Adapting a physical science core course for online delivery has been challenging. Currently, integrated labs give students experience with the scientific method, scientific writing, quantitative literacy, and help sustain interest levels. Our first online plan envisioned a "lab in your car" approach with students recording and analyzing real-world driving data from OBD2 data loggers in their car or location information from cell phones. While offering real pedagogical advantages, concern about student safety (and university liability) from possible distracted driving was a serious issue. Keeping the high-interest focus on cars, we addressed safety concerns by recording data for students and helping them access the rich body of publicly available data from motor sports, such as drag racing. Simple numerical strategies using Euler's method permit students to explore interesting motion models of increasing complexity by adapting spreadsheets. Students use computer animation to visualize motion models and collaborate on a group research project.

PST1C07: 8-8:45 a.m. Teaching Physics with iPads: The 1:1 Classroom

Poster Katie Page Prospect High School 801 Kensington Rd Mt. Prospect, IL 60004 katie.page@d214.org

This session will give teachers a very specific grasp of how to begin to transform their physics classroom into a 1:1 environment with the iPad. I will show how I began by just using the ipad simply as a tool, to adding more and more interactive activities, to completely transforming my classroom to a 1:1 digital environment using the SAMR model. Since transforming my class to a 1:1 environment, students are more prepared, they have less Ds and Fs, and my classroom is more efficient with less transition time between activities. Since we are more efficient with the implementation of videos and flipping the classroom, there is more time for "doing" hands-on activities or practicing the content. Formative quizzing apps make for more effective teaching and learning through student self-assessment and teacher knowledge of student understanding.

PST1C08: 8:45-9:30 a.m. The Effect of Online Lecture on Persistence in a Physics Class

Poster – John C. Stewart, West Virginia University, White Hall Morgantown, WV 26501; johns@UARK.EDU

This poster will examine the difference in the rate students successfully complete a physics class between students attending lecture in person and students choosing to watch the lecture on video as part of an online class. The option to watch the lecture on video was implemented mid-semester in fall 2012 so that the performance of the same set of students could be compared. A fully online lecture section was introduced in spring 2013, but students were allowed to select the lecture viewing option. The online lecture section was continued in the fall 2013 and spring 2014 semesters; however, students were no longer allowed the choice of lecture viewing option. Higher than expect withdrawal rates have been experienced in the online sections of the class. This poster will examine this effect using both data gathered from the performance on required assignments and the rate those assignments were submitted for grading. Differences in student self-reports of examination preparation behavior and time-on-task will also be presented to develop a detailed model of the differences in student behavior between a blended class and a fully face-to-face class.

Session TOP03: History and Philosophy of Physics

Location: Nautilus Hall 3
Sponsor: History and Philosophy in Physics
Date: Monday, January 5
Time: 8–9:30 a.m.

Presider: Shawn Reeves

Session TOP04: Graduate Student Topical Discussion

Location: Nautilus Hall 4
Sponsor: Committee on Research in Physics Education
Co-Sponsor: Committee on Graduate Education in Physics
Date: Monday, January 5
Time: 8–9:30 a.m.

Presider: Ben Van Dusen

Awards Session – Melba Newell Phillips Medal

presented to Thomas L. O'Kuma

Location: Grande Ballroom C
Date: Monday, January 5
Time: 9–11 a.m.

Presider: Gay Stewart

Tom O'Kuma

Growing with AAPT

Thomas L. O'Kuma, Physics Department, Lee College, Baytown, TX

Like many AAPT members, I can link the growth of my professional career to being active in AAPT. Since becoming a student member of AAPT in 1969, I have seen AAPT change, slightly in some ways and dramatically in others. Through AAPT and its sections, I and many other members have grown with AAPT. From my perspective, growing with AAPT has transformed physics education and how I do physics education. Involvement with TYC21, NTFUP, SPIN-UP/TYC, PTRA, NFE, and many other AAPT projects have helped many others and me. In this address, I will share how being active in AAPT has not only been fulfilling, but also how it has affected my career and other AAPT members.

Randy Booker

2014 SPS Outstanding Chapter Advisor Award

presented to Professor Randy Booker, University of North Carolina Asheville

Randy Booker is a tireless champion for SPS at the University of North Carolina Asheville, serving as his local chapter advisor and as a member of the SPS National Council. Through his unmatched teaching and mentoring, he has impacted the lives of countless students and has seen the SPS chapter recognized for excellence repeatedly. Randy received his Ph.D. from Duke University, and has taught at UNC Asheville since 1986, where he received the Distinguished Teacher Award in 1992. He served as department chair from 2000-2010, and currently teaches modern physics, upper-level experimental physics, and astronomy. His research interests include the microwave spectra of molecules found in the Earth's atmosphere and the interstellar medium. For seamlessly picking up where the classroom efforts leave off to ensure the success of students, Randy Booker is truly an SPS Outstanding Chapter Advisor.

Adrian Dingle

2014 AIP Science Writing Award

presented to Adrian Dingle, Atlanta, GA

As a high school chemistry teacher since 1990, Adrian Dingle has hands-on experience getting young people interested in science in general and chemistry in particular, helping kids see that science is involved in both the wondrous and the everyday. The first 10 years of his career were spent in and around London, teaching chemistry in a number of different public and private institutions. In 2000 he moved to the United States, and he has been teaching at The Westminster Schools in Atlanta, GA, since then. His outside work includes projects for Barnes & Noble SparkNotes, Shmoop, The Discovery Channel and many others. In his recent book, *How to Make a Universe with 92 Ingredients: An Electrifying Guide to the Elements*, from publisher OwlKids, he tackles questions such as what gives comets their tails and how matches ignite. This book is the winner of the 2014 American Institute of Physics (AIP) Science Writing Award in the Writing for Children category. More about the book and Adrian can be found at website: http://www.adriandingleschemistrypages.com


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Session DA: Using Social Networking to Enhance Your Physics Class

Location: Nautilus Hall 1
Sponsor: Committee on Educational Technologies
Date: Monday, January 5
Time: 11 a.m.–12:20 p.m.

Presider: Andrew Duffy

DA01: 11-11:30 a.m. Eliminating the Physics Fear Factor with Piazza

Invited – Tony Luckett, Piazza, 101 University Ave., Suite 100, Palo Alto, CA 94301; Tony@piazza.com

Science courses can be particularly arduous, intimidating, and isolating for students, leading many to drop out or reconsider their majors. In this session, Tony Luckett will discuss how to reduce the various stressors in physics classes to keep students motivated and engaged. Tony will demonstrate how to use Piazza, the leading social learning platform for physics classes in the country, to foster collaboration, dialogue, and community. Attendees learn from case studies how Piazza can help students get the most out of their academic experience by connecting them with classmates, teaching assistants and professors who can solve even the toughest problems by working together. Instructors will leave with a clear sense of how to use the latest social learning technology to connect with their students in a completely new way.

DA02: 11:30 a.m.-12 p.m. Why Social Networking (Learning) Is Icing on the Cake of 21st Century Pedagogy?

Invited – Ali Jafari, CyberLab, 101 SELB, 350 N Blackford St., Indianapolis, IN 46202; jafari@iupui.edu

Professor Jafari has created four Learning Environments; open source such as Oncourse (now Sakai), ANGEL Learning, and now CourseNetworking system. He will discuss his new vision and system (theCN.com) as well as elaborating on the advantages of integrating social network in both F2F and online courses, as a new enabler to make learning more engaged, global, rewarding, and sticky.

DA03: 12-12:10 p.m. Course Networking from an Instructor's Perspective

Contributed – Andrew D. Gavrin, IUPUI, 402 N. Blackford St., LD154 Indianapolis, IN 46202; agavrin@iupui.edu

Course Networking (http://www.thecn.com) is a new social media tool designed specifically for the educational environment. It incorporates the ability for an instructor to create "tasks" based on course content, time periods, or other structures. It also allows instructors and students to create posts, polls, reflections on prior posts, and to "like" other's work. This talk will report on a first use of Course Networking in an introductory calculus-based mechanics course at IUPUI. Enrollment in this course is over 150 students. Further, IUPUI is a predominantly computer campus, so many of the students have little opportunity for social interactions in their classes. Particular attention will be paid to student attitudes about this new tool and their perceptions of its impact on learning and social engagement with their peers.

DA04: 12:10-12:20 p.m. Student Interactions Within an Online Homework Forum in Introductory Physics

Contributed – James Kisiel, California State University, Long Beach, 1250 Bellflower Blvd., Long Beach, CA 90840-0119; j.kisiel@csulb.edu

Brandon Kawata, California State University, Long Beach

Student conversations in an online homework forum (Social Homework) for introductory physics were examined to see how students interact in this new type of setting. With the ability to "like" posts and make comments to a discussion (as with Facebook), Social Homework was designed so students in a large lecture hall could participate in small learning groups. Initial analysis of the most liked discussions revealed that most of the posts are related to physics however, most of these posts were procedural (e.g. Here is the formula we should use) as opposed to conceptual (the net force includes friction). Further research found that most of the contribution within these online discussions came from 1-2 students. Social Homework provides an opportunity for students and instructors to contribute to physics discourse but some modifications may be needed to support a more meaningful learning experience.

References: Kortemeyer, G. (2006). "An analysis of asynchronous online homework discussions in introductory physics courses," *Am. J. Phys.* **74**(6), 526-536.
National Research Council. (2012). *Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering.* S.R. Singer, N.R. Nielsen, and H.A. Schweingruber, Editors. Washington, DC: The National Academies Press.
Song, L., & McNary, S. W. (2011). "Understanding students' online interaction: Analysis of discussion board postings," *J. of Interactive Online Learn.* **10**(1), 1-14. Chicago

Session DB: Physics Outreach at Science Festivals

Location: Executive 1
Sponsor: Committee on Science Education for the Public
Date: Monday, January 5
Time: 11 a.m.–12:30 p.m.

Presider: Peggy Norris

The last five years have seen a surge in the number of science festivals around the United States. A science festival is a fun event that provides an opportunity for our community to bring physics activities to large numbers of people in a short period of time; however, surging crowds, weather, noise, and other factors can cause problems that may not be anticipated and are hard to control. This panel discussion will present ideas and best practices for physics activities at science festivals large and small. There will be plenty of time for discussion, so bring your own successes and war stories.

DB01: 11-12:30 p.m. Catching Gravitational Waves (and people's attention) at Science Festivals

Panel – Marco Cavaglia, University of Mississippi, Department of Physics and Astronomy, University, MS 38677-1848 ;cavaglia@olemiss.edu

As a frontier physics effort, a core mission of the Laser Interferometer Gravitational-wave Observatory (LIGO) Scientific Collaboration is to increase interest in, and understanding of, gravitational-wave astronomy and fundamental science among students and the broader community. Over the past decade, LIGO has participated to many science events across the U.S., from local fairs with just a few tens of visitors, to national gatherings such as the World Science Festivals in New York City and the USA Science and Engineering Expos in Washington D.C. In many of these occasions, LIGO's participation featured "Astronomy's New Messengers: Listening to the Universe with Gravitational Waves," an innovative outreach project reproducing the physics and technology of the actual LIGO instrument in an eye-catching and entertaining way. We will discuss the elements of the Astronomy's New Messengers exhibit and share some of the experiences (and lesson learned) from this project. Astronomy's New Messengers is funded by the National Science Foundation through grant NSF-0852870 from the Informal Science Education program, the EPSCOR program, and the Office of Multidisciplinary Activities, and managed by the LIGO Scientific Collaboration. Astronomy's New Messengers is funded by the National Science Foundation through grant NSF-0852870 from the Informal Science Education program, the EPSCOR program, and the Office of Multidisciplinary Activities, and managed by the LIGO Scientific Collaboration.

DB02: 11-12:30 p.m. Making Science Festive: The Challenge of Outreach at Science Festivals

Panel – Brian Jones, Colorado State University, Physics Department, Fort Collins, CO 80523; physicsjones@gmail.com

Most of the programs the Little Shop of Physics presents are hands-on programs at schools. Our audiences are all the same age, are directed by responsible adults, and are eager for the experience, which compares favorably to most classroom instruction. Science festivals are a different matter. Audiences are a mix of ages and interests, and we are competing with other presenters--and other entertainments and distractions. This challenging but rewarding environment has given us a chance to hone our skills and made us better presenters in all of the work that we do.

Session DC: Historical Incidents Useful for Teaching Physics

Location: Nautilus Hall 2
Sponsor: Committee on History and Philosophy in Physics
Date: Monday, January 5
Time: 11 a.m.–12 p.m.

Presider: Ruth Howes

DC01: 11-11:10 a.m. Nobel Prizes as Motivators for Physics Students

Contributed – Chuck Winrich, Babson College, Kriebel 203, Babson Park, MA 02457-0310; cwinrich@babson.edu

The Nobel Prizes are simultaneously contemporary and historical events: contemporary in the sense that they are awarded annually and widely known through the popular press; historical both in the sense that there is a history of prizes, and in the sense that the prizes are typically awarded for historically significant achievements. The contemporary/historical nature of the Nobel Prize makes it ideally suited as a historical motivational tool for physics students, as they already have some context around the Nobel Prize. The Nobel Laureates' speeches and writings about their prizes provide readings that are generally useable in courses for college non-science majors and advanced high school students. The Nobel Foundation also produces educational materials based on prizes awarded. An example unit on semiconductors for college non-majors which uses the 1956 Nobel Prize in Physics will be presented. Additional examples will also be discussed.

DC02: 11:10-11:20 a.m. Combining Physics and History: Modern Physics, Modernism, and the Bomb

Contributed – Andrew F. Rex, University of Puget Sound, Physics Department, CMB 1031, Tacoma, WA 98416; rex@ups.edu

For over 20 years, we have regularly offered a course that introduces the rise of modern physics within the context of world history from 1895 to 1945. Normally team taught by a physicist and a historian, this course is intended for college juniors and seniors and satisfies a general graduation requirement. There are no prerequisites, so we draw students representing many different majors, which enriches class discussion. Despite the lack of physics prerequisites, social science and humanities majors gain some understanding of nuclear physics, for example by learning how to compute the energy released in a fission event or other nuclear reaction. Physics majors appreciate the context of the rise of modern physics and the participation in historical events by physicists, particularly Szilard, Einstein, Bohr, and Oppenheimer. The course culminates in a focused study of the Manhattan Project and the use of the atomic bomb in World War II.

DC03: 11:20-11:30 a.m. How Quantum Mechanics History Informs Our Understanding of Scientific Models

Contributed – Anne E. Leak Gevirtz, Graduate School of Education - University of California, Santa Barbara, Santa Barbara, CA 93106-9490; aemerson@education.ucsb.edu

Peter J. Chung, Danielle B. Harlow Gevirtz, University of California, Santa Barbara

While much is known about the nature of scientific models and theories after their development and acceptance within scientific communities, physics teachers and students must also be familiar with the processes leading to their acceptance. One of the most recent and significant developments of a new scientific model occurred during the early part of the 20th century with the introduction of quantum mechanics. This time period is rich in debates regarding critiques of quantum mechanics and insight into what it means to be a good scientific model. This study uses historical letters, publications, presentations, and articles documenting two key debates in the early history of quantum mechanics to better understand the nature of scientific models. Results of this historical analysis provide a guide for structuring activities and discussions with students much like those key conversations between Einstein, Heisenberg, Schrödinger, and their contemporaries who shaped the formative model of quantum mechanics.

DC04: 11:30-11:40 a.m. The Origins of the Induction Coil

Contributed – Thomas B. Greenslade, Jr., Kenyon College, Department of Physics, Gambier, OH 43022 greenslade@kenyon.edu

The induction coil, still used to excite Geissler tubes for demonstrations, has its origins in two simultaneous bursts of innovation, both in the late 1830s. One was Irish, the work of the Rev. Nicholas Callan of St. Patrick's College in Maynooth. The other was the first avowed American electrical inventor, Charles Grafton Page. Examples of their designs will be shown, as well as the perfected version of the French apparatus manufacturer Heinrich Rhumkorff.

DC05: 11:40-11:50 a.m. Tickling the Tail of the Dragon

Contributed – Paul R. Ohmann, University of St. Thomas, OWS 153, Saint Paul, MN 55105-1080; prohmann@stthomas.edu

Our Modern Physics course: From the Atom to the Big Bang explores relativity, nuclear physics, particle physics, and cosmology. In the nuclear physics unit we talk at length about radioactivity, comparing what we naturally encounter to man-made sources and accidents. We discuss the Fukushima disaster, comparing the radiation emitted with those from other incidents, notably those associated with the Manhattan project. This brings to life physicists of yore, including Feynman and Fermi, who cautioned researcher Louis Slotin about "tickling the tail of a sleeping dragon" during his rather cavalier experiments with a plutonium nuclear core. This core acquired the epithet "demon core" after separate mishaps killed Slotin and his colleague Harry Daghlian, and was later used in the Able tests on the Bikini Atoll. Lessons learned are many: respect for atomic power, the need for careful experimentation, and concern for the environment all feature prominently.

DC06: 11:50-12 p.m. Benjamin Thompson's Life and Work in Bavaria

Contributed – Ruth H. Howes, Emerita, Ball State University, 714 Agua Fria St., Santa Fe, NM 87501; rhowes@bsu.edu

After the American Revolution ended in a defeat for England, Benjamin Thompson recognized that his utility to the English government had come to an abrupt end. He managed to gain a recommendation to the Duke of Bavaria and was asked to present a plan for reforming the Bavarian military. The Duke was so impressed that he appointed Thompson Minister of War, Minister of Police, Major General, Chamberlain of the Court and State Councilor so that he could implement his reforms. In the process of doing so, Thompson found himself required to answer several fundamental questions in physics. The story of his work highlights both his ability as a physicist and the unusually close ties between the physics questions he investigated and their applications to social problems.

Session DD: Single Photon Detectors

Location: Nautilus Hall 3
Sponsor: Committee on Apparatus
Date: Monday, January 5
Time: 11 a.m.–12:10 p.m.

Presider: Gabe Spalding

DD01: 11-11:30 a.m. The Weirdness of Quantum Mechanics, One Photon at a Time

Invited – Theresa W. Lynn, Harvey Mudd College, 301 Platt Blvd., Claremont, CA 91711-5990; lynn@hmc.edu

Richard Haskell, Harvey Mudd College

Spontaneous parametric down conversion provides a simple and affordable source of entangled photon pairs, and single-photon counting modules are increasingly affordable tools for detecting individual photons with high efficiency. These technologies allow undergraduates to gain hands-on experience with some of the most important —and strangest—aspects of quantum mechanics. Using entangled photon pairs as a source of heralded single photons, students demonstrate that light is quantized by observing anticoincidence between photon counts on the two output ports of a beam splitter. Then, replacing the simple beam splitter with a Mach-Zehnder interferometer, students observe single photons interfering with themselves! The interference is destroyed by which-way information but revived when which-way information is "erased," demonstrating a quantum eraser. Finally, by measuring the polarizations of entangled photon pairs, students observe the violation of local realism in quantum mechanics. An hour's worth of data easily violates Bell's inequality by more than 100 standard deviations.

DD02: 11:30 a.m.-12 p.m. Photon Counting Instrumentation in Quantum Optics and Nano-Optics Teaching Laboratory*

Invited – Svetlana G. Lukishova, The Institute of Optics, University of Rochester, 275 Hutchison Road, Rochester, NY 14627-0186; lukishova@gmail.com

I will outline my experience of using single-photon counting avalanche photodiode modules (Perkin Elmer) and low-light level, cooled EM-CCD cameras of Andor Technology in undergraduate teaching experiments on quantum optics and nano-optics. We developed four teaching laboratory experiments on generation and characterization of single and entangled photons: Lab. 1. Quantum entanglement and Bell's inequalities. Polarization and angular momentum of light. Discussion of quantum cryptography, quantum teleportation and quantum computing; Lab. 2. Single-photon interference (Young's double slit and Mach-Zehnder interferometers), quantum eraser. Low-light level EM-CCD cameras and sources of noise. Lab. 3 Single-photon source: Confocal microscope imaging of single-emitter fluorescence, atomic force microscope imaging of nano-emitter topography. Nanoplasmonics, photonic bandgap materials and metamaterials. Lab. 4. Single-photon source: Hanbury Brown and Twiss setup. Photon antibunching. Single-photon counting avalanche photodiode modules. Electronics for photon counting instrumentation.

*This activity was supported by four NSF Grants (Material-Research-Instrumentation, CCLI Phase I, CCLI Phase II, NUE program).

DD03: 12-12:10 p.m. Quantum Mechanical Ghost Interference

Contributed – David P. Jackson, Dickinson College, Department of Physics, Carlisle, PA 17013-2896; jacksond@dickinson.edu

Quantum-mechanical ghost interference is a phenomenon in which a double-slit interference pattern is observed without sending light through a double-slit aperture. This phenomenon makes use of a source of entangled photons that produces two beams of light (the signal and idler beams). When placing a double-slit aperture in the signal beam, an interference pattern is not observed in the signal beam unless the signal and idler beams are observed in coincidence. Remarkably, an interference pattern can also be observed in the idler beam even though the double-slit aperture is in the signal beam. In this talk I will give a brief overview of our attempt to perform such an experiment with undergraduate students.

Session DE: Mentoring Newly Graduated Teachers to Improve Retention

Location: Nautilus Hall 4
Sponsor: Committee on Teacher Preparation
Date: Monday, January 5
Time: 11 a.m.–12:40 p.m.

Presider: David Rosengrant

DE01: 11-11:30 a.m. Addressing Early Career Physics Teacher Attrition by Developing Professional Vision

Invited – Gregory Rushton, Kennesaw State University, 1000 Chastain-Road #1203, Kennesaw, GA 30144-5591; grushton@kennesaw.edu

Brett Criswell University of Kentucky

David Rosentgrant, Michelley Dean, Justin Polizzi, Kennesaw State University

Through a five-year, NSF supported professional development program that seeks to recruit, prepare and retain STEM professionals in secondary physics teaching careers, we are studying how the formation of their professional identity influences their dispositions towards implementing reform-based practices and their decision to remain in the K12 profession. We have been developing intentional experiences during the pre-service and induction phases using Gee's identity framework and Goodwin's notion of professional vision as the lenses through which we see the teachers' development as competent and active members of the teaching community of practice. Herein we describe the theory base for our study, the research methods for studying the teachers' identity formation and progress, and the nature of the professional development experiences that we hope will positively impact their views of using research-based practices in their classrooms and their choice with respect towards remaining in the career for an extended period of time.

DE02: 11:30 a.m.-12 p.m. Friday Night Physics: Learning Communities to Improve Teacher Retention

Invited – Danielle Buggé, Rutgers University, 10 Seminary Place, New Brunswick, NJ 08901-1183; danielle.bugge@gse.rutgers.edu

Eugenia Etkina. Rutgers University

A feeling if isolation is one of the reasons for teachers to leave the profession. Thus a strong physics teacher preparation program should not only prepare pre-service teachers to implement high-quality instruction but must also support them after graduation. A community of graduates can help provide this support naturally. Experienced teachers share experiences with the new teachers, the new teachers provide a constant support of energy and enthusiasm and both groups grow together solving common problems. What does it take to create and sustain such community? What effects does it have on the participants? The goal of this talk is to answer these questions and to provide helpful hints for those who are interested in organizing similar communities.

DE03: 12-12:30 p.m. Collaborative PER as a Form of Teacher Induction and Mentoring*

Invited – Emily Quinty, University of Colorado Boulder, 249 UCB Boulder, CO 80309-0249; emily.quinty@gmail.com

Valerie K. Otero

The Teacher Research Teams model improves teacher retention by increasing job satisfaction through the intellectually engaging activity of working with other researchers to investigate difficult problems of practice. The model provides opportunities and support for engaging in collaborative, publishable, discipline-based education research. These research experience also: (a) provide teachers with the skills necessary to advocate for themselves regarding the instructional decisions they make, especially when dealing with parents, administrators, and colleagues and (b) is a form of scholarly professional development since teachers induce principles about effective practice from their research. Since prospective teachers also serve on these teams, the experience is a progressive model for teacher preparation. Three Physics Research Teams are currently field-testing the Physics and Everyday Thinking-High School Curriculum and studying its implementation and class participation. We are investigating teacher learning and teacher preparation throughout this process. Our project will be described and our preliminary results will be discussed.

*This work is partially funded by the Gill Foundation and NSF Grant #1340083, 1240073, 0934921

DE04: 12:30-12:40 p.m. Fifteen Years of Success from the Exploratorium's Leadership Program

Contributed – Marc 'Zeke' Kossover, Exploratorium, Pier 15/17, Suite 100 San Francisco, CA 94116 zkossover@exploratorium.edu

The Exploratorium's Beginning Teacher and Leadership Programs have been training teachers new to the profession since 1998. The program has several components from three weeks of training for coaches and mentors, three weeks of pedagogy and content training for new teachers, mentor meetings during the academic year, observations from coaches in the classroom of the beginning teachers, an exclusive email list to get help, and ongoing pedagogy and content workshops for teachers' entire careers. We find that this whole teacher approach helps to decrease attrition, rapidly develop teaching skills, and create solid content knowledge that is passed on to students. Further, it creates a corps mentors that help teachers outside our program.

Session DF: Interactive Lecture Demonstrations – What's New? ILDs Using Clickers and Video Analysis

Location: Nautilus Hall 5
Sponsor: Committee on Research in Physics Education
Co-Sponsor: Committee on Educational Technologies
Date: Monday, January 5
Time: 11 a.m.–12 p.m.

Presider: Priscilla Laws

DF01: 11-11:30 a.m. Interactive Lecture Demonstrations: Active Learning in Lecture Including Clickers and Video Analysis

Invited – David Sokoloff, University of Oregon, Department of Physics, Eugene, OR 97403-1274; sokoloff@uoregon.edu

Ronald K. Thornton, Tufts University

The results of physics education research and the availability of microcomputer-based tools have led to the development of the Activity Based Physics Suite.[1] Most of the Suite materials are designed for hands-on learning, for example student-oriented laboratory curricula such as RealTime Physics. One reason for the success of these materials is that they encourage students to take an active part in their learning. This interactive session will demonstrate "through active audience participation" Suite materials designed to promote active learning in lecture—Interactive Lecture Demonstrations (ILDs),[2] including those using clickers and video analysis.

1. E.F. Redish, T*eaching Physics with the Physics Suite* (Wiley, Hoboken, NJ, 2004).
2. David R. Sokoloff and Ronald K. Thornton, I*nteractive Lecture Demonstrations* (Wiley, Hoboken, NJ, 2004).

DF02: 11:30 a.m.-12 p.m. Interactive Lecture Demonstrations: Effectiveness in Teaching Concepts

Invited – Ronald K. Thornton, Tufts University, 4 Colby St., Medford, MA 02155; ronald.thornton@tufts.edu

David R. Sokoloff. University of Oregon

The effectiveness of Interactive Lecture Demonstrations (ILDs) in teaching physics concepts has been studied using physics education research based, multiple-choice conceptual evaluations.[1] Results of such studies will be presented, including studies with clicker ILDs. These results should be encouraging to those who wish to improve conceptual learning in their introductory physics course. 1. David R. Sokoloff and Ronald K. Thornton, "Using Interactive Lecture Demonstrations to Create an Active Learning Environment," Phys. Teach. 35, 340 (1997).

1. David R. Sokoloff and Ronald K. Thornton, "Using Interactive Lecture Demonstrations to Create an Active Learning Environment," *Phys. Teach.* **35**, 340 (1997).

Session DG: Writing in Physics

Location: Seabreeze 1-2
Sponsor: Committee on Laboratories
Co-Sponsor: Committee on Physics in Undergraduate Education
Date: Monday, January 5
Time: 11 a.m.–12:30 p.m.

Presider: Andy Dawes

DG01: 11-11:30 a.m. Discourse Communities as a Framework for Writing in Physics

Invited – Heather M. Whitney, Wheaton College, 501 College Ave., Wheaton, IL 60187; heather.whitney@wheaton.edu

James Beitler, Wheaton College

Writing assignments in upper-level physics courses can be a refreshing way for students to more fully engage with the material, but these assignments must have careful construction for the greatest efficacy. Connecting with your institution's writing program can be a fruitful partnership that gives students the opportunity to transfer learning between fields. We present our experience with framing student writing in an upper-level analytical mechanics course around the framework of discourse communities, and compare student achievement of learning outcomes both with and without this framework.

DG02: 11:30 a.m.-12 p.m. Writing as a Means to Provide a Meaningful Classroom Experience

Invited – Calvin S. Kalman, Physics Department, Concordia University, 7141 Sherbrooke St., W. Montreal, QC H4B 1R6 Canada; calvin.kalman@concordia.ca

Writing can be used before students enter the classroom to enable them to try and understand the textbook as much as possible. If students also try problems in addition to writing, the classroom can become a place of interaction between students and the instructor. Writing can also be used after the class has taken place. Students can explore concepts to get a deep understanding. Our research (http://reflectivewriting.concordia.ca/) has shown that using writing, students can change their way of learning physics and can do better on traditional problem-solving examinations.

DG03: 12-12:30 p.m. The Conference Paper as an Alternative Assessment Tool in Physics

Invited – Teresa L. Larkin, American University, 4400 Massachusetts Ave. NW, Washington, DC 20016-8058; tlarkin@american.edu

The pedagogical value of a writing-based approach to learning has been widely documented. This presentation will describe a writing-intensive alternative model for assessment of student learning in introductory physics. A second-level course at American University provides the setting for this work. Students are exposed to all aspects of preparing a professional conference paper that they present at the end of the term. Following a description of the course, the specific structure for the conference paper activity will be outlined. The assessment strategies employed throughout the writing experience provide for multiple "snapshots" that often more robustly reveal what students are actually learning. Whether used as a stand-alone tool or coupled with more traditional measures, a writing-based approach to learning can provide an enhanced and more authentic way to capture what students are actually learning throughout all phases of the learning process.

Session DH: Panel of Support and Information for Graduate Students

Location: Executive 2A/2B
Sponsor: Committee on Research in Physics Education
Date: Monday, January 5
Time: 11 a.m.–12:30 p.m.

Presider: Abigail Daane

This 90-minute panel session will address many of the professional concerns brought up by graduate students during the past Crackerbarrels/Topical Group Discussions. Topics covered include: CV Writing, Job Hunting, Getting Involved with Committee, Publishing Articles, and Reviewing Articles.

Speakers:

Warren Christensen, Department of Physics, South Engineering 301, North Dakota State University, Fargo, ND 58105

Michael Loverude, Department of Physics, California State University Fullerton, Fullerton, CA 92834

Session DI: Updates and Resources for Introductory Physics for Life Science (IPLS) Courses

Location: Executive 3A/3B
Sponsor: Committee on Physics in Undergraduate Education
Date: Monday, January 5
Time: 11 a.m.–12:30 p.m.

Presider: Nancy Beverly

DI01: 11-11:30 a.m. The National Conversation About Introductory Physics for Life Science Students

Invited – Dawn Meredith, University of New Hampshire, 9 Library Way, Durham, NH 03824; dawn.meredith@unh.edu

Over the past several years, there has been much activity to reform the Introductory Physics Course for Life Science (IPLS) students, spurred on by the realization that this course did not meet the needs of the intended audience. In 2014 there were two national conferences devoted to IPLS issues, and we report here on themes, questions and recommendations related to learning goals, topic coverage, strategies, and resources that grew out of conference discussions and talks.

DI02: 11:30a a.m.-12 p.m. Finding and Developing Pedagogical Materials for the IPLS Course

Invited – Juan Burciaga, Mount Holyoke College, Department of Astronomy, South Hadley, MA 01075-1424; jburciag@mtholyoke.edu

Though new standard course materials such as textbooks and problem sets are gradually being implemented for the Introductory Physics for the Life Sciences (IPLS) course, many faculty are still struggling to find a good mix of content and pedagogy that will support the needs of reformed IPLS courses. But there has been a groundswell of curricular development and much of this material is being developed and archived in online sites, such as ComPADRE (http://www.compadre.org) and the Pre-Health iCollaborative (https://www.mededportal.org/icollaborative/) of the AAMC. The talk will focus on the content of these online archives, the process of incorporating the curricular materials into a course, and how to use these archives for curricular development. The talk will conclude by summarizing some of the proposed modifications to these archives that should make them more accessible, interactive, and productive for the physics community.

DI03: 12-12:30 p.m. Multimedia Modules for Teaching Physics to Pre-Health and Life Science Students*

Invited – Ralf Widenhorn, Portland State University, SRTC, 1719 SW 10th Ave., Room 134, Portland, OR 97201; ralfw@pdx.edu

We will present multimedia materials including videos by biomedical researchers and physicians that can be used in introductory physics or an intermediate level physics course for students pursuing a career in the life sciences or the medical field. The videos are used to give students a background on how the physics covered in the course is used by biomedical researcher or in a clinical setting. They are supported by written pre-lecture introductions to the relevant physics and are ideal for a flipped classroom environment. Physics instructors can use the answers to online pre-lecture questions to shape in-classroom instruction. The online homework developed for these modules explore essential physics concepts in a biomedically relevant manner. The initial concepts focus on biomedical applications of waves and optics, for example through ultrasound imaging, endoscopy or laser eye surgery, but will eventually span all fields of physics.

*This work is supported by NSF grants DUE 1141078 and DUE 1431447

DI04: 11 a.m.-12:30 p.m. A Kinesthetic Circulatory System Model for Teaching Fluid Dynamics*

Poster – James Vesenka, University of New England, 11 Hills Beach Road, Biddeford, ME 04005; jvesenka@une.edu

Elizabeth Whitmore, Katherine Misaiko, David Grimm, University of New England

Previous research has shown that life science students at the University of New England have difficulty applying what they have learned in the physics classroom to concepts of anatomy and physiology, primarily fluid dynamics as they pertain to the circulatory system. To help integrate multiple disciplines into our introductory physics course, we are developing a kinesthetic circulatory system model. Using this model consisting of common hardware tubing and connectors, we hope to improve the students understanding of the equation of continuity, Bernoulli's and Hagen-Poiseuille's principles, and hydrostatic pressure as they apply to the cardiovascular system. The impact of this model on improved student understanding of these concepts has been assessed through a combination of pre- and post-test conceptual assessments and open-ended questions. Preliminary studies indicate students had a better perspective for conservation of mass, hydrostatic pressure, and pressure differences due to local (Bernoulli) and global (Hagen-Poiseuille) conditions.

*This research has been supported by NSF DUE 0737458 and 1044154 grants.

DI05: 11 a.m.-12:30 p.m. Biomechanics Lab Activities and Worksheets

Poster – Nancy Beverly, Mercy College, School of Health and Natural Sciences, Dobbs Ferry, NY 10522; nbeverly@mercy.edu

For the many institutions that have a sizeable pre-physical therapy or exercise science population in their ILPS course, teaching mechanics in the context of biomechanics can easily make the course more relevant and meaningful. Pre-meds and pre-vets also benefit from this approach. A large set of biomechanics lab activity ideas with associated student worksheets, developed at Mercy College, is now available on a website to be easily adapted for use at other institutions. The laboratory activities at Mercy College are integrated with the other classroom activities, so these are not the typical stand-alone labs. However, these activities could be bundled and modified for a more traditional lab format. The materials are in a state of continual progress, but are usable/adaptable in their present condition, with updates coming in the future.

DI06: 11 a.m.-12:30 p.m. Using Openstaxcollege Online Textbooks

Poster – Donald G. Franklin, Spelman College/Penfield College of Mercer University, 39 West Main St., Hampton, GA 30228; dgfrank1@aol.com

Openstaxcollege has a collection of online science textbooks. Using them you can design a syllabus that combines biology and physics. This brings reality to the students that physics is a pre-med science, not a memorization course.

DI07: 11 a.m.-12:30 p.m. Considerations for Multiple Science Majors: Attitudes and Cognition

Poster – Andrew J. Mason, University of Central Arkansas, Lewis Science Center, 171, Conway, AR 72035-0001; ajmason@uca.edu

Data taken in the spring 2014 semester of an introductory algebra-based physics course suggests that different science majors exhibit different goal orientations towards a metacognitive problem-solving framework activity, which in turn seems to affect the likelihood of attitudinal gains and to some extent conceptual gains. A preliminary classification of framework orientation vs. performance orientation appears to extend to a population of non-physics science majors, and may suggest an empirical link between learner identity, attitudinal gains on the CLASS, and conceptual understanding gains on the FCI for a course population at a regional PUI physics course. Relative interest with respect to major, academic performance within the course, and additional variables are discussed considered with respect to utilizing metacognition more optimally for respective majors.

Session DJ: Recruiting and Retaining Underrepresented Physics Teachers

Location: Spinnaker 1-2
Sponsor: Committee on Diversity in Physics
Co-Sponsor: Committee on Physics in High Schools
Date: Monday, January 5
Time: 11 a.m.–12 p.m.

Presider: Daniel M. Smith, Jr.

DJ01: 11-11:30 a.m. Recruiting and Retaining Underrepresented Physics Teachers – What's Going On?

Invited – Elizabeth Walker, North Cobb High School, 3400 Hwy 293 N, Kennesaw, GA 30144; elizabeth.walker@cobbk12.org

In recent years more high schools have made pPhysics a graduation requirement, thus increasing the demand for qualified physics teachers. While efforts have been made to increase the number of qualified high school physics teachers and the quality of physics instruction, attracting qualified individuals to consider teaching physics as career continues to be a challenge. Has the recruitment and training of underrepresented groups kept pace with the increasing diversity of our high school classrooms?

DJ02: 11:30 a.m.-12 p.m. Preparing Physics Teachers to Teach Diverse Student Populations Through Collaborations

Invited – Geraldine L. Cochran, Rochester Institute of Technology, 138 Lomb Memorial Drive, SAU 2312, Rochester, NY 14623; glcsps@rit.edu

Andrea G. Van Duzor, Mel S. Sabella, Chicago State University

Scott V. Franklin , Rochester Institute of Technology

As the demographics of the K-12 population continue to change, it is imperative that pres[ervice teachers are prepared to teach diverse populations of students. For physics teachers, this requires preparation in physics pedagogical content knowledge and early teaching experiences with diverse populations. Effective use of the Learning Assistant program and external collaborations can facilitate this. At Chicago State University, a four-year university serving predominantly African American students on Chicago's Southside, faculty in the Department of Chemistry and Physics have collaborated with local community colleges, in-service physics teachers, and retired veteran teachers to prepare prospective teachers to teach students on Chicago's Southside. At Rochester Institute of Technology, a private institution in Upstate New York, faculty and staff in the Center for Advancing Science/Mathematics, Teaching, Learning, and Evaluation (CASTLE) have built up collaborations with local schools and CASTLE-affiliated programs to provide prospective teachers with experience teaching diverse populations of students. Both programs will be presented.

2015 Winter Meeting Plenary

Location: Grande Ballroom C
Date: Monday, January 5
Time: 2–3 p.m.

AAPT
PHYSICS EDUCATION

Presider: Janelle Bailey

How Light Has Changed Our Lives

by Eugene G. Arthurs , SPIE CEO

Eugene Arthurs

As Nobel laureate Ahmed Zewail puts it, "Light is life". Our existence and evolution have depended on and been shaped by light from the Sun. It is only a few centuries since we used optics to augment vision, helping us understand biology and the universe, and about 150 years since Maxwell built on millennia of studies to advance our understanding of the nature of light. Planck and Einstein were not the first to propose the idea of light as made up of particles, but they added the modern quantum concept. And now our understanding of the production, control, and detection of light have brought us the broadband internet, the ubiquitous affordable large area color rich displays, medical systems that promise both personally optimized medicine through genomics, and new imaging weapons for the war against diseases. The list is much, much longer, and during 2015, The International Year of Light, we hope to get a better sense of how much we already rely on light and the rich promise for future masters of light.

Session EA: Career Pathways – Mentoring Undergraduates

Location: Nautilus Hall 4
Sponsor: Committee on Physics in Two-Year Colleges
Date: Monday, January 5
Time: 3:30–5 p.m.

Presider: Toni Sauncy

This tutorial/workshop style session will feature results from the American Institute of Physics (AIP) Career Pathways Project. While physics departments do an excellent job of preparing students for physics graduate school, the statistics show that 40% of all physics majors in the United States opt to enter the workforce after graduating with a bachelor's degree. AIP conducted an NSF-funded research effort to understand, compile, and disseminate effective practices for preparing undergraduate physics students to enter the STEM workforce. Several results have emerged, including a unique set of resources for students and a guide for faculty. If you are interested in learning about how to educate your students (and your colleagues) about the multitude of career pathways made possible by a bachelor's degree in physics and learning how to best prepare students for those career opportunities, then this session is for you!

Session EB: Evaluation of Teachers and Professors

Location: Nautilus Hall 1
Sponsor: Committee on Women in Physics
Co-Sponsor: Committee on Professional Concerns
Date: Monday, January 5
Time: 3:30–5:10 p.m.

Presider: Alyssa Cederman

EB01: 3:30-4 p.m. Using RTOP to Evaluate Teachers and Professors

Invited – Kathleen Falconer, Buffalo State College, 27 East Girard Blvd., Buffalo, NY 14217; falconka@buffalostate.edu

Daniel MacIsaac, Buffalo State College

Recent accountability requirements in education have focused on student test scores and value-added as large percentage of the teacher evaluation rather than the typical principal/administrator classroom observation. Ignoring the reliability, validity, and stability issues inherent in many student assessments, the use of student test scores to evaluate teachers' effectiveness disregards the complex nature of teaching and learning. While student learning, especially conceptual learning, should be a factor in the evaluation of teachers and professors, there needs to be a systemic and comprehensive evaluation of the classrooms. The evaluation of teachers should emphasize lesson planning, lesson implementation and instruction, content knowledge, pedagogical content knowledge, classroom culture, and teacher reflection and professionalism. Using an instrument including these multiple domains of practice, with a properly trained evaluator with the prerequisite content and pedagogical knowledge will ensure a multifaceted and more complete picture of a teacher's effectiveness than a primary focus on test scores.

EB02: 4-4:30 p.m. Teacher Evaluations in New York State: Education Law 3012-c

Invited – Bradley F. Gearhart, Buffalo Public Schools, 446 Hammocks Dr., Orchard Park, NY 14127; fizz6guy@yahoo.com

In response to Race To The Top (RTTT) Assurance Section D: Great Teacher and Leaders, requiring improving teacher and principal effectiveness based on performance, New York State passed Education Law 3012-c which provided significant changes in the way teachers are supported and evaluated. In August 2010, New York State was awarded nearly $700M in funding through Race To The Top, partially based on their adoption of an Annual Professional Performance Review (APPR) as a method for teacher evaluation in accordance with Education Law 3012-c. The APPR bases 60% of a teacher's evaluation on measures of teaching practice, half of which should be gained through classroom observations. The remaining 40% of a teacher's score is based on measures of student learning. APPR scores are then used to assign a HEDI rating (Highly Effective, Effective, Developing or Ineffective) to each teacher based on these multiple measures of teacher effectiveness. The intention of this law is to create a fair, accurate and equitable evaluation system for teachers across NYS that would enable easy identification of teachers at all levels of professional proficiency. In my presentation, I will describe the APPR evaluations enacted in one high needs urban district in NY, and their impact on teaching staff and practices, including the teaching of physics.

EB03: 4:30-5 p.m. Evaluating Teaching Effectiveness: Lack of Alignment Between Instructors, Institutions, and Research Recommendations*

Invited – Charles Henderson, Western Michigan University, WMU Physics, Kalamazoo, MI 49008-5252; charles.henderson@wmich.edu

Melissa Dancy, University of Colorado Boulder

Chandra Turpen, University of Maryland College Park

Ideally, instructors and their institutions would have a shared set of metrics by which they determine teaching effectiveness. And, ideally, these metrics would overlap with research findings on measuring teaching effectiveness. Unfortunately, the current situation at most institutions is far from this ideal. In semi-structured interviews, we asked 72 physics instructors to describe how they and their institutions assess teaching effectiveness. Results suggest that institutions typically base most or all of their assessment of teaching effectiveness on student evaluations of teaching. Instructors, on the other hand, base most or all of their assessment of teaching effectiveness on student exam performance and nonsystematic formative assessments. Few institutions and instructors use assessment practices suggested by the research literature. Both instructors and institutions could benefit from broadening the assessment sources they use to evaluate teaching effectiveness through increased use of standardized measures based on student learning and greater reliance on systematic formative assessment.

*Supported in part by NSF #1122446.

EB04: 5-5:10 p.m. How Do Student Evaluations of Instruction Relate to Students' Conceptual Learning Gains?*

Contributed – Warren M. Christensen, North Dakota State University, Fargo, ND 58105; Warren.Christensen@ndsu.edu

LaDoris Lee, Northeastern Illinois University

Charles Henderson, University of Western Michigan

Melissa Dancy, University of Colorado at Boulder

Across the United States, Student Evaluations of Instruction (SEIs) are often the primary (if not only) metric used to evaluate the quality of an instructor. Although SEIs probably reflect student attitudes towards the class in some way, it is not clear to what extent SEI scores represent how much students learned in the class. This study looks at data from faculty volunteers who were recruited from a pool of recent attendees of the APS's New Faculty Workshop. The study solicited numerous forms of class artifacts from these faculty including student evaluations of instruction and multiple-choice conceptual survey data. The data indicate that there is no correlation between SEI ratings and normalized learning gains on the FCI, or other instruments. Thus, it appears that faculty receiving high (or low) evaluations from their students has no connection to how much conceptual understanding their students developed throughout the semester.

*Funded in part by NSF DUE #1156974

Session EC: International Networks for Action Research in Physics Education

Location: Nautilus Hall 2
Sponsor: Committee on International Physics Education
Date: Monday, January 5
Time: 3:30–5:30 p.m.

Presider: Dan MacIsaac

EC01: 3:30-4 p.m. Transatlantic Design-based and Action Research in Germany and the U.S.

Invited – André Bresges, University of Cologne Institute of Physics Education, Gronewaldstraße 2, 50931 Cologne, Germany; Andre.Bresges@uni-koeln.de

Dan L MacIsaac, SUNY Buffalo State Physics

In the Transatlantic Design Based Research / Action Research Network for physics teacher preparation, we are designing and assessing lessons and media for both German and U.S. schools. We are monitoring classroom interactions to foster cross-cultural, language-invariant physics teaching approaches for use in challenging heterogeneous multi-national classrooms. We present some theoretical background and literature review for DBR/AR in physics teacher preparation, and several designs that were evaluated in German schools in the local research network of the University of Cologne, and at the Waddell Language Academy of North Carolina.

EC02: 4-4:30 p.m. Transferring and Adapting Teacher Preparation Designs from U.S. to Germany

Invited – Philip Gaudenz, University of Cologne Institute of Physics Education, Gronewaldstraße 2, 50931 Cologne, Germany p.gaudenz@gmx.de, Stefan.Hoffmann@uni-koeln.de, Andre.Bresges@uni-koeln.de, danmacisaac@mac.com*

Stefan Hoffmann University of Cologne Institute of Physics Education

Beginning in 2015, German teacher education students will be required to intern for six months in a public school as part of their Master Degree teacher preparation. As part of their program, they will be required to conduct Inquiry-Based Learning and small Action Research projects, documented in a mandatory portfolio. Prior to the internship, students take a 12-week preparation course where they define and prepare their Action Research project for inquiry learning. We discuss how teacher preparation classroom projects that have proven effective in U.S. classrooms can serve as case studies for the preparation of the students under a cross-cultural perspective. We argue that the careful adaption of the U.S. designs to German classroom needs qualifies as part of an action research project that provide deeper insights into educational processes, and foster a more inclusive, culture-sensitive teaching style.

*Sponsored by A. Bresges

EC03: 4:30-5 p.m. Adapting German Tablet-based Science Lessons for U.S. Classrooms

Invited – Sandra Heine, University of Cologne Institute of Physics Education, Gronewaldstraße 2, 50931 Cologne, Germany; ansabe@arcor.de*

"Planetary Research with iPads" is a collaborative guided discovery science lesson activity, wherein students are guided by an iBook for Apple iPad document that includes motivational video, task description, self-assessment questions, sensor management, and tools to interpret and discuss data. In the activity, students take the role of astronauts and planetary researchers trying to figure out what makes a planetary surface habitable. This activity was developed together with several schools in Germany and adapted to U.S. classrooms with support from the Waddell Language Academy, North Carolina as part of a design-based research projected conducted by German students in the trans-Atlantic design-based research network.

*Sponsored by A. Bresges

Session ED: Project Learning Labs for Undergraduate Innovation and Entrepreneurship in Physics

Location: Nautilus Hall 3
Sponsor: Committee on Educational Technologies
Date: Monday, January 5
Time: 3:30–5:30 p.m.

Presider: Duncan Carlsmith

ED01: 3:30-4 p.m. Project Learning Labs for Undergraduate Innovation and Entrepreneurship in Physics

Invited – Duncan Carlsmith, University of Wisconsin-Madison, 1150 University Ave., Madison, WI 53711; duncan@hep.wisc.edu

Open labs fostering innovation and entrepreneurship through project-oriented learning complement academic physics classwork. This talk will describe innovation and entrepreneurship trends, the UW-Madison Physics Department Garage Physics open lab, and the UW-Madison entrepreneurial ecosystem, and offer program suggestions.

ED02: 4:-4:30 p.m. Beyond Maker Spaces: The Innovation Hyperlab with 52 Technologies

Invited – Randall Tagg, Physics Department, University of Colorado, Denver, P.O. Box 173364, Denver, CO 80217-3364; randall.tagg@ucdenver.edu

Emerging technologies have put powerful tools into the hands of physics student inventors. These tools include 3D printers, microcontrollers, low-cost sensors, and wireless digital communication. However, a trip to a running R&D lab, a manufacturing plant, a thrift store, or a junk yard reveals a broader range of technologies—some quite traditional, some extremely new—that comprise the goods and processes that support 21st century society and foster innovation around the world. This range is a gold mine of applied physics. We have set up the Innovation Hyperlab next to Gateway High School in Aurora, Colorado. The lab integrates 52 technologies into one project space, combining physical resources with online curriculum for learning-on-demand. The lab's motto is "Omnis Technologia Omnibus," or "All of Technology for Everyone." The design is modular so that pieces can be adopted elsewhere as time and space permit.

ED03: 4:30-5 p.m. Updating Physics Curricula: Professional Development and Entrepreneurship Education

Invited – Douglas Arion, Carthage College, 2001 Alford Park Dr., Kenosha, WI 53140; darion@carthage.edu*

The engineering community long ago took on the task of delivering entrepreneurship and professional training to its undergraduates. The physics education community is now poised to do likewise -- to fully develop students for the careers they are likely to undertake. Entrepreneurship and career preparation programs, like the ScienceWorks program at Carthage College, represent just one of the many means by which schools can provide this much needed content to their students. This talk will address delivery methods that can be utilized, as well as pedagogical content and student experiences that can prepare students for careers in physics and allied areas.

*Sponsored by Duncan Carlsmith

ED04: 5-5:30 p.m. Tinker, Thinker, Maker and CEO: Reimagining the Physics Student as Engineer, Inventor, and Entrepreneur

Invited – Crystal Bailey, American Physical Society, One Physics Ellipse College Park, MD 20740; bailey@aps.org

We live in an era of immense opportunity for physics graduates: their scientific training helps to make them key members of industry teams developing new technologies, or translating cutting-edge research into viable products. Physics as a discipline stands to make tremendous gains by implementing new educational approaches that provide training for success in what is increasingly the largest employment base for physicists: the private sector. In this talk, I will examine the role of physicist as innovator and how this role intersects with other similar STEM disciplines (such as engineering), and provide some insight into how implementing physics innovation and entrepreneurship (PIE) education will benefit both physics departments and the students they serve, regardless of students' eventual career choices. I will also talk about some exciting new PIE related developments in the physics community, and provide information about how educators can get involved in this growing movement.

Session EE: Teaching Sustainability in Non-major Courses

Location: Executive 3A/3B
Sponsor: Committee on Science Education for the Public
Co-Sponsor: Committee on Physics in Undergraduate Education
Date: Monday, January 5
Time: 3:30–5:30 p.m.

Presider: Juan Burciaga

EE01: 3:30-4 p.m. Building Physics as an Avenue for Sustainability Studies

Invited – Robert H. Knapp, Evergreen State College, 2700 Evergreen Parkway, Olympia, WA 98505; knappr@evergreen.edu*

Buildings, homes, and workplaces, are a key challenge for sustainability. Almost half of U.S. energy use goes to the building sector, along with other large environmental effects. Progress requires both scientific understanding of constraints and opportunities, and human understanding of building uses and meanings. Physics is at work in buildings in multiple ways, from structures to heating/cooling to lighting to machinery and appliances. So are values, memories and experiences. Non-science students can readily understand the science conceptually and semi-quantitatively, but rightly wish it merged with non-science considerations, whether personal (the beauty of a rainbow) or collective (productivity in a day-lit office). From 15 years of teaching beginning environmental design students in a liberal arts context, this talk brings forward key physics concepts related to sustainable buildings, including heat transfer, solar electricity and daylighting, as well as approaches for science/non-science convergence in studying them.

*Sponsored by Juan Burciaga

EE02: 4-4:30 p.m. Environmental Physics as Part of a Sustainability Certificate and Degree

Invited – Kyle Forinash, Natural Sciences, 4201 Grant Line Rd., New Albany, IN 47150; kforinas@ius.edu

An environmental science course for non-science majors has been taught annually by the physics department at Indiana University Southeast for about 10 years. The course focuses on energy (fossil fuels, conversion process, first and second law of thermodynamics, renewable energy) and introduces students to many important conceptual principles of introductory physics. Recently it has become the core course for a certificate in sustainability available on our campus. We are planning to eventually increase interdisciplinary course offerings so that a BA degree in sustainability can be offered. My talk will first discuss the contents of our science course and then offer some suggestions for getting other disciplines involved in creating a certificate and/or BA degree in sustainability.

EE03: 4:30-5 p.m. Earth Literacy Across the Curriculum: New Materials from InTeGrate

Invited – Anne E. Egger, Central Washington University, 400 E. University Way, Ellensburg, WA 98926-7418; annegger@geology.cwu.edu

Cathryn Manduca, Science Education Resource Center, Carleton College

David Steer, University of Akron

Kim Kastens, Education Development Center

InTeGrate is NSF's STEP Center in the geosciences that seeks to increase the Earth literacy of all students such that they are better positioned to make sustainable decisions in their lives and as part of broader society. Our approach involves rigorous, rubric-based development of curricular materials that use best practices from research on learning, are focused by engagement with grand challenges faced by society, and are suitable for use in diverse institutional, disciplinary, and course settings. Assessment and evaluation data from the first round of teaching with these new materials suggest that students gain skills in interdisciplinary problem solving, show improvements in Earth literacy, and show increased motivation towards sustainable behaviors. All of our resources are (or will become) freely available on the InTeGrate website: http://serc.carleton.edu/integrate/index.html.

EE04: 5-5:30 p.m. A Renewable Energy Course Emphasizing Student Role as Change Agent

Invited – Alexi C. Arango, Mount Holyoke College, 50 College St., South Hadley, MA 01075-1424; aarango@mtholyoke.edu

The strategy underlying our course on renewable energy, a course that regularly attracts over 45 non-major students per semester, is to regard students as change agents, engaging a largely math phobic population to embrace mathematical problem solving. The material is presented as training for activists, with facts and figures as instruments of persuasion, underlying scientific knowledge as the genesis of sound solutions, and cooperative group problem solving as an essential team forming skill. Three central objectives are to (1) account for energy usage of every personal daily activity, (2) determine the size of renewable energy resources, and (3) develop a realistic pathway toward widespread renewable energy production coupled with aggressive gains in energy efficiency. Context-rich problems are designed to reinforce the notion that simple mathematical calculations can profoundly upend conventional wisdom and serve as springboards for important discussions.

EE05: 3:30-5:30 p.m. Broadening Student Exposure to Sustainability: New Course Development

Poster – Barbra K. Maher, 13300 W. Sixth Ave., Lakewood, CO 80228; barbra.maher@rrcc.edu

Lynnette Hoerner, Red Rocks Community College

Incorporating sustainability into non-major science classes has been a focus of curriculum development at Red Rocks Community College. New labs have been written for physics classes of all levels that deal with sustainability. In addition to infusing existing curriculum, we developed several new course offerings to expand student exposure to sustainability and energy issues. Energy Science and Technology (PHY107) is an introductory level, lab-based course exploring many aspects of energy. Introduction to Climatology (MET151) is a new lecture course for non-science majors. Science and Society (SCI105) is a lecture course that focuses heavily on energy and climate change. Field Studies in Energy (PHY208) is a field course that will allow students to study energy topics in locations such as Iceland, Colorado, and Wyoming. These new offerings are generating student interest and excitement about energy, climate, and the relevance of sustainability in their lives.

EE06: 3:30-5:30 p.m. Curricular Goals for a General Education Course in Sustainability

Poster – Juan R. Burciaga, Mount Holyoke College, Department of Astronomy, 50 College St., South Hadley, MA 01075-1424; jburciag@mtholyoke.edu

Sustainability issues will remain one of the most challenging social issues of the short-term and long-term future. But many physics departments have no course in sustainability—or address these issues in courses for non-majors. What can physics contribute to the education of the public? What are the concepts, experiences, perspectives that will encourage an engaged, flexible, critical analysis by non-scientists as they grapple with these issues privately, publicly and commercially? This poster describes the curricular objectives of a non-majors course taught in the spring of 2014, the readings and experiences that framed the content, and the response of the students to the expectations and delivery of the course.

EE07: 3:30-5:30 p.m. Electricity: Generating Interest in Physics and Sustainability

Poster – Chuck Winrich, Babson College, Kriebel 203, Babson Park, MA 02457-0310; cwinrich@babson.edu

Meghan Maclean, Babson College

Babson College is a small private business school where no students can major in science. All science courses taught at Babson are interdisciplinary in nature, however two foundation courses include a significant discussion of electric power generation and distribution: Sustainable Energy Solutions and Electronics. We will present examples from class where we use sustainability as a theme to introduce issues beyond the physics of power generation, including renewable resources, managing distributed generation, and critically analyzing public policy decisions. The explicit discussion of sustainability applications engages the students more deeply with the physics content; and the complexity of the issues around sustainability promotes discussion of the nature of science.

EE08: 3:30-5:30 p.m. Teaching Scientific Modeling and Physics Content Using Alternative Energy

Poster – Rachael A. Lancor, Edgewood College ,1000 Edgewood College Dr., Madison, WI 53711; rlancor@edgewood.edu

Brian Lancor, Edgewood College

We have developed a series of quantitative case studies that force students to examine real world issues through the lens of physics, with a particular emphasis on alternative sources of energy. Wind turbines give students a motivation to study kinetic energy, hydropower teaches gravitational potential energy, and solar panels teach the electromagnetic spectrum and blackbody radiation. Our goal is to help students develop a conceptual understanding of how energy conservation is a useful model for understanding real world systems. These case studies help students to gain practice analyzing data, interpreting graphs, building conceptual and mathematical models, and thinking about broader issues of science in society, all important Scientific Practices articulated in the Next Generation Science Standards. These case studies provide a way to give students use scientific thinking skills outside of the laboratory.

Session EF: Informal Science Education

Location: Executive 2A/2B
Sponsor: Committee on Physics in Pre-High School Education
Co-Sponsor: Committee on Science Education for the Public
Date: Monday, January 5
Time: 3:30–5:30 p.m.

Presider: Robert Hobbs

EF01: 3:30-4 p.m. LIGO Science Education Center: Building an Informal Education Center on Collaborations

Invited – Amber Stuver, LIGO Livingston Observatory, 1003 E. Tom Stokes Ct., Baton Rouge, LA 70810; stuver@ligo-la.caltech.edu

The LIGO Science Education Center (SEC) is co-located with the LIGO Livingston Observatory and seeks to share the search for gravitational waves with students, teachers, and the public. The LIGO SEC is the result of nearly a decade of collaboration between a museum (The Exploratorium), a science laboratory (LIGO), a university (Southern University-Baton Rouge) and a local education agency (Louisiana Board of Regents) to scaffold this outreach. Programs are inquiry-based activities and include guided investigations in our classroom and free exploration of the more than 40 hands-on exhibits in our exhibit hall (mostly built by the Exploratorium). Students also get to visit the working LIGO observatory to interact with scientists and to see the concepts they're learning in action. This talk will focus on how our collaboration has produced a unique environment for students to learn new science, where diversity is spotlighted, and new research on learning is created.

EF02: 4-4:30 p.m. Informal Science Europe: Science Festivals, Shows and Centers

Invited – Stanley J. Micklavzina, University of Oregon, Department of Physics, Eugene, OR 97403-1274; stanm@uoregon.edu

I have had the privilege of doing two sabbaticals in Europe with a focus on science outreach for research labs/universities and also interacting with science centers. As a result, I have been invited to perform physics demo show performances and workshops at meetings and science festivals located in Sweden, Slovenia, The Netherlands, Norway, Slovenia, and most recently Estonia. I offer my experiences working with international colleagues and the experience of interacting with international audiences.

EF03: 4:30-5 p.m. Measuring Impact of Physics "Outreach": University Participation in Informal Learning

Invited – Kathleen Hinko, University of Colorado Boulder, 440 UCB Boulder, CO 80309-0001; kathleen.hinko@colorado.edu

Noah Finkelstein, University of Colorado Boulder

The Partnerships for Informal Science Education in the Community (PISEC) afterschool program is the main outreach effort of the JILA Physics Frontier Center and the Department of Physics at the University of Colorado Boulder, which is facilitated by physics undergraduate and graduate student volunteers for K-8 kids. Physics student participation in PISEC is encouraged by faculty (!) at CU as part of professional development. I will report on the structural elements and the institutional growth of this informal "outreach" program as an activity of formal science education at universities (professional development for physics undergraduate and graduate education). Additionally, I will give examples of outreach research done in collaboration with the PER group at CU: we study the science communication skills and teaching strategies of volunteers in PISEC as well as the impact on kids in the afterschool program in terms of agency, communication and reasoning.

EF04: 5-5:10 p.m. Science at the Stadium: A Physics Lesson for 10,000 Students

Contributed – Brian Jones, Colorado State University, Physics Department 1875, Fort Collins, CO 80523; physicsjones@gmail.com

Sheila Ferguson, Heather Michalak, Adam Pearlstein, Colorado State University

In April, 2014, Colorado State's Little Shop of Physics crew had the pleasure of partnering with the Colorado Rockies and the local NBC affiliate to present "Weather and Science Day," a one-hour science lesson before a baseball game. It is far and away the biggest thing we've ever done. Our 200 volunteers distributed over 100,000 items to over 10,000 K-12 students, who did hands-on investigations interspersed with large-scale demonstrations on the field and demonstrations led by college student volunteers in the stands. In this talk, I'll share details of the program that we hope will soon be certified as the world's largest physics lesson.

EF05: 5:10-5:20 p.m. 8 Activities 8 Minutes

Contributed – Kathy Holt, LIGO -LLO Science Education Center, P.O. Box 940, Livingston, LA 70754; kholt@ligo-la.caltech.edu

Catch a wave and SWIM to LIGO. SWIM-Science With Inexpensive Material. The LIGO Science Education Center uses inexpensive materials for activities and demonstrations to explain physical science concepts. Experience 8 SWIM activities in 8 minutes. These SWIM activities have been field tested with the public and are just downright fun! Come be inspired and motivated with ideas that will engage and delight the public and can be useful at any grade level. LIGO, Laser Interferometer Gravitational Wave Observatory, is a cutting edge research facility in Livingston, LA.

EF06: 5:20-5:30 p.m. An Electronics Kit for Groups of Home-school Students

Contributed – Shawn Reeves, EnergyTeachers.org, 1559 Beacon St., Apt 1, Brookline, MA 02446; aapt@shawnreeves.net

For several years Shawn Reeves has taught electronics labs to younger and younger home-schooled students, down to the age of nine. With his honed approach, all students learn several concepts about electronic components without a basics-first curriculum, instead diving headlong into intermediate circuits. Shawn will describe the necessary and optional components of a useful kit, how to ensure ownership and authentic enthusiasm, useful literature, trends, costs, and the possibility of a charitable organization to support interested teachers like you.

Session EG: PER in the Professional Preparation of Teachers

Location: Nautilus Hall 5
Sponsor: Committee on Research in Physics Education
Co-Sponsor: Committee on Teacher Preparation
Date: Monday, January 5
Time: 3:30–5:30 p.m.

Presider: David Meltzer

EG01: 3:30-4 p.m. PER as a Guide to In-service Teacher Preparation in Physics

Invited – Lillian C. McDermott, University of Washington, Department of Physics, Seattle, WA 98195-1560; lcmcd@phys.washington.edu

No more than 35% of high school physics teachers in the United States have majored in physics or physics education.[1] In 1999 this situation led to an AAPT/APS joint resolution urging physics departments to participate actively in teacher preparation. Thus far, most of the emphasis has been on pre-service teachers. The shortage of qualified teachers is so severe, however, that a concerted effort beyond short workshops is also necessary to improve the preparation of in-service teachers to teach physics. Examples will be presented of how research and research-based curriculum development can contribute to inservice teacher professional development.[2]

1. David E. Meltzer and Valerie K. Otero, "Transforming the preparation of physics teachers," [guest editorial], *Am. J. Phys.* **82**(7), 633-637 (2014).
2. L.C. McDermott and the Physics Education Group at the University of Washington, *Physics by Inquiry* (John Wiley and Sons, NY, 1996).

EG02: 4-4:30 p.m. Teacher Research Teams: Dual Roles for Teachers Impacts their Practice*

Invited – Valerie K. Otero, University of Colorado Boulder, 249 UCB Boulder, CO 80309-0249; valerie.otero@colorado.edu

Teacher Research Teams are designed to meet three goals: (1) scholarly professional development—teachers induce principles about effective practice from their own research, (2) self advocacy—teachers develop skills, confidence, and courage necessary for defending their (sometimes unpopular) instructional decisions to administrators, parents, colleagues and (3) retention and job satisfaction--the intellectually engaging activity of conducting publishable research on "problems of practice" is challenging and satisfying. The original nine teachers currently lead 60 teachers and prospective teachers in nine teams. Their publications and talks have increased from two in 2010 to 25 in 2013. The dual role of teacher/researcher has affected teachers' practice by supporting or refuting teachers' claims about what is best for students. For example, an interrupted time series analysis revealed that a slight modification of whiteboard usage and teacher talk led to an increase in student participation in consensus discussions. These and other results will be discussed.

*This work is partially funded by the Gill Foundation and NSF Grant #1340083, 1240073, 0934921

EG03: 4:30-4:40 p.m. PER to the Rescue: Incorporating Research in Physics Teacher Education*

Contributed – Marina Milner-Bolotin, The University of British Columbia, 2125 Main Mall, Vancouver, BC V6T 1Z4 Canada; marina.milner-bolotin@ubc.ca

Physics methods courses provide a great opportunity to interest physics teacher-candidates in physics education research (PER). While acquiring physics teaching skills, teacher-candidates have to become aware of the PER implications on teaching physics and of the research-informed pedagogies. However, raising awareness is insufficient to assure teacher-candidates teachers will use PER in their practice. To do so, they have to become members of the physics education community of practice. In this presentation I will discuss how PER became a backbone of the Physics Methods Course I teach at the University of British Columbia. In this course teacher-candidates have an opportunity to experience PER-informed pedagogies and design PER-informed lessons. They also explore and discuss PER papers and incorporate their findings in their practicum classrooms. Most importantly, teacher-candidates become members of the local physics teaching community and have an opportunity to be mentored by experienced physics teachers outside of the university walls.

This research is generously supported by the University of British Columbia Teaching and Learning Enhancement Fund.

EG04: 4:40-4:50 p.m. Quantifying Changes in School Teachers' Practices*

Contributed – Gordon J. Aubrecht, Ohio State University at Marion, 1465 Mt. Vernon Ave., Marion, OH 43302-5695; aubrecht.1@osu.edu

Jennifer L. Esswein, Education Northwest

Jessica G. Creamer, Education Specialist

Bill Schmitt, Science Center of Inquiry

Grant agencies are requiring documentation that goes beyond anecdote. We work with inservice middle and high school teachers in two high-needs urban school districts in Ohio. The Ohio Department of Education requires supported programs to involve at least 120 hours of professional development, with at least half during the school year. We estimate that new teachers who attend the summer institutes received at least 188 hours of professional development involvement this past year (70 h, summer; 70 h, grade-level meetings; 48 to 96 h, common formative assessment (CFA) analyses; plus staff classroom visits and voluntary attendance at professional society meetings). We expect to see changes in teacher practice as a result. This presentation explains our attempt to quantify changes in teacher practice by using student common formative assessments, RTOP, and other self-assessments to quantify changes in teachers and teaching practice.

*This work supported in part by grants from the Ohio Department of Education C1457-OSCI-09-49 (2008-2009), C1667-MSP-10-410 (2009-2010), EDU01-0000006141 (2010-2011), EDU01-0000007902 (2011-2012), GRT00029161 (2012-2013), ODE-MSP-10673 (2013-2014), and EDU01-0000013704 (2014-15).

EG05: 4:50-5 p.m. Adapting Modeling Workshops for the Distance Learner

Contributed – M. Colleen Megowan-Romanowicz, American Modeling Teachers Association, 2164 E Ellis Dr., Tempe, AZ 85282; colleen@modelinginstruction.org

For 25 years Modeling Workshops have reached high school physics teachers nationwide with 90-hour summer professional development experiences targeted at helping them optimize their effectiveness in designing and managing the learning environment in their physics classroom. Demand has risen in recent years for an online version of the Modeling Workshop that will provide teachers who cannot manage the travel to a workshop location with sufficient grounding in Modeling Theory and practice to successfully deploy it in their physics classrooms. Modeling Instruction is discourse-intensive and student-centered. It relies heavily on small group work and whole group sense-making discussion. To what extent can this be reproduced in an online setting? This presentation will report on what we learned from two pilot distance learning Modeling Workshops offered on different distance learning platforms; what we learned, and where we will go from here.

EG06: 5-5:10 p.m. Elementary Teacher Candidate's Personal Interest in Physics

Contributed – Wendy K. Adams, University of Northern Colorado, Department of Physics and Astronomy, Greeley, CO 80639; wendy.adams@unco.edu

The literature shows that pre-service elementary teachers have lower personal interest than most, if not all, other populations that have been evaluated with the CLASS instrument. This is very concerning for the future students of these teacher candidates. It is also a plausible contributor to the lack of personal interest in high school students and women since elementary teachers are predominantly female. In this talk I will present several years of data for pre-service elementary teachers at the University of Northern Colorado collected from two different courses which provides data for students in their freshman-sophomore year and again in their junior/senior years. The courses are Physical Science Concepts and Principles of Scientific Practices, a capstone course. Pre-post data will also be presented showing significant increases in personal interest of students in the capstone course which was taught using research-based practices.

EG07: 5:10-5:20 p.m. Internships in High School STEM Academies for Undergraduate Physics Majors

Contributed – Stacey L. Carpenter, University of California, Santa Barbara, 645 Riverstone Ln., Apt. 138 Oak Park, CA 91377; scarpenter@education.ucsb.edu

Danielle B. Harlow, University of California, Santa Barbara

To address the need to recruit more physics and engineering majors into teaching, a scholarship program was created at the University of California, Santa Barbara. In this program, undergraduates majoring in the physical sciences or engineering have an opportunity to "intern" in local physical science and engineering classrooms. These internships take place in the unique classroom contexts of STEM-focused academies within traditional public K-12 schools where interns are able to observe and interact with exceptional teachers. One of these academies is a project-based engineering academy with an integrated physics, visual arts/design, and engineering curriculum. The other academy includes separate courses in physics and engineering that focus on environmental issues. We are investigating how these different contexts contribute to the preparation of prospective physics teachers. Findings on the development of interns' ideas about effective physics and engineering teaching will be presented.

EG08: 5:20-5:30 p.m. Preparing Future Physics Teachers at the University of Wisconsin-La Crosse

Contributed – Jennifer L. Docktor, University of Wisconsin-La Crosse, 3809 Cliffside Drive #6, La Crosse, WI 54601; jdocktor@uwlax.edu

Gubbi Sudhakaran, University of Wisconsin-La Crosse

The University of Wisconsin-La Crosse (UW-L) Physics Department is nationally recognized as a thriving undergraduate physics program, and routinely ranks among the top producers of physics majors among bachelor's-only granting institutions. Recently, UW-L was selected as a targeted site by the Physics Teacher Education Coalition (PhysTEC) and has made focused efforts to increase the number of students pursuing careers in physics teaching. Effective practices identified include: establishing a "point person" within the physics department to advise and mentor teacher candidates and collaborate with the School of Education, fostering a departmental culture which values teaching, providing undergraduates with early experiences, and building a community of secondary education teacher candidates. This talk will include a description of these practices and additional changes which have been made to further improve pre-service physics teacher education at UW-L.

Session EH: Research Experiences for Teachers (RET)

Location: Spinnaker 1-2
Sponsor: Committee on Teacher Preparation
Co-Sponsor: Committee on Physics in High Schools
Date: Monday, January 5
Time: 3:30–4:40 p.m.

Presider: John Stewart

EH01: 3:30-4 p.m. Incorporating Summer Research Experience into the STEM Teacher Preparation Pathway

Invited – John M. Keller, Cal Poly San Luis Obispo, 1 Grand Ave., San Luis Obispo, CA 93407; jmkeller@calpoly.edu

Brian L. Paavo, Cal Poly San Luis Obispo

Since 2007, the California State University STEM Teacher and Researcher Program (STAR) has provided 425 paid summer research internships at national laboratory and campus facilities for 332 pre-service and early career science and mathematics teachers. Over nine weeks, STAR Fellows engage in mentored research projects and participate in weekly half-day workshops integrating their research experience into future classroom practice. At an annual Closing Conference, Fellows present research posters and related lesson plans aligned with the Common Core State Standards and Next Generation Science Standards. The program is open to pre-service teachers affiliated with any CSU campus or Noyce Scholar Program across the country. Partner lab sites include over 20 research facilities run by NASA, NOAA, NSF, DOE, and DOD, along with several CSU campuses and non-profit research organizations. This collaborative endeavor involving eight 100Kin10 organizations provides a powerful model for the development of "teacher-researchers" as an innovation in teacher preparation.

EH02: 4-4:30 p.m. QuarkNet: 15 Years of Teachers Contributing to International Research

Invited – Thomas Jordan, Physics Department, 225 Nieuwland Science Hall, Notre Dame, IN 46556; jordant@fnal.gov

QuarkNet* is a collaboration of physicists and physics teachers that has worked since 1999 to introduce particle physics to high school classes. The project invites teachers to collaborate with particle physicists at nearby universities. There are currently 54 universities and labs in the U.S.; each year, about 550 teachers attend summer meetings. Some of those teachers perform research and contribute to the local university's efforts on large experiments at facilities such as CERN and Fermilab. I will focus on the science research that these teachers have carried out in the 15 years of the project. It ranges from the exploration carried out in particle accelerators to the discoveries made in large sky surveys and dark energy searches.

*Supported by the National Science Foundation and the US Department of Energy.

EH03: 4:30-4:40 p.m. Physics, Astronomy & S.O.F.I.A.

Contributed – Cliff Gerstman, Middle College High School, 3325 Gondar Ave., Long Beach, CA 90808; cliffg37@verizon.net

In June of 2013, I flew into the stratosphere on the NASA plane SOFIA (Stratospheric Observatory For Infrared Astronomy.) The plane flies into the stratosphere specifically to get above the weather and the water vapor in the atmosphere. This allows her 2 meter tall telescope to see far more clearly than any view from Earth. The NASA Airborne Ambassador program was designed to give teachers a science/astronomy lesson that they could take back to the classroom and the public. After a rigorous application process I was selected and made my flight. There was much science to be seen, including astronomy, physics, and cosmology. This talk will show what project S.O.F.I.A. is all about and what we can learn from her flights.

Session EI: Remote Labs

Location: Grande Ballroom B
Sponsor: Committee on Apparatus
Date: Monday, January 5
Time: 3:30–4:10 p.m.

Presider: Yongkang Le

EI01: 3:30-4 p.m. Interactive Online Labs: Status and Outlook

Invited – Mats Selen, University of Illinois, Department of Physics, 1110 W. Green St., Urbana, IL 61801; mats@illinois.edu

We have developed an inexpensive battery-powered wireless laboratory system that allows students to do hands-on physics activities outside the classroom, guided by their own computer. The system, called IOLab, combines flexible software with a wireless data acquisition platform containing an array of sensors to sample and display real-time measurements of position, velocity, acceleration, force, rotation rate, orientation, magnetic fields, voltages, light intensity, sound intensity, pressure, and temperature. In this talk I will describe recent progress in the development of IOLab content and pedagogy for students at both College and K-12 levels, as well the latest word on manufacturing and availability.

EI02: 4-4:10 p.m. Remotely Controlled Lab on Newton's Rings

Contributed – Yongkang Le, Fudan University, Physics Department, No. 220, Handan Road, Shanghai, China; yongkangle@gmail.com

Xinyuan Wei, Jun Zhu, Fudan University, Physics department

The lab on Newton's rings is a very illustrative demo of the wave nature of light. The lab is also frequently employed in undergraduate level for the measurement of wavelength when the light speed is give or vise versa. Recently, we upgraded our apparatus of the lab on Newton's rings so that it can be remotely controlled via the Internet. Necessary modification to the apparatus will be discussed in detail.

Session EJ: Upper Division Undergraduate

Location: Grande Ballroom B
Sponsor: AAPT
Date: Monday, January 5
Time: 4:30–5 p.m.

Presider: Jan Mader

EJ01: 4:30-4:40 p.m. Developing an Upper Division Lab for Materials Discovery and Characterization

Contributed – R. D. Averitt, UC San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0014; raveritt@ucsd.edu

N. R. Dilley, S. Spagna, Quantum Design, Inc.

D. N. Basov, M. B. Maple, UC San Diego

We describe our efforts to develop a modern physics-based materials discovery and characterization laboratory. A primary course goal is to strike an appropriate balance between (i) student-initiated materials synthesis (ii) materials theory and (iii) learning the operation and methodology of modern research tools. Students form teams that develop and implement a research proposal that includes sample growth with subsequent structural analysis using x-ray diffraction and materials characterization using a Quantum Design VersaLab physical property measurement system. The VersaLab enables measurements of transport, magnetization, and specific heat from 50 to 400K using a closed system cryostat. This immersive experience fosters student creativity while providing instrumentation to follow through on independent ideas. The team effort culminates in a research paper and presentation with examples ranging from exotic materials such as heavy fermion compounds to high temperature superconductors. Learning modules based on course content are being created and will be made publicly available.

EJ02: 4:40-4:50 p.m. Non-Linear Dynamics of a Magnetically Coupled Rotor

Contributed – Satinder S. Sidhu, Washington College, 300 Washington Ave., Chestertown, MD 21620; ssidhu2@washcoll.edu

The rotary motion of a bar magnet mounted near, and parallel to, an identical second magnet exhibits interesting oscillatory behavior. The restoring torque acting on the rotating magnet is a complicated function of the angle it is rotated away from the stable equilibrium position. This function depends sensitively on the inter-magnet separation, showing two maxima separated by a trough. The rotor behaves chaotically when driven externally, with a much richer behavior than that of the extensively-studied chaotic pendulum. Experimental measurements of the static restoring torque, and of the free and driven oscillatory motions will be described, along with results of computational explorations of the dynamics.

EJ03: 4:50-5 p.m. Synthesis and Optical Magnetic Properties of Lanthanides Doped Gd2O3

Contributed – Jiawei Yan, Sun Yat-sen University, No. 135, Xingang Xi Road, Guangzhou, 510275, P. R. China; 290892615@qq.com

Chufeng Liu, Dekang Xu, Yueli Zhang, Sun Yat-sen University

Gd2O3 samples with different morphologies are obtained via thermal treatment from the precursors Gd(OH)3, which are hydrothermally prepared using different additives: Citrate acid (CA), Oleic Acid (OA) and Ethylenediaminetetraacetic acid (EDTA). XRD patterns show that the structure of the as-prepared samples are typical cubic phase with Ia-3 space group and slight differences in lattice constants: 10.8225Å (CA)?10.8114Å (OA)?10.8320Å (EDTA). SEM images show that the size of particles with different additives are 63nm (CA), 300nm (OA), 2?m (EDTA), respectively. The upconversion (UC) and magnetic properties of Gd0.78Yb0.20Ln0.02O3 (Ln = Er, Ho) were also studied. The results show that morphologies have a great impact on lanthanides doped UC luminescence intensity and paramagnetic susceptibility of Gd2O3 samples. Among them, both UC luminescence intensity and paramagnetic susceptibility of rare-earth doped Gd2O3 powders derived from EDTA additive reach the optimum values.

Session FA: Introductory Courses

Location: Nautilus Hall 1
Sponsor: AAPT
Date: Monday, January 5
Time: 7–8 p.m.

Presider: Kenneth Cecire

FA01: 7-7:10 p.m. Inquiry-based and Active Learning in the Physics Freshman Lab

Contributed – Nina Abramzon, California State Polytechnic University, Pomona, 3801 W Temple Ave., Pomona, CA 91768-4031; nabramzon@csupomona.edu

Peter B. Siegel, California State Polytechnic University, Pomona

Barbara M. Hoeling, University of Applied Sciences Landshut, Germany

This project investigates new elements of research experience introduced in the physics freshman level laboratory course. All lab experiments were re-designed in the spirit of inquiry-based learning with very short handouts and minimal lectures. Where possible, students are not told the laws of physics governing their assigned experiments, but are required to”discover and verify” them. In these labs, instructors also introduce new active learning elements, such as open-ended experiments. Students in these lab courses gain experience in the act of discovery, in which they actively learn by determining, processing, and applying the information that is important to their assigned experiments. They engage in higher-order thinking tasks such as analysis, synthesis, and evaluation. Other studies have shown that more discovery-oriented and student-active teaching methods ensure higher student motivation, more learning at higher cognitive levels, and longer retention of knowledge. The design elements will be presented in detail together with assessment of student learning and student attitudes.

FA02: 7:10-7:20 p.m. Trying to Put the "Wow" Back in the Intro Laboratory

Contributed – Mark F. Masters, IPFW, 2101 Coliseum Blvd. E, Fort Wayne, IN 46805; masters@ipfw.edu

Jacob Millspaw, IPFW

We have tried many different formats and topics in our introductory laboratories with fairly significant success at improving student learning. However, we have felt that there was something missing from the laboratory experience. What was missing was the "wow" of discovery. The process that would give students ownership of an investigation and the opportunity to make their own discoveries. For context we will present a very brief overview of our previous laboratory innovations followed by a description of our latest "experiment" on the introductory laboratory curriculum.

FA03: 7:20-7:30 p,m. Predict-Experiment-Assess Labs for Large-Enrollment General Physics Course

Contributed – Kasey Wagoner, Washington University in St. Louis, 1 Brookings Dr., St. Louis, MO 63130; kwagoner@physics.wustl.edu

Kathryn M. Hynes, Daniel Flanagan, Washington University in St. Louis

Physics labs tend to follow recipes, using equipment unfamiliar to students. Those labs lose students' attention and don't maximize instruction. We developed a series of innovative, inquiry-based labs for our large-enrollment, active-learning, introductory physics course. Using familiar objects (bicycles, Christmas lights, speakers, etc.), students answer a series of questions in three steps: predict, experiment, assess. In this series students create models, build equipment, and design their own experiments. These labs have captured the attention and piqued the natural curiosity of our students by elucidating physics in their everyday environment, providing a historical perspective, and putting each experiment in the context of a story. Pre-Lab activities introduce students to lab apparatuses while preparing them for in-lab activities. This allows more time for experiments in lab, maximizing student learning. Student and teaching assistant feedback indicates students are more engaged and leave lab with a better perceived understanding of the material.

FA04: 7:30-7:40 p.m. Is Angular Displacement a Vector Quantity?

Contributed – William A. Dittrich, Portland Community College, PO Box 19000, Portland, OR 972280; tdittric@pcc.edu

A fundamental error in the foundation of rotational kinematics and dynamics is described. All current textbooks treat angular displacement as a scalar quantity, yet the time derivative of angular displacement is suddenly a vector quantity. This fundamental violation of the mathematical laws of vector calculus is corrected by adoption of a new vector definition of angular displacement, from which all equations of rotational kinematics and dynamics can be derived while improving the symmetry between equation sets of both linear and rotational kinematics and dynamics. This preserves the vector nature of all subsequent angular quantities including angular momentum.

FA05: 7:40-7:50 p.m. Integrating the Fundamentals Principles of Physics Into the Training

Contributed – Mohammmad S. Alshahrani, TVTC- Bisha College of Technology, Bisha, Aseer 61922 Saudi Arabia; msscti@gmail.com

As one of the biggest training organizations in the Middle East, we are interested in helping Saudi youth to find job. We enroll the trainees and provide a professional learning and training environment; not just on the infrastructural level but also in the teaching and training methods that we use. As a matter of fact that most of our training programs are based on the students' need to understand some elementary physics concepts such as the electric current, torque, the rotation motion, and so forth. The goal of this paper is aimed at explaining some innovative new ideas about teaching physics in two-year colleges. It contains new technique to help the trainees to understand and practice physics better throughout their training. We integrate the training with the teaching itself to make the students feel, see, and smell the aroma of physics.

FA06: 7:50-8 p.m. Form and Function: Rube Goldberg Machines in Conceptual Physics

Contributed – Franz J. Rueckert ,Wentworth Institute of Technology, 550 Huntington Dr., Boston, MA 02115; rueckertf@wit.edu

Conceptual Physics at Wentworth Institute of Technology presents a survey of physics topics to an audience of mostly interior and industrial design majors. The goal of the course is to develop the ability of students to evaluate the form and function of their work through an understanding of general physical principles. In the past, student engagement has suffered as students struggled to relate class topics to the design fields. To better complement the practical and applied nature of these disciplines, we have recently redesigned this course to focus on project-based learning rather than traditional problem solving and calculations. As a centerpiece of the course, standard exams are replaced with the construction and presentation of novel Rube Goldberg chain-reaction machines. This provides a structure by which students can demonstrate their understanding of physics topics while highlighting their creativity and ingenuity. In this talk, we will outline the new structure of the course and detail the effect of the changes on student comprehension, retention, and engagement.

Session FB: Biophysics Labs Beyond the First Year

Location: Nautilus Hall 2
Sponsor: Committee on Laboratories
Co-Sponsor: Committee on Physics in Undergraduate Education
Date: Monday, January 5
Time: 7–8:10 p.m.

Presider: Ben Zwickl

FB01: 7-7:30 p.m. Guiding the Transition: Biophysics Laboratory on Research Design and Implementation

Invited – Philbert S. Tsai, University of California, San Diego, 9500 Gilman Dr., La Jolla, CA 92093-0374; ptsai@physics.ucsd.edu

David Kleinfeld, University of California, San Diego

We present the design and implementation of a laboratory course for physics/biophysics seniors and first-year physics and biology graduate students. This hands-on course is based on table-top exercises and quarter-long projects across a broad spectrum of biophysical topics including fluorescence microscopy, pulsed nuclear magnetic resonance, electromyographic recording, two-photon and second-harmonic scanning microscopy, microbial growth, fly olfaction, and visual encoding on the fly. Students are encouraged to select a project for which they have little or no previous experience. No formal instruction manual is available for the student projects. Instead, students are given access to the final reports of previous students and guided in performing literature searches for background and experimental details. Equipment manuals are provided. An emphasis is placed on teaching students to design, implement, and troubleshoot their own variants of a project. The course therefore serves to transition students from manual-based experimentation to independent research projects.

FB02: 7:30-8 p.m. Tethered Particle Motion with Single DNA Molecules

Invited – Allen Price, Emmanuel College, 400 The Fenway, Boston, MA 02115; priceal@emmanuel.edu

I will present a method for measuring the Brownian motion of microbeads tethered to surfaces by individual DNAs. The data can be used to test models of tethered particle motion and to determine the spring constant of the DNA. The method is suitable for integration into upper-division undergraduate physics or biology labs. In the method, modified Lambda DNAs are attached to functionalized glass coverslips and tethered to commercially available microbeads. Capillary action is used to load samples into a sample cell and data is collected using a webcam mounted on an upright microscope. Video data can be tracked manually using freely available software and analyzed in a number of ways. Sample lab protocols and material lists are available.

FB03: 8-8:10 p.m. Radar Systems for Biometric Experiments in Advanced Labs

Contributed – Douglas T. Petkie, Wright State University, 248 Fawcett Hall, Dayton, OH 45435; doug.petkie@wright.edu

There are several commercial radar sensor modules in the 24-35 GHz region that we have used for both undergraduate research projects and for an advanced laboratory course. These simple modules provide a powerful capability to combine electronics, data acquisition, signal processing, optics, and electromagnetic topics to explore any one of a number of physics-based applications that include biometric sensing. The continuous-wave homodyne I/Q architecture of these radar modules allow Doppler signatures to be measured to sense displacement, physiological signatures, such as heart beat and respiration rates, and micro-Doppler signatures to study intricate dynamical systems, such as human gait. We will describe a series of systems and experiments that have been performed that incorporate these topics.

Session FC: Video Update – Advanced Video Techniques

Location: Nautilus Hall 3
Sponsor: Committee on Educational Technologies
Co-Sponsor: Committee on Apparatus
Date: Monday, January 5
Time: 7–8:30 p.m.

Presider: David Maiullo

FC01: 7-7:30 p.m. Beyond Your Camcorder and Other Consumer Video Hardware

Invited – Samuel Sampere, Syracuse University, Department of Physics/201 Physics Building, Syracuse, NY 13244; smsamper@syr.edu

Video technology is advancing rapidly. What was possible only in research labs just a few years ago is becoming almost typical classroom technology today. As instructors are venturing into new teaching strategies such as flipped classrooms, MOOCS, etc., utilizing these new tools can be a great asset. I will discuss relevant video techniques, the physics behind them, and various ways to incorporate them in your classroom, website, or You Tube presentation.

FC02: 7:30-8 p.m. InfraRed Experiments Made Awesome – for HS and College

Invited – James Lincoln, PhysicsVideos.net 2231, Vista Huerta, Newport Beach, CA 92660; James@PhysicsVideos.net

It's time that Infrared Light stopped being invisible! In this talk I outline video and experimental techniques that will make Infrared Light as real as visible light. I will address Near, Far, and Intermediate IR Light and vividly demonstrate several video and photographic techniques that you can replicate. Many of these demos are original, to be seen nowhere else! Special attention is paid to interactive engagement, direct measurements, and practical demos for both the beginner and the advanced physics instructor.

FC03: 8-8:10 p.m. Creating Screencasts

Contributed – Paul G. Hewitt, City College of San Francisco, 300 Beach Drive NE, #302, St. Petersburg, FL 33701; pghewitt@aol.com

I'll discuss my learning curve in creating Hewitt-drew-it screencasts using a Wacom tablet with the ScreenFlow program, and my wife Lil's assistance in polishing them. I'll show a sample cast.

FC04: 8:10-8:20 p.m. Screencasts and Video Tutorials for Online and Face-to-Face Classes

Contributed – Kate E. Dellenbusch, Bowling Green State University, 104 Overman Hall, Bowling Green, OH 43403-0001; dellenk@bgsu.edu

With the increasing emphasis many colleges and universities are placing on distance learning, how can we make our online physics courses more engaging and effective for our students? A first step is to enhance simple narrated PowerPoint lecture recordings. Through the use of technologies such as screencasting software and graphics tablets, more diverse and engaging lectures and video tutorials can be created. These same technologies can also be used in more traditional face-to-face courses to supplement and expand upon what is already being done in the classroom. Strategies for making screencast videos will be discussed.

FC05: 8:20-8:30 p.m. The Effect of Online Lecture on Persistence in a Physics Class

Contributed – John C. Stewart, West Virginia University, 140 Waitman St., Morgantown, WV 26501 United States johns@UARK.EDU

This talk will examine the difference in the rate students successfully complete a physics class between students attending lecture in person and students choosing to watch the lecture on video as part of an online class. The option to watch the lecture on video was implemented mid-semester in fall 2012 so that the performance of the same set of students could be compared. A fully online lecture section was introduced in spring 2013, but students were allowed to select the lecture viewing option. The online lecture section was continued in the fall 2013 and spring 2014 semesters; however, students were no longer allowed the choice of lecture viewing option. Higher than expect withdrawal rates have been experienced in the online sections of the class. These will be examined in the context of the historical performance of the class and the differences in engagement in the class measured by the rate at which students submit required assignments.

Session FD: Recruiting & Facilitating Alternative Certification of Teachers

Location: Nautilus Hall 4
Sponsor: Committee on Teacher Preparation
Co-Sponsor: Committee on Physics in High Schools
Date: Monday, January 5
Time: 7–8:30 p.m.

Presider: Kris Whelan

FD01: 7-7:30 p.m. Helping Scientists Become Teachers: This Distance Education Program Delivers!

Invited – Robert N. Carson, Montana State University, 249 Reid Hall, Bozeman, MT 59717-2000; rcarson@montana.edu*

The Northern Plains Transition to Teaching program (NPTT) evolved from the nexus of two major challenges -- providing an exceptionally rich preparation and licensure program to increasing numbers of non-traditional learners, and creating a source of highly qualified teachers for the small, isolated schools in the vast rural areas we serve. Ensuring high quality and rigor for an audience of advanced learners meant creating entirely new course and program structures, and developing new strategies for the practica, supervision, and performance assessments at a distance. NPTT now serves as a model for advancing the quality and structure of teacher preparation for working professionals who are already qualified in their subject matter. Find out why this might be a surprisingly robust response to the shortage of qualified math and science teachers, and why this program attracts an international clientele.

*Sponsored by David Hembroff

FD02: 7:30-8 p.m. Alternative Teacher Certification: A Personal Account

Invited – David W. Hembroff, Stillwater Christian School, 255 FFA Dr., Kalispell, MT 59901; dhembroff@scscougars.org

Adults who want to become teachers have often been required to quit their jobs and go back to college in order to become qualified to teach in the public school classroom. They often find themselves sitting in classrooms with 20-somethings who forgot to do their homework. The curriculum is at an undergraduate level, and traditional teacher education has a significant task of helping young people grow up enough to become responsible for the education of other people's children. This is a poor fit for mature adults who have already acquired high levels of professionalism, personal responsibility, academic achievement, and work-related experience. This presentation explores the path of one high school teacher in his transition from one profession into the world of teaching--the options available and experiences in the certification program. The presentation will also look at the challenges faced moving from industry into the high school classroom.

FD03: 8-8:10 p.m. Physical Science PD: An In-Road for HS Physics Certification*

Contributed – Steven J. Maier, NWOSU, 709 Oklahoma Blvd., Alva, OK 73717-2799; sjmaier@nwosu.edu

One way to increase the number of teachers certified to teach physics statewide is to recruit from the pool of already certified in-service teachers. NWOSU's ToPPS program has offered Oklahoma teachers professional development opportunities in physical science since 2011. As a result, a network of Oklahoma physics and physical science teachers has grown, and some of these participants have become certified to teach HS physics. The successes of the ToPPS program will be shared along with challenges, outlook and goals for the future.

*The NWOSU ToPPS program is supported by the ESEA Title II state grant program through the Oklahoma State Regents for Higher Education (OSRHE)

Session FE: MOOCs as Outreach, Moving Towards MOOO

Location: Nautilus Hall 5
Sponsor: Committee on Science Education for the Public
Co-Sponsor: Committee on Educational Technologies
Date: Monday, January 5
Time: 7–8 p.m.

Presider: Jan Mader

FE01: 7-7:30 p.m. Superheros and Complexity: Two Examples of MOOCs as Outreach

Invited – Michael Dennin, UC Irvine, 4129 Frederick Reines Hall, Irvine, CA 92697-4575; mdennin@uci.edu

Developments in online technology for teaching have led to a wide range of experiments. Among those that have received the most press are Massive Online Open Courses (MOOCs). MOOCs attempt to provide an educational experience to 10,000 or more people. Two challenges for MOOCs are establishing any reasonable model for course credit or making money. Having been involved in both MOOCs and more simple OpenCourseWare courses (where there is no attempt at course credit or money), there is strong evidence that MOOCs are really best suited as outreach vehicles instead of classes. In this presentation, I will discuss two past experiences with MOOCs (one on superheroes and one on zombies), both of which are better described a outreach, and a planned MOOO (Massive Online Open Outreach) on complexity. I will discuss issues related to the effort to create these vehicles and their expected impact.

FE02: 7:30-7:40 p.m. Educating Educators with edX: How Will MOOCs Impact Teaching?

Contributed – Daniel T. Seaton, Davidson College, Campus Box 7198, Davidson, NC 28035; dseaton@gmail.com

Cody A. Coleman, MIT

Julie P. Goff, Davidson College

Patrick A. Sellers

Aaron M. Houck, Davidson College

Massive Open Online Courses (MOOCs) can be conceptualized as public-facing education that provides opportunities to better share and manage content for a variety of educators and institutions. However, the impact on current teaching practices around the world is still unclear, particularly since the majority of MOOC providers are still focused solely on delivering content through a student-centric user experience. Surveys addressing teacher enrollment in 10 spring MIT MOOCs provide evidence that attention should perhaps also be given to teachers, where nearly 1 in 10 (9%) respondents identify as being a current teacher. Offering alternative user experiences for teachers could potentially accelerate sharing or reuse of content and pedagogy. Such possibilities will be discussed in terms of the Davidson Next project at Davidson College, which is providing Advanced Placement modules to high school teachers within the edX platform. This presentation will discuss both the development and deployment of Davidson Next as an alternative model for impacting students and teachers using the edX MOOC platform.

FE04: 7:50-8 p.m. 8.05x: a MOOC for Undergraduate Intermediate Quantum Mechanics

Contributed – Saif Rayyan, MIT, 77 Massachusetts Ave - Room 8-310, Cambridge, MA 02139-4307; srayyan@mit.edu

Barton Zwiebach, MIT

The physics department at MIT will be offering a MOOC: "8.05x, Mastering Quantum Mechanics" starting on Feb. 10, 2015. The course follows the syllabus of MIT residential Quantum Mechanics II (8.05) course; the second of a series of three courses in Quantum Mechanics offered to physics majors. The course features video lectures and notes by Professor Barton Zwiebach. Homework assignments and exams are transformed into a machine gradable format using the tools of the edX platform. A discussion forum offers the opportunity to collaborate with others in the course, and interact with Professor Zwiebach and TAs from MIT. Part of our target audience are undergraduate physics students looking to deepen their understanding of quantum mechanics by taking a course that may not be available at their home institutions. The course will also be open to MIT students for credit during the off-semester when the residential version is not usually offered.

Poster Session 2

Location: Grande Ballroom A
Sponsor: AAPT
Date: Monday, January 5
Time: 8:30–10 p.m.

Persons with odd-numbered posters will present their posters from 8:30–9:15 p.m.; even-numbered will present 9:15–10 p.m.

Pre-College, Informal and Outreach

PST2A01: 8:30-9:15 p.m. Chespirito's Characters Helping Physics Learning

Poster – Mario Humberto Ramirez Diaz, CICATA-IPN, Av. Legaria 694, Col. irrigación Mexico, MEX 11500 México; mramirezd@ipn.mx

Luís Antonio García Trujillo, Universidad Autónoma de Coahuila

Eduardo Chávez, Lima ESCOM-IPN

In Latin America, especially in Mexico since the '70s, the kids have fun with the characters created by Chespirito. An anti-hero like "Chapulin Colorado" or the adventures of a little boy "El Chavo del 8" provides fun for several generations. On the other hand, it is common in the last years to use superheroes or action movie characters to try to teach science, however these kind of personages have no relationship with the Latin America region. In this work we want to show the use of Chespirito's characters to present some themes of physics, for example waves and sound with the "Chicharra paralizadora" of Chapulin Colorado or equilibrium with the plays of Chavo del 8. The objective is showing to the kids some phenomena in a friendly form like a first step to introduce them to the physics themes.

PST2A02: 9:15-10 p.m. IYPT and USIYPT – Physics Contests for High School Students

Poster – Donald G. Franklin,Spelman College/Penfield College of Mercer University, 39 West Main St., Hampton, GA 30228; dgfrank1@aol.com

The International Young Physicists Tournament will be held June 27-July 3 in Nakhon Ratchasima, Thailand. One team can represent a country. I would like to see the U.S. develop a contest to select a team to compete each year. The USIYPT will be held at Woodberry Forest School, Woodberry Forest, VA. The dates are Jan. 30-31, 2015. This contest was designed for U.S. schools, but International school can also attend. Check both websites for more information on questions and information.

Lecture/Classroom

PST2B01: 8:30-9:15 p.m. Analysis of Classroom Demonstrations: Newton's Cradle and Bouncing Stacked Balls

Poster – Michael B. Ottinger, Missouri Western State University, 4525 Downs Dr., St Joseph, MO 64507; ottinger@missouriwestern.edu

Newton's Cradle and Bouncing Stacked Balls are frequently used to demonstrate conservation laws in elastic collisions. However, student and instructor misconceptions lead to misinterpretation of the demonstrations. For example, in Newton's Cradle when two balls are pulled back, released, and allowed to collide with the remaining balls, two balls exit on the opposite end. This is frequently explained as "the only way to conserve both energy and momentum." That is not totally accurate. The same result does not occur when the two initial balls are replaced with a single ball of twice the mass, even though the initial momentum and energy remain the same. This poster provides a quantitative explanation of Newton's Cradle including a demonstration using multiple low-friction carts. A similar analysis is also presented for the Bouncing Stacked Balls demonstration.

PST2B02: 9:15-10 p.m. Analyzing How Internal and External Factors Affect Student Attention

Poster – David Rosengrant, Kennesaw State University, Science Building, 370 Paulding Ave., Kennesaw, GA 30144; drosengr@kennesaw.edu

Amanda Burke, Kennesaw State University

In this study we investigate the gaze patterns of undergraduate college students attending a lecture-based physical science class to better understand student attention during class with the help of an eye-tracker. These students are elementary education majors and were selected based on the following factors: age, gender and G.P.A. Once the class ended, we were able to analyze other student factors such as location in the classroom, grade earned in the class, how they took their notes and material that the instructor covered at the time. We then placed each student into a group for each factor (those sitting in the front of the room versus those in the back of the room for example) and compared how long they spent on task (looking at board, notes, instructor, discussion partner) in each category with the time spent off task (focusing on other students, other peoples computers, etc.).

PST2B03: 8:30-9:15 p.m. Early Investigations Gauging Effects of Classroom Design on Learning Outcomes

Poster – Eric Mandell, Bowling Green State University, 3206 Penrose Ave., Toledo, OH 43614-5338; meric@bgsu.edu

Glenn Tiede, Kate E Dellenbusch, Bowling Green State University

As active-learning activities have become more common, institutions have invested in the redesign of many learning spaces, replacing the traditional chalkboards and row upon row of desks with whiteboards, huddleboards, smartboards, and a variety of table and seating arrangements. Introductory college physics classes were used to investigate the effect that the learning space itself might have on course learning outcomes. Some students met for recitation in an older, traditional-style classroom with a blackboard and rows of desks, while others met in a newly constructed active-learning classroom equipped with circular tables, whiteboards, and huddleboards. Both groups performed the same active-learning activities throughout the semester. Here, we measure student performance through coursework, conceptual gains using tests such as the FCI and EMCS, and survey student attitude in an effort to better understand the effect of the learning space on students.

PST2B04: 9:15-10 p.m. Just In Time Teaching in Large Physical Science Classes

Poster – Jean-Francois Van Huele, Brigham Young University, N151 ESC BYU, Provo, UT 84602-4681; vanhuele@byu.edu

We illustrate how Just in Time Teaching can enhance the experience of students and instructor in a large General Education Physical Science class, with examples of assignments, instructor feedback, and student feedback on the feedback.

PST2B05: 8:30-9:15 p.m. Modernizing Modern Physics

Poster – Hai Nguyen, University of Mary Washington, Physics Department, 1301 College Ave., Fredericksburg, VA 22401-5358; hnguyen@umw.edu

Modern Physics is a gateway course for physics majors. However, because modern physics concepts were never introduced in K-12 education, students taking modern physics after their first year of introductory physics often have misconceptions and confusions on the fundamental knowledge, practicality and relevancy of relativity and quantum mechanics. To reflect the ever changing nature of "modern" physics in the 21st century and its relevancy, new concepts and applications such as Bose Einstein Condensations, Higgs Bosons, and Satellite Atomic Clocks were introduced into the curriculum. We present learning opportunities, practical challenges, and assessment outcomes of these changes to the modern physics course at the University of Mary Washington.

PST2B06: 9:15-10 p.m. The Physics of Smartphone Sensors

Poster – Al J. Adams, University of Arkansas at Little Rock, 2801 South University Ave., Little Rock, AR 72204-1099; ajadams@ualr.edu

The principles we teach in physics are embodied in all modern technology, perhaps none so abundantly as in the smartphone. In addition to the basic communication functions requiring radiowave and acoustic transceivers, the smartphone is literally packed full of sensors, most of which measure physical parameters which make possible useful applications. Examples of sensors include acceleration, rotation, magnetic field, light, and even the presence of the human body near the display. Ambient environmental parameters including temperature, atmospheric pressure, and humidity are also being seriously considered for future implementation. This presentation will identify the physics which underpins many of the sensors found in smartphones. It will relate the physics to the physical structure and function of the actual sensors within the phone. It will suggest ways to introduce these sensors into the relevant topics within the introductory and advanced courses of our curriculum, and present several examples of introductory laboratories which help to reveal the physical principles behind smartphone sensors.

PST2B07: 8:30-9:15 p.m. Using Clickers for Active Learning in Small-to-medium-sized (30-50 students) Classes

Poster – Naresh Sen, California Polytechnic State University (Cal Poly,) 1 Grand Ave., Department of Physics, San Luis Obispo, CA 93407; nsen1343@gmail.com

Physics education research (PER) shows that student understanding of concepts is enhanced when students are actively engaged in the classroom. In the classroom, student engagement can be facilitated by positing conceptual questions that students discuss in small groups and respond individually using “clickers.” A common setting in which clickers are used is large-enrollment courses, typically more than 100 students. However, clickers can be used just as effectively in smaller classes with 30-50 students. This poster discusses the author’s use of clickers in introductory physics courses in such small classes. Examples of student response histograms show that even in these classes, clickers can be used effectively to get students engaged and to serve as launching pads for extended discussions when appropriate. Thus, clickers can be effective in classes of almost all sizes that are typical of introductory physics courses at most educational institutions.

PST2B08: 8:30-9:15 p.m. Active Engagement Materials for Nuclear and Particle Physics Courses

Poster – Jeff Loats, Metropolitan State University of Denver, Physics Department, CB 69 1201 5th St., Denver, CO 80212; jeff.loats@gmail.com

Ken Krane, Oregon State University

Cindy Schwarz, Vassar College

20+ years of Physics Education Research has yielded a variety of research-based instructional strategies for use in introductory courses. Putting those techniques to use in upper-division courses presents a time and energy barrier that is daunting to most physics faculty. In this NSF-TUES grant we have developed hundreds of active engagement items for nuclear and particle physics in a handful of categories. These materials are currently being tested and reviewed. We will present examples of these materials, including: a) Conceptual discussion questions for use with Peer Instruction; b) warm-up questions for use with Just in Time Teaching, c) ‘Back of the Envelope’ estimation questions and small-group case studies that will incorporate use of nuclear and particle databases, as well as d) conceptual exam questions. Visit bit.ly/subatomicgrant to see our materials or get in contact.

PST2B09: 9:15-10 p.m. Using Narratives to Enhance Critical Thinking Skills in Introductory Classes

Poster – William L. Schmidt, Meredith College, 3800 Hillsborough St., Raleigh, NC 27607-5298; schmidtw@meredith.edu

Kathleen Foote, North Carolina State University

Studies in the past few decades have shown that traditional methods of problem solving may not be the best approach for developing problem-solving skills and critical thinking in introductory physics courses. To develop critical thinking and communication skills necessary for problem solving, we had students write multiple narratives over the course of the semester, describing in detail how they solve complex real-world problems. The narratives require students to think critically about the problem-solving process and “tell a story” about each problem in their own words. Sophistication of the narratives was compared during the semester to investigate development of critical thinking skills. We administered the CLASS as an epistemological pre- and post- assessment tool to investigate attitudes and approaches to problem solving. Emphasizing the problem-solving story in conjunction with the final answer puts students at a higher level of problem-solving accountability and mastery.

Labs/Apparatus

PST2C01: 8:30-9:15 p.m. Refractive Index of Transparent Substances Using a Home Tool: The Laser Meter

Poster – Romulo Ochoa, The College of New Jersey, 2000 Pennington Rd., Ewing, NJ 08628; ochoa@tcnj.edu

Richard Fiorillo, Cris R. Ochoa, The College of New Jersey

Laser distance meters can be purchased at hardware stores or online for under $100. They are commonly used in home improvement projects. Although intended to measure distances, we have adapted them to measure index of refraction of liquids and transparent solids. The laser meter uses the accepted value of the speed of light in vacuum to determine distances based on the phase shift between an internal reference and an outgoing beam that is reflected back to the device. Given that light slows through media, such as water or glass, the laser meter is “tricked” into displaying a longer apparent distance when measuring a length of a transparent material as compared to the same length of air. A simple ratio of the two distances results in the index of refraction of the substance. Measured values for sugar solutions and glasses are in excellent agreement with accepted values for these substances.

PST2C02: 9:15-10 p.m. A Low-Cost Arduino-Compatible Instrument for Resonance Studies

Poster – Jeffrey R. Groff, Shepherd University, PO Box 5000, Shepherdstown, WV 25443-5000; jgroff@shepherd.edu

Sytil Murphy Shepherd University

An Arduino-compatible microcontroller with an on-board timer configured to generate audio-frequency square waves provides a low-cost alternative to a function generator for driving a speaker for resonance experiments. The hardware and software components of this apparatus are described, and the apparatus is demonstrated by calculating the speed of sound via a study of resonance in an air column. In addition, data from a lab for non-science majors using this system is presented.

PST2C04: 9:15-10 p.m. Magic Eggs: Magnetism at Any Level of Sophistication

Poster – Martin G. Connors, Athabasca University 11560 80 Avenue Edmonton, AB T6G 0R9 Canada martinc@athabascau.ca

Mark Freeman, University of Alberta

Farook Al-Shamali, Athabasca University

Brian Martin, King’s University

The concept of a dipole field is of basic importance in electromagnetism, but poses conceptual difficulties for students, which may in particular underlie the difficulties in teaching about magnetism. “Magic Eggs” are strongly magnetized, cm-scale spheres often sold as toys. At a low level of sophistication, they allow exploration of many aspects of magnetism, including the ideas of attraction and poles. With progressing levels of knowledge of physics, they can help illuminate concepts ranging from the nature of fields in space to the properties of magnetic materials. A uniformly magnetized sphere has the external field of an ideal dipole despite being a macroscopic object. Quantitative measurements that are easily done with inexpensive apparatus allow a link to be made between theory and measurement that is particularly instructive and satisfying.

PST2C05: 8:30-9:15 p.m. "Bullet Time" for K-12 Outreach

Poster – Larry Engelhardt, Francis Marion University, PO Box 100547, Florence, SC 29501-0547; lengelhardt@fmarion.edu

Ray A. Freeman, Francis Marion University

Our SPS group is building and programming a "bullet time" apparatus for use in outreach activities with local high school students. This is the effect that was made famous in the movie "The Matrix," wherein time freezes while a camera pans around a scene. We are achieving this using programmable "Raspberry Pi" computer boards, as described at Ref. 1. We will discuss what we have done and what we have planned for the future.

1. http://pifacedigital.wordpress.com/2013/12/06/bullet-time-effect-frozen-pi/

PST2C06: 9:15-10 p.m. Strategies for Assessing Student Laboratory Skills within the Physics Program.

Poster – Steven C. Sahyun, University of Wisconsin - Whitewater, Upham Hall, Whitewater, WI 53190-1319[sahyuns@uww.edu

Jalal Nawash, Paul Rybski, Ozgur Yavuzcetin, University of Wisconsin-Whitewater

The purpose of this project was to develop an initial assessment program to evaluate student laboratory skills across the physics program at the University of Wisconsin-Whitewater. A UW-Whitewater physics faculty team met in 2014 to develop a method for assessing student proficiency at laboratory skills fundamental to all of our laboratory courses. The overarching theme was that students should be able to set up equipment to Acquire some "signal," Analyze data related to the signal, and Assimilate the results into their understanding by communicating results in a manner consistent with departmental goals. We are calling the evaluation of students' ability for Acquisition, Analysis and Assimilation as our "AAA" activities. This poster will discuss the series of embedded AAA activities and checklist type rubric evaluations for our laboratory courses that were developed to assess student proficiency in these fundamental skills.

PST2C07: 8:30-9:15 p.m. PSoC-ing the Laboratory

Poster – Mark F. Masters, IPFW, 2101 Coliesum Blvd. E, Fort Wayne, IN 46805; masters@ipfw.edu

A PSoC is a programmable system on a chip made by Cypress Semiconductor. In particular, we will be describing various uses of the PSoC 4. The PSoC is a 32 bit Arm microcontroller with some analog capabilities. While not as flexible as the PSoC 1, 3 or 5 for mixed signal processing, Cypress has just released the CY8CKIT-049. This is a developer kit for the PSoC 4 that costs only $4 and plugs directly into your USB port for programming. It is very flexible and quite powerful. We present a number of uses we have found for PSoC 4s and for the dev kit as well.

PST2C08: 9:15-10 p.m. Trying to Keep the Intro Lab from Being Mind-numbingly Boring

Poster – Mark F. Masters, IPFW, 2101 Coliseum Blvd. E, Fort Wayne, IN 46805; masters@ipfw.edu

Often times, the introductory laboratories become incredibly tedious for the students and the instructor. Even though we have had very successful laboratories (as measured by student learning), we have felt that the labs do not excite students. Therefore, we wanted to develop a laboratory that would get the students much more engaged in physics and mirror scientific experience. Our hopes were that this would be less boring. This poster will describe our most recent introductory laboratory innovation and some of our measures of success (or failure).

Teacher Training/Enhancement

PST2D01: 8-9:15 p.m. A Table of Specifications for a Physics Teaching PCK Instrument

Poster – Alyssa Pauli, SUNY Buffalo State College, Physics SCIE462 1300, Buffalo, NY 14222; adcede19@gmail.com

Dan L MacIsaac, SUNY Buffalo State College Physics

As part of my graduate project in physics education, I am conducting a literature review and survey preparing a Table of Specifications for a possible instrument that could eventually assess the Pedagogical Content Knowledge (PCK) of HS physics teachers. This instrument might inform physics teacher candidate preparation or physics teacher professional development. For example, most introductory HS physics content includes significant mechanics, kinematics, some electrostatics, circuits, waves, sound and optics, so new teachers should know something about common student conceptual difficulties associated with these topics (like Aristotelian physics, confuting position, velocity and acceleration; graph reading, centripetal acceleration direction) as well as touchstone pedagogical measurements and activities (FCI and FMCE; developing kinematics equations from the motion of battery operated toys) and something of research-based introductory curricula. As part of my presentation I am seeking feedback and nominations of possible physics PCK topics for HS teachers (or specifications or even possible items).

PST2D02: 9:15-10 p.m. Developing PCK in Physics Teachers: Collaboration Between Scientist and Educator

Poster – William A. Stoll, Georgia State University, 2232 Dunseath Ave., NW #310, Atlanta, GA 30318; wstoll2@student.gsu.edu

Brian D. Thoms, Kadir Demir, Sumith Doluweera, Georgia State University

Brett Criswell University of Kentucky

Effective pedagogical content knowledge (PCK) integrating the expertise of physics content knowledge with pedagogical methods is a challenge in pre-service science teacher preparation. A unique physics class designed to develop pre-service teachers' PCK focused on facilitating deep conceptual understanding in high-school physics students is the focus of this presentation. The course collaboratively developed and co-taught by physics and science education faculty integrated physics content with a conceptual change pedagogy in a modeled environment. In addition, the course was designed around providing students a practical teaching component -- leading mini-lessons in a SCALE-UP undergraduate physics class. First year results show the teacher candidates exhibiting a growing awareness of the important role students' ideas play in the teaching and learning of physics; an increase in both their physics conceptual knowledge and their confidence in understanding of physics; but limited confidence in applying teaching for conceptual change.

PST2D03: 8:30-9:15 p.m. Action Research and Design-based Research for Physics Teacher Preparation: A Literature Review

Poster – Joseph T. Heimburger, SUNY Buffalo State College, Physics SCIE462, 1300 Elmwood Ave., Buffalo, NY 14222; jtheimburger@gmail.com

Dan L. MacIsaac, SUNY Buffalo State College, Physics

We describe a literature review of Design Based Research and Action Research used for the preparation and development of physics teachers. AR projects have been widely used in the US for teacher development, notably by physics teachers enrolled at Arizona State University. This review was prepared to inform and guide an initiative creating a Transatlantic Design Based Research / Action Research Network for physics teacher preparation in German and U.S. schools. Authors will undertake DBR/AR projects with German physics teaching students during spring of 2015.

PST2D04: 9:15-10 p.m. Physics and the Berkeley Engineering Research Experiences for Teachers (BERET)

Poster – Benedikt W. Harrer, University of California, Berkeley, 469 Evans Hall, Berkeley, CA 94720; harrer@berkeley.edu

Elisa M. Stone, University of California, Berkeley

With the widespread adoption of the Next Generation Science Standards, engineering has moved into the center of K-12 science instruction. However, many science teachers are not well prepared to take on the challenge of engaging their students in authentic engineering practices. The Berkeley Engineering Research Experiences for Teachers (BERET) program provides pre- and in-service teachers with summer research fellowships and guides them to develop and teach lessons that connect engineering research to K-12 science and mathematics curricula in the classroom. We present the experiences of pre- and in-service physics teacher pairs in their respective research laboratory placements.

PST2D05: 8:30-9:15 p.m. Lessons From an Integrated Engineering & Physics Summer Course for K-12 Teachers

Poster – Dan L. MacIsaac, SUNY Buffalo State College, Physics 462 SCIE, 1300 Elmwood Ave., Buffalo, NY 14222; danmacisaac@mac.com

Kathleen A. Falconer, David S. Abbott, SUNY Buffalo State College Physics

Bradley F. Gearhart, SUNY, Buffalo Learning and Instruction

Joseph Zawicki, SUNY Buffalo State College Earth Science and Science Education

Since 2012 we have been developing and offering summer workshop courses integrating physics and engineering content following NGSS guidelines for K-12 teachers from a struggling LEA as part of an NSF-funded Math Science Partnership called ISEP (Integrated Science and Engineering Partnership). We describe the curriculum evolution to date, demographics of enrolled teachers and teachers aides, participant work samples and pre-post evaluation of participant efficacy and content knowledge. Comparisons to other teacher and education professional populations will also be presented, together with interpretations and lessons learned.

PST2D06: 9:15-10 p.m. PET, PSET, and LPS Will Become NextGen-PET

Poster – Fred M. Goldberg, San Diego State University, CRMSE, San Diego, CA 92120; fgoldberg@mail.sdsu.edu

Steve Robinson, Tennessee Technological University

Ed Price California, State University at San Carlos

Danielle B. Harlow, University of California at Santa Barbara

Julie Andrew, University of Colorado at Boulder

Michael McKean, San Diego State University

For instructors who have taught using PET*, PSET* or LPS*, or for those who have not, this poster provides information about a new set of robust and flexible curriculum materials that build on the previous curricula, and are more explicitly aligned with the science and engineering practices and physical science core ideas of the Next Generation Science Standards. The Next Generation PET curricula consists of modules that focus on: (1) developing models for magnetism and static electricity; (2) energy; (3) forces; (4) waves; (5) matter and interactions; and (6) teaching and learning physical science. All or a subset of these modules could serve the needs of instructors and students in small-enrollment physics or physical science courses for prospective elementary or middle school teachers, large-enrollment general education courses, science methods courses, or workshops for in-service teachers. An extensive set of online tutorial-style homework assignments accompanies the printed materials.

**Physics and Everyday Thinking, Physical Science and Everyday Thinking*, and *Learning Physical Science* are all published by It?s About Time, Mount Kisco, NY.

PST2D08: 9:15-10 p.m. Social Context in a Physics Class for Future Elementary Teachers*

Poster – Claudia Fracchiolla, Kansas State University, 116 Cardwell Hall, Manhattan, KS 66506; fracchiollac@ksu.edu

N. Sanjay Rebello, Kansas State Univrsity

We investigate how the pedagogy and tools utilized in a class affects students' attitudes towards science. There has been research on the self-determination theory and its impact on learning. In a physics class for future elementary teachers we have incorporated tools that allow students to express themselves and engage with other students in the class to make them feel more integrated into the classroom community. Typically students in this class have been known to be apprehensive about physics. We describe the extent to which the class pedagogy and tools creates an environment where students feel more comfortable expressing their ideas and transforms their negative attitudes toward physics and science into a positive experience.

*Supported in part by NSF grant 1140855.

PST2D09: 8:30-9:15 p.m. Physics by Inquiry Programs for Grades K-5 and 5-12 Teachers*

Poster – Robert J. Endorf, University of Cincinnati, Department of Physics, Cincinnati, OH 45221; robert.endorf@uc.edu

Don Axe, Amy Girkin, Kathleen M. Koenig, Jeffrey Radloff, University of Cincinnati

We describe and evaluate the effectiveness of the Physical Science by Inquiry professional development programs that we have been conducting at the University of Cincinnati for teachers in grades K-5 and grades 5-12 every year since 1996. Separate graduate courses in Physics by Inquiry are offered each summer for teachers in grades 5-12 and for teachers in grades K-5 with follow-up academic-year seminars. The courses use modules from Physics by Inquiry[1] developed by Lillian McDermott and the Physics Education Group at the University of Washington. Data will be presented from pretests and posttests taken by the participants that illustrate large gains in the teachers' science content knowledge, science process skills, and confidence in being able to prepare and teach inquiry-based science lessons.

* Supported by The Improving Teacher Quality Program administered by the Ohio Board of Regents.

1. L.C. McDermott and the Physics Education Group at the University of Washington, *Physics by Inquiry,* John Wiley & Sons (1996).

PST2D10: 9:15-10 p.m. Project-based Instruction and Foundations in STEM

Poster – Joel C. Berlinghieri, The Citadel, Department of Physics, Grimsley Hall, Charleston, SC 29409; berlinghieri@citadel.edu

Lisa A. Zuraw, The Citadel, Department of Chemestry

Chrysoula Malogianni, The Citadel, STEM Center

The Master of Education in Interdisciplinary STEM Education at The Citadel is designed for current educators and others who seek to advance their skills in the STEM disciplines. The online program facilitates an appreciation of the interdisciplinary nature of STEM, a deeper knowledge of STEM content, and the use of a project-based approach for the teaching and learning of STEM content. Graduate students entering the program are exposed to physics, chemistry, biology, mathematics, and engineering/technology content through project-based instruction. Since student applicants come with a variety of science or engineering backgrounds two Foundation Courses are designed to even out content knowledge and preparation for other courses in the degree program. Presented here will be the project-based approach for covering content in physics, chemistry, and biology in the Foundations in STEM I course along with the challenges of an online course environment.

PST2D11: 8:30-9:15 p.m. The OK PhysTEC Collaborative*

Poster – Steven J. Maier, NWOSU, 709 Oklahoma Blvd., Alva, OK 73717-2799; sjmaier@nwosu.edu

Jenny Sattler, NWOSU

Kristen Baum, OSU

Karen Williams, ECU

Brian Campbell, SWOSU

The OK PhysTEC Collaborative is a statewide effort to recruit HS and undergraduate students into HS physics certification programs among Oklahoma institutions. Efforts to achieve the goals of the program include a statewide marketing campaign, shared colloquia speakers, travel to high schools, support for HS teachers/advisors and higher education program collaborations. Currently, members of the collaborative include NWOSU, ECU, OSU and SWOSU. Funding for the program began in the fall of 2014. We will share our progress to date and welcome ideas for the future.

*The OK PhysTEC program is funded by a PhysTEC Recruitment Grant.

Other

PST2E01: 8:30-9:15 p.m. Identity Development for Undergraduate Female Physics Majors

Poster – Mary Elizabeth Mills, Indiana University, 1231 Basswood Circle, Bloomington, IN 47403; millsme@indiana.edu

Gayle A. Buck, Indiana University

Research has shown that identity formation during college shapes vocational decision-making. In this mixed methods study, we assessed the physics identify formation of 1249 undergraduate female physics students. The results from this study formed a set of characteristics that these undergraduate women believe define a "physicist" and fell into three categories—skills, attitudes, and experiences. Additionally, three predictors for whether a student would call herself a physicist were identified—satisfaction with her institution's physics department, belief in her future in physics, and the amount and type of negative feedback she has received from others. This project has led to the need and desire for a deeper examination of these students' identity formation, specifically how a student's experiences in the physics community affects her identity development, how a physics identity plays a role in career choice, and whether developing a physics identity can help retain women in physics.

PST2E02: 9:15-10 p.m. Student Response to "Equality Through Awareness" Club at CSM

Poster – Libby K. Booton, Colorado School of Mines, Department of Physics; 1523 Illinois St., Golden, CO 80401-1843; lbooton@mymail.mines.edu

Kristine E. Callan, Alex Flournoy, Colorado School of Mines

The physics student-run club Equality Through Awareness (ETA) is entering its second year of existence at Colorado School of Mines (CSM). The club aims to promote equality in STEM by spreading awareness about the issues faced by underrepresented groups. One of the club's three main components is a weekly, student-only discussion group, where students discuss articles they've read about various topics related to underrepresented groups in STEM. This poster will describe the topics discussed, and the results from an anonymous survey of students' reactions to this discussion group.

PST2E03: 8:30-9:15 p.m. Dealing with Still More Climate Myths

Poster – Gordon J. Aubrecht, Ohio State University at Marion, 1465 Mt. Vernon Ave., Marion, OH 43302-5695; aubrecht.1@osu.edu

Many scientists understand that climate change has a sociopolitical aspect, but some scientists are unwilling to address the issue lest they be perceived as political themselves. Nevertheless, when we scientists find climate myths, I think it is our duty as scientists to be willing to debunk them. Posters at Orlando and Minneapolis on this topic were well received. This poster exhibits some more climate myths and contrasts them with the science.

PST2E04: 9:15-10 p.m. Interdisciplinary Nanomaterials Research for Undergraduate Students

Poster – Michelle Chen, Point Loma Nazarene University, 3900 Lomaland Dr., San Diego, CA 92106-2899; michellechen@pointloma.edu

With this poster I will share my experience involving undergraduate students of all levels on interdisciplinary nanomaterials research at a primarily undergraduate institution. I will present projects on carbon nanotube / graphene synthesis and their interactions with biological cells that were carried out by both lower- and upper-level undergraduate researchers. Collaborations with major research institutions that were instrumental for our research will also be discussed.

PST2E05: 8:30-9:15 p.m. Anomalous Effects in Crookes' Radiometer

Poster –Timothy A. Heumier, Azusa Pacific University, PO Box 7000, Azusa, CA 91702; theumier@apu.edu

Landon Block, Devon Fischer, Azusa Pacific University

When the vanes of a Crookes' radiometer are subjected to constant illumination (thereby differentially heating the black and white sides of the vanes), they begin to spin, reaching an equilibrium rotation rate. Upon removal of the light source, the vanes coast to a stop, sometimes reversing direction briefly. In contrast, if the vanes are caused to rotate without illumination (e.g., by shaking in a swirling motion), they take longer to coast to a stop from the same initial rotation rate, with no reversal. This suggests that there is a reverse force acting on the vanes after the illumination is removed, and possibly even during the forward motion. We show the experimental configuration and display data illustrating this effect. We also discuss the ongoing attempts to extract the temporal behavior of the thermal forces from the vane position data.

PST2E06: 9:15-10 p.m. Different Faces of Crackpottery

Poster – Sadri Hassani, Illinois State University, Physics Department, Normal, IL 61790-4560; hassani@phy.ilstu.edu

Traditionally, crackpot science was the prerogative of people whose most advanced scientific knowledge came from watching programs on the Discovery Channel and Nova or reading articles in Reader's Digest and Popular Mechanics. Recently, however, more and more professionals have been attracted to crackpottery. This poster shows some examples of crackpottery in physics and points out some of its main characteristics. Among the people with tendencies toward crackpot ideas are some well known physicists, whose strange ideas are discussed in the poster.

PST2E07: 8:30-9:15 p.m. Using the Peer Review to Help Students Understand their Physics Laboratory

Poster – Mark F. Masters, IPFW, 2101 Coliseum Blvd., E Fort Wayne, IN 46805; masters@ipfw.edu

Students often fail to understand their physics laboratory. This is in part because, like "All the king's horses and all the king's men" the students fail to put together the humpty dumpty of physics involved in their laboratory investigation. When students write a laboratory paper they direct the paper to the Instructor who will fill in all the gaps. This inhibits student sense making of their laboratory investigations. To correct this we created JAUPLI; the Journal of the Advanced Undergraduate Physics Laboratory Investigation. In this journal the students write for peers at other universities, perform peer review on the student manuscripts with complete anonymity. We present our results from our most recent experiences with this process.

PST2E08: 9:15-10 p.m. Clouds From Other Worlds: Example – Titan Methane Cloud Droplet Microphysics*

Poster – Tersi Arias-Young, University of California, Los Angeles, 134 N Clark Dr. #202, West Hollywood, CA 90048; tersiarias@ucla.edu

One of the most interesting aspects of Titan having an atmosphere is the formation of clouds. On Earth, the atmosphere contains significant concentrations of particles – aerosols – of micron and sub-micron size which have an affinity for water and serve as centers for droplet condensation or cloud condensation nuclei. On Titan, the atmosphere contains a large amount of the so called tholins—a photochemical byproduct of nitrogen and methane—which are believed to serve as cloud droplet nuclei. Like for water droplets on Earth, methane droplets on Titan will need to be formed by heterogeneous nucleation for the liquid phase. We approximate a value for the supersaturation needed for pure methane droplets to form and confirm that homogeneous nucleation is most likely not found in Titan's atmosphere and, we present the microphysics needed for insoluble heterogeneous nucleation —known as Fletcher theory—of methane cloud droplets with tholins as nuclei.

*This research project is supported by the NASA - Outer Planets Research Program for Research Opportunities in Space and Earth Science – 2012 (ROSES-2012).

Tuesday, January 6 Highlights

Outdoor Yoga
7–8 a.m.
Bayview Lawn

AAPT Awards: Oersted Medal presented to Karl Mamola; DSCs; Presidential transfer
10:30 a.m.–12 p.m.
Grande Ballroom C

AAPT Symposium on Physics Education and Public Policy
2–3:30 p.m.
Grande Ballroom C

Session GA: Disentangling Student Reasoning From Conceptual Understanding

Location: Nautilus Hall 1
Sponsor: Committee on Research in Physics Education
Date: Tuesday, January 6
Time: 8:30–10:30 a.m.

Presider: MacKenzie Stetzer

GA01: 8:30-9 a.m. Using a Possibilities Framework to Understand Student Deductive Reasoning Attempts

Invited – Jon D. H. Gaffney, Eastern Kentucky University, 521 Lancaster Ave., Richmond, KY 40475; jon.gaffney@eku.edu

Students in physics courses often struggle to use or even follow formal reasoning when solving problems or analyzing physical situations. Instead, they tend to rely on "intuition" or temporarily salient thoughts that may be irrelevant to the situation at hand. Understanding what makes those ideas salient and why students make decisions based on them is necessary for improving communication with our students and helping them develop intuition based on proper reasoning. We approach this problem by assuming that students are authentically trying to reason, but they make subtle, nearly unconscious errors. Psychology research in deductive reasoning informs us that novice reasoners err by failing to consider all possibilities afforded by a given situation, either by failing to "see" them or by prematurely striking them down. We discuss how such errors may arise in physical situations and implications for instruction.

GA02: 9-9:30 a.m. Mathematical Reasoning Skills for Introductory Physics*

Invited – Stephen Kanim, Department of Physics, PO Box 30001, MSC3D Las Cruces, NM 88003; skanim@nmsu.edu

Suzanne Brahmia, Rutgers University

Andrew Boudreaux, Western Washington University

Why do so many students struggle with mathematics in introductory physics, even though most of this math should be very familiar to them from math classes? As part of an NSF-supported project to study student use of proportional reasoning in physics, we have noticed that many students have become proficient at mathematical procedures without having developed the conceptual understanding of mathematical notions and symbols that allow for the flexible and generative uses of mathematics essential for physics. In this talk, I will emphasize the differences between how many of our students have learned mathematics and the ways that mathematics is used in physics courses, and I will argue for a broadening of the goals for introductory physics to include the initial development of the habits of mind that are characteristic of physicists' use of mathematical tools to make sense of patterns in nature and in society.

*This work is supported in part by NSF DUE-1045227, NSF DUE-1045231, NSF DUE-1045250.

GA03: 9:30-10 a.m. The Contours that Influence Reasoning

Invited – Andrew F. Heckler, Ohio State University, 191 W Woodruff Ave., Columbus, OH 43210; heckler.6@osu.edu

One goal of science instruction is, at least implicitly, to improve students' ability to reason logically about physical phenomena, data, and scientific concepts and models. Here I discuss a way of describing the origins of student difficulties with reasoning using the analogy of a contoured terrain or boundary. Specifically, reasoning and decision making is often constrained by strong tendencies to, for example, reply quickly, use the most available information, and make unwitting assumptions and observations aligned with beliefs and experience. I will provide some data on several examples in the context of physics education. In one of the cases studied the results provide tantalizing implications on how to "reshape the contours" and generally improve some reasoning skills. However, in most cases it is not clear if or how one might be able to improve reasoning skills beyond the specific contexts in which the skills are practiced.

GA04: 10-10:30 a.m. Analyzing Inconsistencies in Student Reasoning Using Dual Process Theory*

Invited – Mila Kryjevskaia, North Dakota State University, Department of Physics, Fargo, ND 58108-6050;p mila.kryjevskaia@ndsu.edu

A set of theoretical ideas, referred to broadly as dual process theory, asserts that human cognition relies on two largely independent thinking systems. The first is fast and intuitive, while the second is slow, logically deliberate, and effortful. A common, and particularly puzzling phenomenon has been a focus of an ongoing, collaborative investigation: introductory students often demonstrate competent reasoning on one task, but not on other, closely related tasks. In some cases, students may simply not possess the formal knowledge and skills necessary to arrive at a correct answer. In other cases, however, students may switch their cognitive mode, seeming to abandon the formal knowledge and skills in favor of (perhaps more appealing) intuitive ideas. In order to probe the nature of such inconsistencies, we developed a paired-question methodology that allows us to disentangle reasoning approaches from conceptual understanding and use dual process theory to account for the observed inconsistencies. *This work is supported in part by the National Science Foundation under Grant Nos. DUE-1245999, DUE-1245993, DUE-1245313 and DUE-1245699.

Session GB: Mentoring Graduate Students for Careers Outside of Academia

Location: Nautilus Hall 2
Sponsor: Committee on Graduate Education in Physics
Co-Sponsor: Commitee on Profesional Concerns
Date: Tuesday, January 6
Time: 8:30–10 a.m.

Presider: Tim F. Slater

GB01: 8:30-9 a.m. Mentoring Graduate Students for Their Likely Non-Academic Careers

Invited – Lawrence Woolf, General Atomics Aeronautical Systems, Inc., 6995 Flanders Dr., San Diego, CA 92121; Lawrence.Woolf@ga-asi.com

Most graduate students will not have academic careers. This talk will provide recommendations for how to mentor graduate students throughout their graduate program. Topics to be discussed include statistics on post graduate school employment, the recommendations of the second graduate education in physics conference, internships and collaborations with industry, and mentoring for professional skills, research and development skills, and science and engineering skills. I'll conclude with some thoughts about restructuring the graduate education program to better prepare students for industrial careers.

GB02: 9-9:30 a.m. Bridging the Gap Between Graduate Programs and Careers in Industry

Invited – Stefano Spagna, Quantum Design Inc., 6325 Lusk Blvd., San Diego, CA 92121; stefano.spagna@qdusa.com

Traditional PhD and Master Physics programs teach little about how to apply the acquired knowledge to careers in "high-tech" companies. Quantum Design, the world leader in the manufacture of automated temperature and magnetic field platforms for materials characterization, has successfully partnered with UCSD to better prepare students for a career in industry. Quantum Design's sponsorships are structured to give students the opportunity to learn in a manufacturing environment, working alongside industry professionals to transform physics and engineering knowledge into products to be sold worldwide. Here we describe our graduate student mentoring process that yields new applications of cutting-edge technologies and original research for their Thesis. New skills are learned, and new mentoring situations arise as a result of academia and industry collaborations.

GB03: 9:30-10 a.m. Thriving in Industry: Tips and Tricks

Invited – Paul van der Wagt, Teradyne 7924 Corte Cardo, Carlsbad, CA 92009; wagt@sbcglobal.net

This talk covers technical career development principles that I have accumulated over many years in industry in my roles as individual contributor and team lead: –Think long term even during crises. – Focus on gaining knowledge and skills. –Document work thoroughly. –Perfectionism is tolerated if you consistently hit schedules. –Five to 10 years is enough to reach expert level in any sub-field: Move on. –Avoid projects with difficult personalities or budding management conflicts. –Do tasks in the efficient order, not the externally requested order: You will hit some deadlines while others hit none. –Automate and/or delegate what you can. –Dysfunctional work environment: A written record, an email, can force weak management to act, since in-action now has a risk attached. –Leadership and delegation require letting others make mistakes while they grow and are empowered -- did I mention to think long term?

Session GC: Assessing Pedagogical Content Knowledge (PCK) for Teaching K-12 Physics

Location: Nautilus Hall 3
Sponsor: Committee on Teacher Preparation
Co-Sponsor: Committee on Research in Physics Education
Date: Tuesday, January 6
Time: 8:30–10:30 a.m.

Presider: Stamatis Vokos

GC01: 8:30-9 a.m. Employing Distractor-Driven Assessments in Measuring Teacher SMK and PCK

Invited – Philip M. Sadler, Harvard Smithsonian Center for Astrophysics, 60 Garden St., Cambridge, MA 02138; psadler@cfa.harvard.edu

Two exceeding simple measures of science teacher knowledge are investigated using distractor-driven assessments based upon the content of the National Research Council's Science Education Standards. Items are designed to force a choice between well-documented misconceptions and accepted scientific concepts. As a measure of SMK teachers select the correct answer. As a measure of PCK, teachers select what they believe to be the most popular student choice among the wrong answers, deemed PCK-M. We find that high SMK is a necessary, but not sufficient, predictor of high PCK-M. Examples are given for physical and life sciences at the primary, middle, and high school level. Using both measures, and a host of control variables, we examine knowledge gains for 9556 students of 181 middle school physical science teachers. We find that teacher SMK is a strong predictor of student gains on concepts not associated with students misconceptions. However, we find that only teachers who have both PCK-M and SMK (but not SMK alone) facilitate student gains for physical science concepts that are associated with strong student misconceptions. We find that this new measure of PCK is easy to assess and should be part of every teacher preparation, professional development, and state certification program for teachers of science.

GC02: 9-9:30 a.m. Assessing Specialized Content Knowledge for Teaching Energy in HS Physics*

Invited – Lane Seeley, Seattle Pacific University, 3307 Third Ave. W., Seattle, WA 98119-1997; seelel@spu.edu

Eugenia, Etkina Rutgers University

Stamatis Vokos, Seattle Pacific University

Content knowledge for teaching energy (CKT-E) is the specialized content knowledge that teachers use or need to support student's productive scientific engagement with energy concepts and analysis. We will describe a set of assessment items that we have created to specifically probe the CKT-E that is relevant for recognizing and responsively engaging with the energy ideas of HS physics students. We will share results from pilot studies of over 500 HS physics teachers and analyze responses to both multiple choice and constructed response items. We will highlight the example of the use of systems for energy analysis that we have found to be both particularly relevant and conspicuously incomplete among many of the HS physics teachers surveyed.

*This work was supported in part by NSF grant DRL-1222732.

GC03: 9:30-9:40 a.m. Change in Teachers' Views about Energy in the MainePSP*

Contributed – Carolina Alvarado, University of Maine, 5727 Estabrooke Hall, Orono, ME 04469-5727; carolina.alvarado@maine.edu

Michael C. Wittmann, University of Maine

The Maine Physical Sciences Partnership is an NSF-funded project to improve the teaching and learning of the physical sciences in grades 6-9. As part of the project, teachers have answered questions on a specially designed survey about energy. In one question about a block sliding down a ramp, teachers are asked to give a correct answer, predict and explain the most common incorrect student answer, and describe what they might do in class if a student gave that answer. We discuss the differences found in teachers' responses in two consecutive years of PD. We observe a refinement in teachers' interpretation of energy transformation, transference and conservation; in the recognition of the knowledge of student ideas; and a change in the pedagogical approach they consider to use when facing the students' alternative conceptions in the classroom.

*Supported in part by NSF grant #0962805

GC05: 9:50-10 a.m. Developing PCK in Physics Teachers: Collaboration Between Scientist and Educator

Contributed – William A. Stoll, Georgia State University, 2232 Dunseath Ave. NW #310, Atlanta, GA 30318; wstoll2@student.gsu.edu

Brian D. Thoms, Kadir Demir, Sumith Doluweera, Georgia State University

Brett Criswell, University of Kentucky

Effective pedagogical content knowledge (PCK) integrating the expertise of physics content knowledge with pedagogical methods is a challenge in pre-service science teacher preparation. A unique physics class designed to develop pre-service teachers' PCK focused on facilitating deep conceptual understanding in high-school physics students is the focus of this presentation. The course collaboratively developed and co-taught by physics and science education faculty integrated physics content with a conceptual change pedagogy in a modeled environment. In addition, the course was designed around providing students a practical teaching component -- leading mini-lessons in a SCALE-UP undergraduate physics class. First year results show the teacher candidates exhibiting a growing awareness of the important role students' ideas play in the teaching and learning of physics; an increase in both their physics conceptual knowledge and their confidence in understanding of physics; but limited confidence in applying teaching for conceptual change.

GC06: 10-10:10 a.m. How Do We Promote PCK Development? Model Its Use Ourselves!*

Contributed – Gay B. Stewart, West Virginia University, Department of Physics, White Hall, Box 6315 Morgantown, WV 26506-6315; gbstewart@mail.wvu.edu

At WVU we are developing an instructional program to better promote PCK in our pre-service teachers. At University of Arkansas we were part of a successful PhysTEC implementation, expanded by an NSF Noyce scholarship program. Our students are exposed to the use of pedagogy built upon an understanding of how students learn in their own introductory courses. They are then brought into those courses as apprentice teachers, with topic-specific teaching preparation each week, including the most useful forms of representing and communicating content and how students best learn the specific concepts to be covered (Shulman, 1987). Acquiring this sophisticated knowledge and developing a practice that is different from what teachers themselves experienced as students requires learning opportunities that are more powerful than reading and talking about new pedagogical ideas (Ball & Cohen, 1996). We ease this transition by providing both the powerful opportunity and building upon how they were taught.

*This work supported in part by the PhysTEC and the Noyce program through grants DUE-9455732 PHY-0108787 and DUE-0733841

Session GD: Undergraduate Research

Location: Nautilus Hall 4
Sponsor: Committee on Physics in Two-Year Colleges
Date: Tuesday, January 6
Time: 8:30–10:30 a.m.

Presider: Dennis Gilbert

GD01: 8:30-9 a.m. Comparative Cognitive Task Analysis of Experimental Science and Instructional Laboratory Courses

Invited – Carl Wieman, 325 Sharon Park Drive, #613 Menlo Park, CA 94025; cwieman@stanford.edu

Undergraduate instructional labs in science generate intense opinions. Their advocates are passionate as to their importance for teaching science as an experimental activity and providing "hands-on" learning experiences, while their detractors (often but not entirely students) offer harsh criticisms that they are pointless, confusing, and "cookbook." Both to help explain the reason for such discrepant views and to aid in the design of instructional lab courses, I will compare the cognitive activities associated with a physicist doing experimental research with the cognitive activities of students in a typical instructional lab. Examining the detailed cognitive activities of experts ("cognitive task analysis") has proven to be useful in designing effective learning activities and in designing better measurements of student learning.

GD02: 9-9:30 a.m. Understanding and Measuring Project Ownership in Undergraduate Inquiry-based Laboratory Courses

Invited – David I. Hanauer, Indiana University of Pennsylvania, 2015D Leonard Hall, Indiana, PA 15705; hanauer@pitt.edu

A growing body of research documents the positive outcomes of research experiences for undergraduates, including increased persistence in science. Study of undergraduate lab learning experiences has demonstrated that the design of the experience influences the extent to which students report ownership of the project, and that project ownership is one of the psychosocial factors involved in student retention in the sciences. The current study discusses the initial qualitative study that generated data on project ownership and presents a new instrument for measuring project ownership -- the Project Ownership Survey (POS). Data on the reliability and validity of the instrument will be presented as a study on the ability of the tool to differentiate between traditional and inquiry-based laboratory experiences. The ramifications and potential uses of the tool will be discussed.

GD03: 9:30-9:40 a.m. Student-Directed Research at Guilford College

Contributed – Donald Andrew, Smith Guilford College, 5800 W. Friendly Ave., Greensboro, NC 27410; dsmith4@guilford.edu

Student-driven research is threaded through the curriculum of the physics program at Guilford College. Each student is required to carry out a senior thesis with his or her own research question and experimental design. They must write a proposal for their project that defines a timeline and justifies their budget. Alumni-endowed funds support expenses and stipends. They report on their progress in a weekly one-credit seminar. They must write a thesis, defend it to a committee, and present their work at a conference. This student-driven approach to Undergraduate Research has the strengths of supporting their curiosity, initiative, and self-confidence, but it has the weakness that the students often pick subjects outside the specific expertise of our faculty, making it more challenging to advise them. I will close the presentation with examples of recent student research projects.

GD04: 9:40-9:50 a.m. Looking at Data From Different Perspectives Through Unbiased Approaches by an Undergraduate Researcher

Contributed – Ximena C. Cid, University of Washington, 3910 15th Ave. NE, Box: 351560 Seattle, WA 98195-0001; ximena.c.cid@gmail.com

Mentoring undergraduates to do research is tricky business. There is a fine line between guiding students to come to their own conclusions and not guiding them enough in order to formulate coherent thoughts. On the other hand, one of the biggest advantages of having undergraduates do research in your lab is utilizing their unbiased approaches and ideas to explore the data. This talk will focus on an undergraduate's approach to reinterpreting collected data. We will highlight one approach that takes advantage of different representations which lead to unexpected results.

GD05: 9:50-10 a.m. Promoting Retention and Completion with Research and Design Cohorts

Contributed – Gregory Mulder, Linn-Benton Community College, 6500 Pacific Blvd. SW, Albany, OR 97321; mulderg@linnbenton.edu

At Linn-Benton Community College we have created a series of Research and Design Cohorts (RDCs) that students are encouraged to join their first term on campus. RDC projects include designing and building underwater ROVs, payloads on rockets, and experiments for use in nearby drop tower. All RDCs start with a 1-credit micro-controller class that focuses on programming and data collection skills. Students then pursue an RDC for their one to three years at the community college. RDCs allow students to use the content knowledge gained in their traditional classes to solve interesting and open-ended research questions while building ties with faculty and other students.

GD06: 10-10:10 a.m. Seeking Exoplanets with Inexpensive Cameras

Contributed – Martin G. Connors, Athabasca University, 11560 80 Avenue Edmonton, AB T6G 0R9 Canada; martinc@athabascau.ca

Olivier Guyon, University of Arizona

Josh Walawender, Subaru Telescope

Every year sees better Digital Single Lens Reflex (DLSR) cameras come to market, with higher resolution, better lenses, and increased sensitivity. Most modern cameras can be attached to a computer for control and data download. These allow many levels of interaction with the night sky, from taking beautiful photos to quantitative analysis, all of which have appeal to students at various levels. On an inexpensive mount that gives pointing and tracking ability, a DSLR can survey an impressive amount of "real estate" in the Galaxy. The images can be analyzed on a computer to look for changes in stellar brightness that range from dramatic in the case of eclipsing binary or pulsating stars, to very subtle in the case of transits of exoplanets in front of their star. We explore the rapidly developing technologies that allow undergraduates to do cutting-edge astronomical research, highlighting Project Panoptes (http://projectpanoptes.org).

Session GE: Teaching Advanced and Honors Students

Location: Nautilus Hall 5
Sponsor: Committee on Physics in Undergraduate Education
Date: Tuesday, January 6
Time: 8:30–10:20 a.m.

Presider: Juan Burciaga

GE01: 8:30-9 a.m. Serving Dessert First: An Inverted Introductory Course for Potential Majors

Invited – Thomas Moore, Pomona College, Physics, 610 N. College Ave., Claremont, CA 91711; tmoore@pomona.edu

How can one entice incoming students having a variety of different backgrounds to explore physics as a possible major? By serving dessert first! This talk will describe Pomona College's introductory sequence for potential physics majors having at least some high school physics and calculus. The first semester, instead of reviewing (yet again) the mechanics of frictionless blocks on inclined planes, introduces students to conservation laws, special relativity, quantum mechanics, and statistical mechanics. Second-semester half-courses then allow students to improve their strength in classical physics as needed. I will also discuss implications for upper-level courses as well as the latest data on enrollment patterns and the sequence's impact on the number of physics majors we attract.

GE02: 9-9:30 a.m. Honors Physics Instruction at a Large State University

Invited – Paul A. Crowell, University of Minnesota, 116 Church St. SE, Minneapolis, MN 55455-0213; crowell@umn.edu

The College of Science and Engineering at the University of Minnesota admits approximately 1000 students as freshmen each year. Of these, approximately 120 are admitted to the University Honors Program (UHP). The School of Physics and Astronomy has offered an introductory course for these students since approximately 1985. The vast majority of the UHP students enroll in this class for two semesters. A third semester, which is required by only a few majors in the college, enrolls about 30% of the honors class. Although the prerequisites are similar to those for the standard calculus-based introductory class, the honors sequence has its own laboratory sections and is provided with more instructional resources than the standard course. Although the level of difficulty is generally higher than in the regular sequence, the honors course is not intended to cover more material, nor is it specifically designed to appeal to prospective physics majors. I will discuss the strengths and weaknesses of this approach from the standpoint of the College as well as the physics program. In the 2013-2014 academic year, the department inaugurated a new honors introductory class with a much smaller enrollment (approximately 20) and much more selective entrance requirements. One of the goals of this class is to serve prospective physics majors, although it is open to all who meet the prerequisites. As the instructor for this class, I will offer my perspective based on our one year of experience. Finally, I will review the role of the honors program in the upper level physics curriculum.

GE03: 9:30-10 a.m. Honors Physics for First-Year College Students

Invited – Keith Griffioen, College of William & Mary, PO Box 8795, Williamsburg, VA 23187; griff@physics.wm.edu

William & Mary has long offered an honors course in introductory electromagnetism for those who did well in introductory mechanics. Two years ago we introduced an honors mechanics course for incoming undergraduates. We put 40 eager, mathematically inclined students into a class together with the goal of creating a microcosm of the larger physics community, complete with collaboration, peer review, experimentation, mutual problem-solving, and presentation. We expect our students to understand mechanics thoroughly, to develop mathematical sophistication in problem-solving, to gain insight into how physical theories are constructed and tested, to get a sense for what is currently on the forefront of physics, and to see what majoring in physics might be like. I will discuss trials, errors, and successes.

GE04: 10-10:10 a.m. Outcomes of Learning Undergraduate Physics Through a Transdisciplinary Science Program

Contributed – Scot A.C. Gould, W.M. Keck Science Department of Claremont McKenna, Pitzer & Scripps 925 N. Mills Ave., Claremont, CA 91711-5916; sgould@kecksci.claremont.edu

AISS, Accelerated Integrated Science Sequence, is an honors-based yearlong, transdisciplinary double course for students majoring in the natural sciences at the W.M. Keck Science Department of Claremont McKenna, Pitzer, and Scripps colleges. AISS integrates topics from introductory biology, chemistry, physics, calculus and computer science. We report on how we have incorporated the principles of physics into AISS in relation to these other disciplines, and describe the pedagogical modifications we have made to our regular physics program in response to what we have learned from teaching this transdisciplinary course. Outcomes of AISS include: students and faculty in the life sciences are more likely to approach problems using statistical physics methods, and physics/biophysics majors are more likely to participate in internships or attend graduate school in non-physics disciplines. Since the inception of AISS, the number of students majoring in physics or biophysics has nearly quadrupled.

GE05: 10-10:20 a.m. A Course and Textbook on Physical Models of Living Systems*

Contributed – Phil Nelson, University of Pennsylvania, Physics DRL / 209 South 33d St., Philadelphia, PA 19104; nelson@physics.upenn.edu

I'll describe an intermediate-level course on "Physical Models of Living Systems." The only prerequisite is first-year university physics and calculus. The course is a response to rapidly growing interest among undergraduates in several science and engineering departments. Students acquire several research skills that are often not addressed in traditional courses: * Basic modeling skills * Probabilistic modeling skills * Data analysis methods * Computer programming using a general-purpose platform like MATLAB or Python * Dynamical systems, particularly feedback control. These basic skills, which are relevant to nearly any field of science or engineering, are presented in the context of case studies from living systems, including: * Virus dynamics * Bacterial genetics and evolution of drug resistance * Statistical inference * Superresolution microscopy * Synthetic biology * Naturally evolved cellular circuits. Publication of a new textbook by WH Freeman and Co. is scheduled for December 2014.

*Work supported in part by National Science Foundation EF -0928048 and DMR-0832802, and by WH Freeman and Company.

Session GF: Effective Practices in Educational Technology

Location: Harbor Island 1
Sponsor: Committee on Educational Technologies
Date: Tuesday, January 6
Time: 8:30–10:20 a.m.

Presider: Fran Mateychik

GF01: 8:30-8:40 a.m. A Few Ideas for Using Smart Phones as Data Collection Devices

Contributed – Kyle Forinash, Indiana University Southeast, Natural Sciences, 4201 Grant Line Rd., New Albany, IN 47150; kforinas@ius.edu

Ray Wisman, Indiana University Southeast

We will discuss some introductory physics laboratory exercises using smart phones as data collection devices. Example exercises include the use of the accelerometer, magnetometer, and microphone. We also show a simple external headset circuit that extends the smart phone capabilities for photo gate timing and other data collection. The smart phone apps are adaptable for other exercises, performing data collection and analysis entirely on the smart phone using a spreadsheet that can also be downloaded to a computer. The reaction to this approach at recent workshops in Argentina was very positive.

GF02: 8:40-8:50 a.m. Measure the Speed of Sound with an iPhone

Contributed – William H. Fenton, The Hotchkiss School, 11 Interlaken Rd., Lakeville, CT 06039-2130; wfenton@hotchkiss.org

Jack Humphries, The Hotchkiss School

The one piece of lab equipment that students always bring to class is the iPhone (or similar smartphone). They use them for video analysis, calculations, timing and linear measurement. I will describe and demonstrate a method for determining the speed of sound with only an iPhone and a video analysis app.

GF03: 8:50-9 a.m. Becoming Scientists Through Video Analysis

Contributed – Hwee Tiang Ning, MOE Singapore, Blk 669 Jalan Damai #14-57, 410669 Singapore; ninght2013@hotmail.co.uk

This sharing highlights how the Tracker Video Analysis and Modeling Tool is used as a pedagogical tool in the effective learning and teaching of kinematics of a falling ball to grade 9 students in a Singapore classroom. Implemented with an inquiry-based approach, lessons facilitated varied opportunities involving students in active learning—obtain real data, engage in evidence-based discussions, make inferences, and create a model to explain how the physical world works, in their technology-enabled environment. Students improved in sense-making and relating abstract physics concepts to real life. This work stems from a project collaboration (of four schools and education technology department) aim to encourage students to learn while behaving like scientists, aligned with the K12 science education framework. It has afforded teachers professional learning experiences, to be reflective and lead in their teaching practices.

GF04: 9-9:10 a.m. Circular Motion: An Online Interactive Video Vignette

Contributed – Priscilla W. Laws, Dickinson College, Department of Physics & Astronomy, Carlisle, PA 17013 ;lawsp@dickinson.edu

Catrina Hamilton-Drager, David P. Jackson, Patrick J. Cooney, Dickinson College

Robert Teese, Rochester Institute of Technology

Members of the LivePhoto Physics Group have been creating and conducting educational research on a series of Interactive Video Vignettes (IVVs) involving introductory physics topics. Vignettes are designed for web delivery as short, ungraded exercises to supplement textbook reading, or serve as pre-lecture or pre-laboratory activities. Each Vignette includes videos of a physical phenomenon, invites the student to make predictions, complete observations and/or analyses, and, finally, compare findings to the initial prediction(s). A new Vignette on Circular Motion will be shown, and the speaker will present results of preliminary research on student learning associated with its use. (NSF #1122828 & #1123118).

GF05: 9:10-9:20 a.m. Online Team Homework for Solving Numerical Problem Sets*

Contributed – Thomas Gredig, California State University, Long Beach, Department of Physics and Astronomy, Long Beach, CA 90840-9505; thomas.gredig@csulb.edu

Many introductory physics textbooks minimize problem sets that require numerical computation due to its inherent complexity. Problems that include ball trajectories that take into account air friction and the electrical fringe field of capacitors are treated qualitatively, even though the methods to compute them numerically are presented in principle. Here, we show how students in introductory physics courses work out numerical problem sets using an online discussion forum. The unique part of the forum is how the teams are formed and its members are structured, so that they perform specific tasks. The other feature investigated is an integrated presentation platform that allows teams to present and share their final results with peer teams and vote them up accordingly. This online peer instruction method enables students to explore real world phenomena using numerical computation, share the results, and receive quick feed-back from peers.

*Part of this work has been supported by the Chancellor's Office of the California State University through Gerry Hanley.

GF06: 9:20-9:30 a.m. Online Interactive Pre-class Adaptive Learning Exercises

Contributed – Cheryl B. Davis, Brigham Young University, N313 ESC, Provo, UT 84602-0002; cheryl_davis@byu.edu

Robert C. Davis, Brigham Young University

A series of online interactive pre-class adaptive learning exercises was developed and initially tested with a class of 150 introductory physics students at Brigham Young University this past fall. These exercises -- which we call the Physics Guide -- start with a challenge question that tests the ability of students to apply select physics concepts. Students who correctly answer the initial challenge question are immediately given credit for the unit; students that do not are taken to a short tutorial consisting of short screencast explanations and several more basic questions that build the pieces needed to answer a larger final synthesis question. In addition to multiple choice interactions, we have students enter graphs and free-body diagrams using a "Drag and Drop" interface. The primary goal of the pre-class Physics Guide is for students to arrive at class with a stronger more uniform background ready to engage in active classroom learning.

GF07: 9:30-9:40 a.m. A Better Way to Study Sound Waves and Beats

Contributed – Larry Engelhardt, Francis Marion University, PO Box 100547, Florence, SC 29501-0547; lengelhardt@fmarion.edu

I will discuss a new laboratory experiment that involves analyzing sound waves and beats using free software that I have developed.[1,2] This software allows students to explore the concepts of amplitude, frequency, and phase shift in a very intuitive, hands on fashion. On a computer, students drag automatically created sliders to adjust parameters in their mathematical model and watch how each parameter affects the agreement between experiment and theory, ultimately formulating a quantitatively correct description of "beats."

1. For a description of an earlier version of this software, see L. Engelhardt, *Phys. Teach.* **50**, 402 (2012).

2. This software can be downloaded from the Open Source Physics collection of ComPADRE at www.compadre.org/OSP/items/detail.cfm?ID=11593

GF08: 9:40-9:50 a.m. Vocal Doubling and Complex Beating

Contributed – David Keeports, Mills College, 5000 MacArthur Blvd., Oakland, CA 94613; dave@mills.edu

Recording artists of the early 1960s, most notably the Beatles, routinely double tracked their vocals. When double tracking, a performer sings a vocal part and then attempts to reproduce that vocal part as closely as possible. Both takes are then mixed together on a recording. Rather surprisingly, the small pitch and timing discrepancies between the two takes improve the overall vocal quality by producing a pleasant shimmering sound. As I will explain, the chorus-like sound of vocal doubling is a consequence of the complex beating between waves that are not simple sinusoidal functions but instead are linear combinations of sinusoidal functions. Said another way, I will compare the simple sound of two beating tuning forks to the much more intriguing beating of complex waves. Finally, I will compare detuning, phase shifting, and chorus, three related effects commonly used to subtly enhance the sound of recorded music.

GF09: 9:50-10 a.m. New HTML5 Interactive Physics Simulations from cK-12 Foundation

Contributed - Byron J. Philhour, cK-12 Foundation / San Francisco University High School, 860 41st Ave., San Francisco, CA 94121; byron.philhour@ck12.org

Miral Shah, Neeru Khosla, cK-12 Foundation

In collaboration with physics teachers, animators, and software developers, the nonprofit cK-12 Foundation has generated dozens of new free-to-use tablet and laptop-ready HTML5-based interactive physics simulations. Our goal for each sim is to build a bridge between compelling real-world situations and the more abstract and mathematical physics descriptions. These sims are appropriate for middle school, high school, and introductory college-level physics. Topical coverage is broad, from motion and mechanics to electricity & magnetism, sound and light, and modern physics. Our physics sims are based in engaging, real-world examples, big questions, a playful interactive sandbox, graphs of data, and diverse modes of instructional feedback. This presentation is one part of our efforts to engage in a discussion with the physics education community about how best this work can be used to facilitate both classroom-based and independent instruction, foster interest in science, challenge misconceptions, and support best practices in online learning.

GF10: 10-10:10 a.m. Doceri in and Out of the Physics Classroom

Contributed – Michael R. Gallis, Penn State Schuylkill, 200 University Dr., Orwigsburg, PA 17961; mrg3@psu.edu

Doceri (https://doceri.com/) is branded as "an Interactive Whiteboard for iPad" and allows users to control, annotate, and record presentations on a presentation workstation using wireless internet connections. The Doceri software provides inexpensive smartboard functionality with great flexibility. This presentation discusses our experience using Doceri for small introductory physics classes. In addition to standard smartboard functions, we'll discuss "in seat' student board work and out of class videos for additional examples and lecture snippets.

Session GG: Development of Perception of Extraterrestrial Life II

Location: Executive 2A/2B
Date: Tuesday, January 6
Time: 8:30–9:10 a.m.

Presider: Julia Olsen

GG01: 8:30-8:40 a.m. The Drake Equation and the Historical Extraterrestrial Life Debate

Contributed – Todd K. Timberlake, Berry College, 2277 Martha Berry Hwy., NW, Mount Berry, GA 30149-5004; ttimberlake@berry.edu

The Drake Equation was formulated in 1961 by radio astronomer Frank Drake as a tool for estimating the number of communicating civilizations in the Milky Way galaxy. The equation is still a centerpiece of discussion about extraterrestrial intelligence. However, ideas about extraterrestrial life have their origins long before 1961. I will report on how I have used the Drake Equation as a teaching tool in a course on the extraterrestrial life debate. The Drake Equation (or a modified version) can be applied to this historical debate, from the Ancient Greeks to today, and the changing values of the parameters in the equation provide a convenient way to see how views about extraterrestrial life have evolved throughout history.

GG02: 8:40-8:50 a.m. Exploring the Scales of the Universe to Understand Fermi's Paradox

Contributed – Richard Gelderman, Western Kentucky University, 1906 College Heights Blvd., Bowling Green, KY 42101-1077; gelderman@wku.edu

Of all the themes in science fiction, one of the most consistently popular is the First Contact between humans and extraterrestrial life forms. Yet we Earth creatures live with the reality of being the only example of life known to us. This presentation describes how we utilize "Fermi's Paradox" (Where is everybody?) as a chance to motivate students to learn about the vastness of space and time in our universe. Given a chance to understand the vastness of our Milky Way galaxy and the difficulties with near light-speed travel, students will tend to conclude that the absence of Federation starships is an expected outcome of how aptly "space" has been named. Then, however, students get exposed to how old is our cosmos and synthesize all the information together to understand that other, more nuanced, arguments are required if aliens exist in a non-"Men in Black" reality.

GG03: 8:50-9 a.m. Aliens in the Classroom: Astrobiology as an Introduction to Science

Contributed – Barbra K. Maher, Red Rocks Community College, 13300 W. Sixth Ave., Lakewood, CO 80228; barbra.maher@rrcc.edu

A recent community college student survey showed an overwhelming majority believe in extraterrestrial life. Red Rocks Community College has introduced the subject of extraterrestrial life into several of our existing physics and astronomy courses through activities, papers and debates. However, such a high interest topic warranted more coverage in the curriculum. After a year in development, in 2013, AST 150:Astrobiology was approved as a guaranteed transfer science course for the Colorado community college system. The course is designed as an introductory level lecture class, with no pre-requisites. AST 150 develops foundational knowledge in astronomy, biology, geology and physics. Astrobiology is an excellent, interdisciplinary introduction to the process of scientific exploration and inquiry. It directly requires that students use critical thinking skills to analyze current theories and develop ideas through activities, presentations, discussions and article reviews, on topics such as extremeophiles, Jovian moons, planet terraforming, exoplanets and UFO sightings.

GG04: 9-9:10 a.m. Advanced Civilizations Below the Dyson Net Level: Terraformed Goldilocks Planets

Contributed – Ronald C. Metzner, Lathrop High School, 5001 Haystack Dr., Fairbanks, AK 99712; ronald.metzner@k12northstar.org

Freeman Dyson proposed that an advanced civilization could disassemble a planet the size of Jupiter and create a net of matter to surround the parent star to utilize all of the star's energy for power. Only waste heat would escape. He proposed that we should look for these infrared signatures as evidence of an advanced civilization. An easier way for a civilization with nuclear power and local space travel to create "living space" would be to "transform" the planets in their "Goldilocks" temperature zone into habitats that support life. The signature of life on our home world is free oxygen in the atmosphere. Our next generation of space telescopes will be capable of finding oxygen in planetary atmospheres. Find one star with all its Goldilock's planets showing oxygen and you may have found an advanced civilization. Find a cluster of stars like that and you have found "The Federation of Planets."

Session GH: Updates and Resources for Introductory Physics for Life Science II

Location: Executive 3A/3B
Date: Tuesday, January 6
Time: 8:30–9:10 a.m.

Presider: Sam Sampere

GH01: 8:30-8:40 a.m. Modifications to the Introductory Lab for Life Science Majors

Contributed – Erick Agrimson, St. Catherine University, 2004 Randolph Ave., St. Paul, MN 55105; epagrimson@stkate.edu

Jolene Johnson, St. Catherine University

At St. Catherine University, we have revitalized labs for both the physics for the health science and the calculus physics courses. The impetus for the project has been that students have shown great excitement for biophysical connections in the course and lab. Our students have consistently commented on how much they enjoy the laboratory component of our courses. We have started the process of developing a laboratory manual for both semesters of our courses that will give voice to many of the biophysical and medical connections that occur in the second semester of physics courses. We present work showing examples of new labs that make biophysical connections as well as revitalized existing labs.

GH02: 8:40-8:50 a.m. Integrating Biological and Biomedical Topics into Undergraduate Physics Labs

Contributed – Irene Guerinot, Maryville College, 502 E. Lamar Alexander Pkwy., Maryville, TN 37804; irene.guerinot@maryvillecollege.edu

Pre-health, biology, and exercise science students are required to take physics courses at Maryville College. The vast majority of these students pass these courses without making the connection between physics and many common biological problems, operations, and techniques. I will present work that we developed to attempt to bridge that gap. The laboratory activities, experiments, and demonstrations discussed will merge key concepts from at least two of the traditional disciplines (physics and biology, physics and chemistry, or physics, biology, and chemistry). Challenges and successes will be discussed.

GH03: 8:50-9 a.m. Osmosis, Colligative Properties, Entropy, Free Energy and the Chemical Potential*

Contributed – Peter Hugo, Nelson Benedictine University, 5700 College Rd., Lisle, IL 60532; pete@circle4.com

A diffusive model of osmosis is presented that explains currently available experimental data. It makes predictions that distinguish it from the traditional convective flow model of osmosis, some of which have already been confirmed experimentally and others have yet to be tested. It also provides a simple kinetic explanation of Raoult's law and the colligative properties of dilute aqueous solutions. The diffusive model explains that when a water molecule jumps from low to high osmolarity at equilibrium, the free energy change is zero because the work done pressurizing the water molecule is balanced by the entropy of mixing. It also explains that equal chemical potentials are required for particle exchange equilibrium in analogy with the familiar requirement of equal temperatures at thermal equilibrium. These are topics that should be considered for inclusion in the redesign of introductory physics courses for the life sciences (IPLS).

NSF DUE-0836833 http://circle4.com/biophysics

http://www.circle4.com/biophysics/modules/BioPhysMod05.pdf

GH04: 9-9:10 a.m. Measuring Cell Phone Signal: Experiment for Pre-Life Sciences Students

Contributed – Wathiq Abdul-Razzaq, West Virginia University, Physics Department, Morgantown, WV 26506; wabdulra@wvu.edu

The inconclusive evidence surrounding the issue of the danger of cell phone signal should motivate students especially the pre-life sciences students in binding physics with their field of study. A lab experiment was developed to measure the intensity of the microwaves emitted by cell phones and compare it to the intensity limit set up by the FDA for acceptable human exposure to microwaves. The intensity of microwaves leaked from microwave oven are also measured and compared to the cell phone radiation.

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Awards Session

Location: Grande Ballroom C
Date: Tuesday, January 6
Time: 10:30 a.m.–12 p.m.

Presider: Gay Stewart

Karl Mamola

Oersted Medal

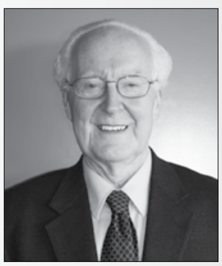
presented to Karl C. Mamola

AAPT, TPT, and me

Karl Mamola, emeritus, Appalachian State University, Boone, NC 28608; mamolakc@appstate.edu

AAPT established *The Physics Teacher* more than 50 years ago as a magazine for high school teachers. Over the decades, the publication has evolved in a number of important ways, and I was privileged to play a part in that evolution. I will describe some of the important preparation I received for that role and share some of the insights I gained during my 13 years as editor. I'll outline the history of *The Physics Teacher*, leading to its eventually becoming a peer-reviewed journal serving a very broad audience. I will also discuss *TPT*'s role in the physics teaching community and the important positive influence it has had on the evolution of AAPT. I'll conclude with some observations and conclusions drawn from my more than 40 years of teaching experience.

Homer L. Dodge Citations for Distinguished Service to AAPT



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AAPT Presidential Transfer Ceremony

Steven Iona
University of Denver
2014 AAPT President

Mary Mogge
California State
Polytechnic University
2015 AAPT President

Session HA: TYC Partnerships

Location: Nautilus Hall 1
Sponsor: Committee on Physics in Two-Year Colleges
Date: Tuesday, January 6
Time: 12:30–1:50 p.m.

Presider: David Weaver

HA01: 12:30-1 p.m. Elements of Successful Two- and Four-year Partnerships: A Case Study

Invited – Charles J. De Leone, California State University, San Marcos, 333 S. Twin Oaks Valley Rd., San Marcos, CA 92096-0001; cdeleone@csusm.edu

Daniel Sourbeer, Palomar College

Many geographically related two- and four-year institutions share a large percentage of their students. However, most two- and four- year institutions have weak STEM-specific linkages between the institutions despite the benefits of such linkages to the students. So, how can local two- and four-year institutions forge strong, lasting relationships between their STEM programs? In this talk we report on results of a study of the elements essential to building robust STEM linkages between two regional institutions, —California State University, San Marcos and Palomar College. The talk focuses specifically on the roles of i) cross-campus trust building, ii) jointly funded of external projects, iii) and activities that support cross-campus linkages at the administrative, faculty, and student level. Lastly, the talk will focus on the current state of this inter-campus relationship and the elements needed to maintain the relationship over the longer term.

HA02: 1-1:30 p.m. Undergraduate Research at a Community College – A Unique Partnership

Invited – Chitra G. Solomonson, Green River Community College, Auburn, WA 98092-3622; csolomonson@greenriver.edu

Christine K. Luscombe, University of Washington

For the past two years Green River Community College and the University of Washington have worked together to introduce Green River students to the nature of research. The University of Washington has provided lab facilities and valuable training to the community college instructor to fabricate and test organic photovoltaic cells. With the help of a grant from NSF, organic photovoltaic cells are now being fabricated at Green River Community College and characterized by Green River Community College students as part of a research-like lab. The students also learn about other energy sources and concepts relevant to the operation of a photovoltaic cell through an online inquiry lab module developed at Green River Community College. This talk will focus on how the partnership started, challenges, successes and ideas for future partnerships.

HA03: 1:30-1:40 p.m. Physics Partnerships with Four-year Schools at the College of DuPage

Contributed – Thomas Carter, College of DuPage, 425 Fawell Blvd., Glen Ellyn, IL 60137-6599; carter@fnal.gov

Carley Kopecky, College of DuPage

All community colleges and public four-year schools in the state of Illinois work within the Illinois Articulation Initiative (IAI) which both guarantees transferability of all two-year college courses and helps to standardize curriculum across the state. The advantages and disadvantages of this program will be reviewed. In addition, we will discuss the Pathways Engineering partnership in which a sub-set of Illinois community colleges have a joint admissions agreement with the state's flagship public engineering department at the University of Illinois. This provides guaranteed seamless transfer for students who meet the criteria of the program.

HA04: 1:40-1:50 p.m. Transfer Pathways: Partnerships Between SUNY Two-Year and Four-Year Colleges

Contributed – Renee Lathrop, Dutchess Community College, 53 Pendell Rd., Poughkeepsie, NY 12601-7312; lathrop@sunydutchess.edu

Beginning January 2014 the State University of New York (SUNY) asked two-year and four-year faculty to discuss through an online platform what courses would be needed for approx. 50 majors, one of them being physics, in the first two years of college study. This was the beginning of a process within the SUNY system to try to improve retention and transfer between the colleges and required faculty at many different campuses to work together. This talk will focus on that journey describing what was learned as two-year colleges and four-year colleges connected their programs.

Session HB: Stories from the Leading Edge of Astronomy

Location: Nautilus Hall 2
Sponsor: Committee on History and Philosophy in Physics
Co-Sponsor: Committee on Space Science and Astronomy
Date: Tuesday, January 6
Time: 12:30–2 p.m.

Presider: Ruth Howes

HB01: 12:30-1 p.m. From One to Many: Habitable Planets and the Multiverse

Invited – Virginia Trimble, Univ. of California Irvine & LCOGT, 4575 Physics, Irvine, CA 92697; vtrimble@astro.umd.edu

Twenty years ago, we were sure of only one normal star with planets (the Sun), one of which was habitable (Earth). But from one system in 1995 to several thousand now, we have learned that something like half of all stars have multiple planets (many of us had suspected this before!). Similarly, from Copernicus onward, scientists have come to think that everything is common—stars, galaxies, clusters, and super-clusters, perhaps even universes. Again the prevailing point of view has changed a great deal in the last 20 years, so that many quite respectable people, not just your speaker, take the Multiverse and many-worlds concepts seriously. The talk will focus on how we have come to change our minds about both these issues; what kinds of tests and evidence you need for an idea to count as scientific; and how one can convey thoughts about the cosmos to friends, relations, and students who had not cared about them before.

HB02: 1-1:30 p.m. The Dramatic Lives of Galaxies and Black Holes

Invited – Alison Coil, UC San Diego, 9500 Gilman Dr., MC 0424, La Jolla, CA 92093; acoil@ucsd.edu

We can use the Universe as a time machine, to observe how galaxies and black holes change with time. Detailed measurements of galaxies nearby and far away reveal that galaxies undergo dramatic changes as they age; they grow substantially in size and mass, they merge with other galaxies, and they form stars at high rates and then suddenly cease to form any new stars at all. Most galaxies also harbor super massive black holes in their centers, with masses of a million to a billion times more massive than a star. In some galaxies these black holes are actively accreting material and shine during this process; in other galaxies they seem to lie dormant. I will talk about how we are using the largest telescopes in the world to observe galaxies and black holes near and far at different wavelengths to learn about what is driving these dramatic changes.

HB03: 1:30-2 p.m. The Dark Energy Survey and the Mystery of the Accelerating Universe

Invited – Joshua Frieman, Fermilab and the University of Chicago, MS 209, Fermilab, Batavia, IL 60510; frieman@fnal.gov

In 1998, two teams of astronomers studying distant supernovae announced evidence that the expansion of the Universe is speeding up, instead of slowing down as one would expect from the attractive nature of gravity. Cosmic acceleration could arise from a new, gravitationally repulsive component of the Universe "dark energy" or alternatively from a breakdown of Einstein's theory of gravity, General Relativity, on cosmic scales. Combined with other observations made in the intervening years, these data point to a Universe composed of 4% ordinary matter (atoms), 25% dark matter, and 70% dark energy. In this talk, I will review the evidence for dark matter and dark energy and describe the methods cosmologists are now using to probe the nature of dark energy and the origin of cosmic acceleration. I will focus on their implementation in the Dark Energy Survey, an ongoing, five-year project using a new, 570-megapixel camera on a 4-meter telescope in Chile to survey hundreds of millions of galaxies and thousands of supernovae. In the process, I will discuss basic observational facts about the Universe, its age, size, expansion, big bang origin, and luminous and dark components; that I believe all high-school and college students should be familiar with.

Session HC: Science and Society

Location: Nautilus Hall 3
Date: Tuesday, January 6
Time: 12:30–1:10 p.m.

Presider: Doug Lombardi

HC01: 12:30-12:40 p.m. Increasing Job Placement Rates for STEM Students with Disabilities

Contributed – Laura E. McCullough, University of Wisconsin-Stout, 327 12th Ave., W Menomonie, WI 54751-2434; mcculloughl@uwstout.edu

Kathleen Deery, Debra Homa, Michael Lawler, University of Wisconsin-Stout

In this talk I will describe an NSF-supported project called "Soft Skills, Hard Science," which aims to improve the employment rates of STEM students with disabilities. Our project involves a curricular intervention focused on soft skills, mentorship with an industry partner, and a short work-based learning internship. Examples of the curriculum and results from our first cohort will be shared. Students in our program loved participating, and the majority who have looked for jobs have found them. Please visit our program's website for further information. http://www.softskills-hardscience.org/

HC02: 12:40-12:50 p.m. Re-envisioning the Panel Discussion*

Contributed – Sytil K. Murphy, Shepherd University, PO Box 5000, Shepherdstown, WV 25443; smurphy@shepherd.edu

Jordan Mader, Shepherd University

Panel discussions typically feature a few people at the front of the room facing a crowd, which may or may not be paying attention. Most of the crowd cannot or will not ask a question. In preparing for the Seeding Your Future Conference—a one-day STEM event for middle-school aged girls, the benefits of a panel were desired -- a chance for the girls to interact with many different female scientists in a short span of time without the "impersonalness" of it. Thus, the panel became more of a speed dating event —each panelist having approximately five minutes with a small group of participants. Impressions from both panelists and participants of the efficacy of the panel discussion will be presented.

*This work is supported by a West Virginia Space Grant Consortium Education Public Outreach Grant.

HC03: 12:50-1 p.m. What Is Modern Superstition?

Contributed – Sadri Hassani, Illinois State University, Physics Department, Normal, IL 61790-4560; hassani@phy.ilstu.edu

Modern superstition is the abuse and mutilation of science to promote non-scientific, pseudo-scientific, and anti-scientific ideas among the educated public. Many college graduates believe in mind/body medicine, Tao of physics, energy field of Qi, and a universe run by a computer code. The aim of this talk is to expose modern superstition as promulgated by doctors, physicists—including Nobel Laureates—and computer scientists.

HC04: 1-1:10 p.m. Teaching Physics with Pseudoscience

Contributed – David C. Dixon, Saddleback College, 28000 Marguerite Parkway, Mission Viejo, CA 92692; stark.effect@gmail.com

University physics instructors occasionally receive unsolicited pseudoscientific theories from amateur scientists. Although they are generally useless as science, some of these "crank" theories may be useful as pedagogical tools by getting students to recognize and address the underlying physical misconceptions. This talk will show a few examples of these object lessons that I employ in both my algebra- and calculus-based introductory physics courses.

Session HD: PER: Examining Content Understanding and Reasoning

Location: Nautilus Hall 4
Sponsor: AAPT
Date: Tuesday, January 6
Time: 12:30–1:40 p.m.

Presider: Hunter Close

HD01: 12:30-12:40 p.m. A Taxonomy of Conceptions about Buoyancy

Contributed – DJ Wagner, Grove City College, 100 Campus Dr., Grove City, PA 16127; djwagner@gcc.edu

Janice Novacek, Ashley Miller, Grove CIty College

Numerous studies, dating back at least as far as Piaget, have used buoyancy to probe students' understanding of density. A few studies have instead probed students' understanding of buoyancy in terms of pressure, buoyant force and Archimedes' Principle. In this talk, we present an overview of our buoyancy conception taxonomy. Included conceptions were collected both from prior studies involving subjects having a variety of ages, and from our own interviews and assessments given to college students.

HD02: 12:40-12:50 p.m. Quantum Mechanics Concept Assessment (QMCA): Development and Validation Study

Contributed – Homeyra R. Sadaghiani, Department of Physics and Astronomy, California State Polytechnic University, Pomona, CA 91768[Pomona, CA 91768-2557; hrsadaghiani@csupomona.edu

Steven Pollock, University of Colorado, Boulder

The Quantum Mechanics Concept Assessment (QMCA) is a 31-item multiple choice (MC) concept assessment instrument for first semester upper-division quantum mechanics. The process of developing this tool started with converting a preliminary version of an existing 14-item open-ended test to a MC format. During two years of testing and refinement, the QMCA has been given in alpha (N=61) and beta versions (N=263) to students in upper division quantum mechanics courses at 11 different institutions with average posttest score of 54%. In this talk, we will discuss the construction process of effective distractors and the use of student interviews and expert feedback to revise and validate both questions and distractors. We will also discuss the results of common statistical tests of reliability and validity, which suggest the instrument is presently in a stable, usable, and promising form.

HD03: 12:50-1 p.m. Physics Learning Study in Uganda: Observations, Suggestions and Questions

Contributed – Lane Seeley, Seattle Pacific University, 3307 Third Ave. W., Seattle, WA 98119-1997; seelel@spu.edu

Andrew Mwanika, Makarere University, Kampala, Uganda

Dorothy Echodu, Pilgrim Africa

Sarah McKagan, Seattle Pacific University

We will present the findings from a recent study of conceptual physics understanding among pre-college students and pre-service physics teachers in Uganda. The study included the Force Concept Inventory, individual and group interviews about both physics content and pedagogical issues. We will discuss the quantitative and qualitative results of this study in the context of the Ugandan physics education system. Finally, we will share recommendations and discuss opportunities for physics learning experts in the U.S. to support instructional reform efforts in Uganda.

HD04: 1-1:10 p.m. Scaffolding Student Understanding of Energy in Physics and Chemistry

Contributed – Beth A. Lindsey, Penn State Greater Allegheny, 4000 University Dr., Mc Keesport, PA 15131-7644; bal23@psu.edu

Megan L. Nagel; Penn State Greater Allegheny

Potential energy is a conceptually rich topic presenting many difficulties for students. One key feature of potential energy is that it is a function of the distance between interacting objects. This concept is relevant to understanding potential energy in both physical and chemical contexts. Data from student responses to written surveys and small-group interviews reveal that students do not spontaneously make connections between ideas they have about energy from physics classes and the ideas necessary for an understanding of energy in chemical contexts, but that they can be guided to draw these connections with appropriate scaffolding. In this talk, I will describe research into the levels of scaffolding that are necessary and sufficient to aid students in drawing connections between energy concepts across the disciplines.

HD05: 1:10-1:20 p.m. Effect of Verbal and Visual Cueing on Conceptual Task Performance*

Contributed – Xian Wu, Kansas State University, 116 Cardwell Hall, Manhattan, KS 66506; xian@phys.ksu.edu

Tianlong Zu, Bahar Modir, Lester Loschky, N S Rebello, Kansas State University

Our previous study shows visual cueing with feedback can be very helpful to students in physics problem solving. Effective linguistic cueing is an obvious complement of visual cueing in computer-aided instruction. In this study, we focus on the effects of verbal cueing and the interaction between linguistic cueing and visual cueing on correctness of students' responses on conceptual physics tasks. Participants solved four sets of conceptual problems, each of them containing one initial problem, six training problems, one near transfer problem, and one far transfer problem. Their spoken answers were analyzed for their reasoning and correctness. Our study provided insights into the relationship between the modality of cueing and students' physics problem solving performance.

*This research is supported in part by the U.S. National Science Foundation under Grants 1138697 and 1348857. Opinions expressed are those of the authors and not necessarily those of the Foundation.

HD06: 1:20-1:30 p.m. Self-Explanations Influencing Performance on Tasks with Feedback or Visual Cues*

Contributed – Elise Agra, Kansas State University, 116 Cardwell Hall, Department of Physics, Manhattan, KS 66506; esgagra@gmail.com

Bahar Modir, John Hutson, Lester C. Loschky, N. Sanjay Rebello, Kansas State University

Research has shown that using visual cues and correctness feedback can improve problem solving. In this study, we investigate the effect of self-explanations as well as visual cues and correctness feedback on conceptual physics tasks. Students enrolled in an introductory mechanics course were interviewed individually and asked to provide self-explanations on conceptual physics tasks. Participants worked through four sets of tasks, each containing a diagram. Each set contained an initial task, six isomorphic training tasks, a near transfer task, and a far transfer task. Students in the cued conditions saw visual cues on the training tasks, and students in the feedback conditions were told whether their responses were correct or incorrect. We discuss the influence of self-explanation on students' ability to solve the training and transfer task with respect to the cue and feedback conditions.

*This material is based upon work supported by the National Science Foundation under Grant Nos. 1138697 and 1348857.

HD07: 1:30-1:40 p.m. Online Homework Activities to Help at Risk Students

Contributed – Tim J. Stelzer, University of Illinois, 1110 W Green St., Urbana, IL 61801; tstelzer@illinois.edu

Noah Schroeder, Brianne Gutmann, Morten Lundsgaard, Gary Gladding, University of Illinois

Introductory physics is a roadblock for many aspiring engineers at the University of Illinois. The overall attrition rate in our introductory mechanics and E&M courses is approximately 15%, however that rate doubles for some under-represented populations. In fall 2014 we introduced a set of online activities designed to provide students both an accurate assessment of their current understanding, and the resources to improve their performance. This talk will describe the design of these activities, and their impact on student attitude and understanding.

Session HE: Panel – Endangered Physics Teacher Preparation Programs

Location: Harbor Island 1
Sponsor: Committee on Teacher Preparation
Date: Tuesday, January 6
Time: 12:30–2 p.m.

Presider: Dan MacIsaac

In 2012, a "perfect storm" of rising teacher certification expectations, a recession, and the end of ARRA funds resulted in a downturn in physics teacher applications to many teacher preparation programs. Physics teacher preparation programs will share struggles and brainstorm short and long-term solutions to downturns of applicants.

Speakers:

Dan MacIsaac, SUNY Buffalo State College, 1300 Elmwood Ave., Buffalo NY 14222; macisadl@buffalostate.edu

Stamatis Vokos, Seattle Pacific University, Physics Otto Miller Hall, Seattle, WA 98119-1997; vokos@spu.edu

Mark J Lattery, Univ of Wisconsin Oshkosh, Halsey Science Center, Oshkosh WI 54901; lattery@uwosh.edu

Eugenia Etkina, Rutgers University, Graduate School of Education, New Brunswick, NJ 08901-1183; eugenia.etkina@gse.rutgers.edu

Robert E. Thorne, Department of Physics, Cornell University, Ithaca NY 14853; ret6@cornell.edu

Session HF: Writing in Physics II

Location: Executive 2A/2B
Sponsor: AAPT
Date: Tuesday, January 6
Time: 12:30–2 p.m.

Presider: Janelle Bailey

HF01: 12:30-12:40 p.m. Writing Throughout the Physics Curriculum

Contributed – Joseph F. Kozminski, Department of Physics, Lewis University, One University Pkwy., Romeoville, IL 60446; kozminjo@lewisu.edu

We have recently implemented a new physics curriculum at Lewis University in which we have paid careful consideration to the development of scientific writing skills throughout the curriculum from the introductory labs through the advanced labs and capstone project. While much writing is done in the laboratory courses, we have also developed two seminar courses which address scientific writing. This talk will give an overview of the development of scientific writing skills in our new curriculum and discuss the types of writing and revising the students do, including our experiences with JAUPLI.

HF02: 12:40-12:50 p.m. How to Change the World, One Physics Class at a Time

Contributed – Gerald Feldman, George Washington University, Department of Physics, Washington, DC 20052; feldman@gwu.edu

Heather Schell, Michael Jarret , Anna Walcutt, George Washington University

We have developed a writing-intensive course for non-science majors based on the framework of Physics for Future Presidents. We focus on scientific literacy, emphasizing not only science principles but also aspects of communication and writing in a public forum. For the latter, we introduce concepts of rhetoric and apply them in a course journal (with peer review) and in an end-of-semester grant proposal project. We also have created a Facebook group for posting/sharing online resources and discussion threads. The course has been co-taught for two semesters by a physics instructor and a writing instructor, and we have made significant changes in the current semester based on student feedback and our own experience in the first semester. In this talk, we address the challenges of an interdisciplinary pedagogical project linking physics and writing, and we explain how we have merged the science and rhetoric elements to enhance the scientific literacy of the students and to help them develop their own analytical skills.

HF03: 12:50-1 p.m. Peer Graded Written Assignments in a Conceptual Physics Class*

Contributed – Edward Price, California State University, San Marcos, 333 South Twin Oaks Valley Road, San Marcos, CA 92096; eprice@csusm.edu

Including science practices can be difficult in large classes. We have used the web-based Calibrated Peer Review* (CPR) system to engage students in the science practices of constructing explanations, engaging in argument from evidence, and evaluating information. With CPR, students submit written work and evaluate each other. Students write a response to a prompt, read and evaluate responses prepared by the curriculum developers, and receive feedback on their evaluations, allowing students to "calibrate" their evaluation skills. Students then evaluate their peers' work and their own work. We have used CPR for in conceptual physics courses for future teachers and general education students with over 350 students at three universities. By independently assessing students' responses, we evaluated the CPR calibration process and compared students' peer reviews with expert evaluations. Peer scores are equivalent to our independent evaluations. I will describe how these assignments support science practices in NGSS, and our findings on the validity of peer-scoring.

* Calibrated Peer Review, http://cpr.molsci.ucla.edu/ Supported by NSF DUE grants 0717791 and 1044172

HF04: 1-1:10 p.m. Effective Reading Strategies to Enhance Student Learning

Contributed – Chuck Stone, Colorado School of Mines, Department of Physics, Golden, CO 80401; cstone@mines.edu

For over 50 years, innovative physics educators have enhanced faculty teaching practices and student learning styles. Activity-based instruction, computer simulations, flipped classrooms, interactive lecture demonstrations, online courses, peer instruction, and social networking have significantly enhanced student learning in numerous disciplines. STEM faculty face the daunting challenge of helping students understand a technical specialty while communicating complex ideas in simpler terms. Today's classrooms, characterized by fast-paced instruction, abbreviated text messaging, and the ability to instantaneously access information off the Internet, have their advantages, but often at the expense of softening students' reading and writing skills. Regardless of the instructional practices employed, reading and writing remain fundamental elements to learning. In this presentation, I share strategies faculty can use to help students become better readers. Careful reading complements effective writing, and both are valuable skills in preparing students for introductory courses, upper division labs, graduate school, and careers in science and engineering.

HF05: 1:10-1:20 p.m. Students Will Read their Textbook If ...

Contributed – John Hubisz, North Carolina State University, Department of Physics, Raleigh, NC 27695-8202; hubisz@mindspring.com

For over 50 years teaching physics, I have required that students read and use their textbook throughout their course. I spend time describing how to read effectively and require assignments that check that they have done so. I have written textbook publishers and authors encouraging them to stay away from chapter summaries and introduce more essay problems, some of which might require that a summary of an idea from a chapter be made.

HF06: 1:20-1:30 p.m. We Can Write Right, Right?

Contributed – Paul D. Schmelzenbach, Point Loma Nazarene University, 3900 Lomaland Dr., San Diego, CA 92106; paulschmelzenbach@pointloma.edu

Inspired by the observation that our undergraduate senior physics majors generally struggle with writing as much as they did when they were freshmen, our department has begun instituting various techniques to build writing skills at key points throughout our curriculum. I will share some lessons learned and some quick ideas that could be implemented in your classroom.

HF07: 1:30-1:40 p.m. What Is Your Evidence? Undergraduate Students – Writing About Changing Models

Contributed – Mariah C. Law, Gervitz School of Education, University of California, Santa Barbara, CA 93111; lawmariah00@gmail.com

Anne E. Leak, Danielle B. Harlow, Gervitz School of Education

Supporting students writing and learning to write about science in large- enrollment physics courses is challenging. Calibrated peer review (CPR) is a web-based tool used to teach students through a unique amalgamation of writing, critical thinking, and peer review. CPRs are adaptable to any class size and discipline. In our study, 79 undergraduates in a Large Enrollment Physics (LEPS) course for perspective elementary teachers completed a CPR assignment on how their model of a circuit changed. We analyzed data from students?' written responses in which they are asked to describe two ways that their final model of an electric circuit was more sophisticated than the initial model, and to use specific observational evidence to support each of their claims. We investigate how students discussed evidence that led to modifying their model, and how well they identified when evidence had been used by their peers.

HF08: 1:40-1:50 p.m. Guided Writing and Assessment in the Introductory Physics Laboratory

Contributed – Eric Mandell, Bowling Green State University, 3206 Penrose Ave., Toledo, OH 43614-5338; meric@bgsu.edu

Andrew Layden, Glenn Tiede, Bowling Green State University

Desiring to further develop students' writing skills in the introductory physics course, instructors would likely first turn to the lab report. However, students often fail to treat the lab report in the same way they would treat other writing assignments, and neglect to connect fully the learning outcomes of a lab activity to the other course activities, such as homework, quizzes, or exams. In an effort to enhance the lab report product and guide teaching assistants in its assessment, we developed a Connect-Experiment-Analyze-Reflect (CEAR) model that places a greater emphasis on student writing and guides reflection. Here, we share the results of our study comparing the observed behaviors and learning outcomes as we transitioned from spreadsheet-driven laboratory activities to our CEAR model.

HF09: 1:50-2 p.m. Writing Assessments Became an Essential Tool in Co-Taught Physics

Contributed – Stephanie C. Marry, Barrington High School, 1427 Valley Lake Dr., Apt 168, Schaumburg, IL 60586; smarry@barrington220.org

At Barrington High School a co-taught physics course was introduced. In this session, I will explore some of the benefits of a co-taught physics course and how writing assessments enhance student understanding. The summative writing assessments helped identify and clarify misconceptions, allowed student to reflect and revise their understanding, and ultimately became a valued learning tool in this new course.

Session HG: High School

Location: Executive 3A/3B
Sponsor: AAPT
Date: Tuesday, January 6
Time: 12:30–1:10 p.m.

Presider: Jan Mader

HG01: 12:30-12:40 p.m. Preparing a MOOC for AP Physics 1

Contributed – Andrew G. Duffy, Boston University, Physics, 590 Commonwealth Ave., Boston, MA 02215; aduffy@bu.edu

This year is the inaugural year of AP Physics 1, one of two courses to replace the algebra-based AP Physics B course in College Board?s Advanced Placement offerings. As part of a new High School Initiative from edX, Boston University, in collaboration with several Boston-area high school physics teachers, has developed a MOOC for AP Physics 1 that is slated to begin on Jan. 5, 2015. It is one of at least five courses on edX that target the various flavors of AP Physics. In this talk, we will preview the course, review our design and content decisions, and focus on how we plan to address the issue of doing labs in an online environment.

HG02: 12:40-12:50 p.m. Tutorial Curricula for Advanced High School Physics

Contributed – Michael Gearen, Punahou School, Honolulu, HI 1601 Punahou St., Honolulu, HI 96822; mgearen@punahou.edu

Stephen Kaback, The Blake School

There is a dearth of tutorial materials available for high school physics courses. Mike Gearen, with support from the University of Washington Physics Education Group, has produced two full curricula for AP Physics 1-2, and AP Physics C based exclusively on tutorial instruction. In these courses, students construct knowledge using carefully sequenced series of questions, thought experiments, and problems rooted in research into student learning. This talk will give a general overview of how content units were constructed, look at a few specific sections to illustrate methods of instruction, introduce assessment results after three years of implementation, and look at how the development of materials will continue moving forward.

HG03: 12:50-1 p.m. Bouncing Ball Lab Introduces Models and Foreshadow Future Physics Concepts

Contributed – Lee S. Trampleasure, Carondelet High School, 690 Athens St., San Francisco, CA 94112; lee@trampleasure.net

In my high school physics classes (both AP and college prep), I begin with a lab that challenges students to determine how high a ball will bounce if dropped from 1.5 meters, but they only have the ball and one meterstick. We develop procedures as a class, then they collect data, analyze it, and make their prediction. After testing their prediction, they all get greater than 90% accuracy, showing that physics experiments can work! But then they are asked to calculate how high the ball will bounce if dropped from 5 meters, and we test this from the second floor next to a stairway. Their accuracy tends to correlate to the density of the ball. This leads to questions, which foreshadow terminal velocity, air resistance, and energy concepts. When we address these topics in the future, we always return to the ball lab. My curriculum follows the Modeling Instruction pedagogy.

HG04: 1-1:10 p.m. Year Long Physics Investigations with Student e-portfolios

Contributed – Levent Sakar, Harmony Public School, 9321 W. Sam Houston Pkwy., S., Hosuton, TX 77099; lsakar@harmonytx.org

High school students complete one interdisciplinary year-long STEM projects in mathematics or science and include social studies and ELA components. Upon completion of these year-long projects, students present their entire work in their website (e-portfolio) that includes the investigation, video presentation and a brochure. I will present some sample students products from physics. This model is defined as STEM SOS (Student on the stage) Model. I will also mention how this model works, the components of this model in terms of 21th century skills and student tasks with written and video tutorials.

SYMPOSIUM on Physics Education

AAPT Symposium on Physics Education and Public Policy

Shirley Malcorn

Lee L. Zia

Tuesday, January 6, 2–3:30 p.m. • Grande Ballroom C

Policymakers formulate decisions everyday that impact curriculum, standards, funding, and many other aspects of physics education at all levels. AAPT works with a number of partners to keep policymakers informed on the views of physics educators and to suggest appropriate policy options within the Association's sphere of influence. This session brings together individuals who play pivotal roles in helping to shape policies and who provide information to policymakers. We hope to provide a look at the process of policy making as well as actions you might make to contribute to decisions about policies affecting physics and STEM education.

This Symposium is being partially sponsored by funds contributed to the Memorial Fund in memory of Mario Iona. Iona, a long-standing and dedicated AAPT member, was the first Chair of the Section Representatives and served on the AAPT Executive Board, was a column editor in *The Physics Teacher*, presenter at many national AAPT meetings, recipient of the Robert A. Millikan Award in 1986, and relentless champion of correct diagrams and language in textbooks. Contributions to the Memorial Fund provide support for many AAPT programs such as the Symposium.

Facilitator: *Noah Finkelstein, Professor of Physics, University of Colorado at Boulder*

Speakers:

Shirley Malcom, *head of Education and Human Resources Programs at AAAS; smalcom@aaas.org*

Lee Zia, *Deputy Division Director, National Science, Technology, Engineering, and Mathematics Education Digital Library (NSDL), NSF; lzia@nsf.gov*

Session IA: Post Deadline Papers

Location: Nautilus Hall 1
Sponsor: AAPT
Date: Tuesday, January 6
Time: 3:30–4:30 p.m.
Presider: Ruth Howes

IA01: 3:30-3:40 p.m. Bringing Research Experiences for Physics Teachers Back into the Classroom

Contributed – Eric B. Botello, Judson Early College Academy, 8230 Palisades Dr., San Antonio, TX 78148; ericb.botello@gmail.com

Jitendra Tate, Nikoleta Theodoropoulou, Texas State University - San Marcos

A summer Research Experience for Teachers can be both personally fulfilling and open your mind as an educator to the current research in physics. These professional developments should have a goal that brings the experience back to the classroom so that the students can be part of the experience as well. As part of two separate RETs at Texas State University–San Marcos offered through the Physics and Engineering Department, classroom instruction and overall environment was enhanced by offering activities not typical in a physics classroom. In the fall of 2014, a mini course in Nanotechnology was offered that highlighted STEM careers, a lab was conducted that highlighted properties of Nanotechnology, and a trip was made to the university to visit the facilities and experience the research first hand. The students became part of the RET by making the experiences a transformative event for the students and the educator.

IA02: 3:40-3:50 p.m. Exercises for Connecting Math Methods to Physics Problems

Contributed – Gary Felder Smith College Smith College Clark Science Center Northampton, MA 0163-0001 gfelder@smith.edu

Many physics curricula include a "math methods" course, a brief introduction to a variety of math topics that students will use in later courses. Under the auspices of an NSF grant, we have developed a set of "motivational exercises" connecting each mathematical topic to the physical topics where it is applied. For example, Taylor series are introduced with an exercise (for homework or in class) in which students write down the equation of motion for an atom in a crystal and recognize that they can't solve it. Then they are handed a linear approximation for the acceleration, plug in some numbers to verify that this new formula approximates the true acceleration well, and easily solve the resulting equation. At the end of the exercise they are told that in this chapter they will learn how to derive the approximation they just used.

IA03: 3:50-4 p.m. The Double Atwood Machine: A Multiple Device*

Contributed – Paulo De Faria Borges, CEFET-RJ Rua Presidente Domiciano, #52 apto, 801 Niteroi RJ, RJ 24210-270 Brasil; pborges@cefet-rj.br

Ricardo José Lopes Coelho, University of Lisbon

The double Atwood machine problem is revisited. We will take account reference frames on fixed and mobile pulleys; coordinate transformations, weak and strong principle of equivalence, gravitational and inertial mass, and invariance of physics laws. To calculate accelerations on machine we will solve this problem from scratch, describing its dynamics in two different reference frames: inertial and non-inertial. Our aim is show that even classically this problem can be solved in any reference frame completely. Besides, we will analyze the system motion according of equivalence principle and the coordinate transformation between both reference frames. Comparing our results with those from other works we can relate the contra intuitive unbalanced motion with the principle of equivalence. Numerical outcomes from these works and our work are in agreement. What is a reference frame and when such object is inertial or non-inertial is also discussed in our work.

*Aknowledgements to FAPERJ, the research support foundation from Rio de Janeiro - Brasil.

IA04: 4-4:10 p.m. Using iPython Notebook and iVisual in an Advanced Mechanics Course

Contributed – Aaron P. Titus, High Point University, 833 Montlieu Ave., High Point, NC 27262-3598; atitus@highpoint.edu

The recent development of iVisual has made it possible to incorporate 3D visualization and vector operation features of VPython with iPython Notebook. As a result, iPython Notebook can be used by teachers and students to write interactive documents that include LaTeX for mathematical typesetting and Python for computational modeling and plotting experimental data. Teachers can develop tutorials, and students can develop lab reports and annotated computational modeling projects. I will present the use of iPython Notebook, along with other tools like Trinket and Google Drive, to flip my Advanced Classical Mechanics course, implement modified problem-based learning, and enable Standards-Based Grading.

IA05: 4:10-4:20 p.m. Making Sense of Y-intercepts in Introductory Laboratories

Contributed – Bradley S. Moser, University of New England, 11 Hills Beach Rd Biddeford, ME 04005-9988 United States bmoser@une.edu

James Vesenka ,University of New England

Modeling instruction methods emphasize paradigm discovery labs that encourage students to invent physical models themselves instead of relying on textbook equations. The key component of each lab is the "linearization" of data collected in order to answer the problem statement "How does Y depend on X?" Students determine the physical meaning of the slope, either through deduction or by defining new quantities. The slope is typically of great importance while the y-intercept is negligible or merely an initial value of the dependent variable. What if, however, the experimental scenario was rich enough to support a y-intercept just as meaningful as the slope? Then a laboratory could host multiple opportunities to hone the art of sense-making. In this talk, we will highlight various paradigm experiments, each with a meaningful and physically interesting y-intercept, such as buoyancy, standing waves, static equilibrium, and Newton's second law.

IA06: 4:20-4:30 p.m. My Journey in Physical Science with Elementary Education Majors

Contributed – Beth A. Marchant, Andrews University, 25756 Little Fox Trl., South Bend, IN 46628; bmarchant@comcast.net

After six years teaching high school physics, nine years as a QuarkNet staff member, and four years teaching as a consultant, I am currently teaching a three-credit-hour university course called "Physical Science for Elementary Teachers." It is the only college-level physics and chemistry course that this group is required to take before entering the elementary school classroom full-time. In the course design and implementation of this lecture and lab course, I have combined research-based backwards design principles, some flipped instructional strategies, standards-based grading measures, and repeated assessment opportunities to enhance student learning. I will present data on my students' learning outcomes in six major content areas, MOSART pre- and post-test results, and student course evaluation data.

Session IB: Post Deadline II Papers

Location: Nautilus Hall 2
Sponsor: AAPT
Date: Tuesday, January 6
Time: 3:30–4 p.m.

Presider: Doug Lombardi

IB01: 3:30-3:40 p.m. Assessing Learning Gain for Undergraduate Physics Courses

Contributed – Emanuela Ene, Texas A&M Department of Physics and Astronomy, 4242 TAMU College Station, TX 77843-4242; ene@physics.tamu.edu

Responding to the acute need to assess the effectiveness of various teaching approaches across different universities, the author demonstrates a metric for knowledge tests that can be calibrated on a small sample size. Physics of Semiconductors Concept Inventory (PSCI), the knowledge test calibrated with this method, is made available to any instructor who wants to employ it for baseline or progress measurement. PSCI comes with a diagnose matrix that may be utilized by instructors for choosing an optimal teaching approach and by students for remediation.

IB02: 3:40-3:50 p.m. Project-based Teaching in Calculus-based Physics Courses

Contributed – Mojgan Matloob Matloob, Haghanikar University of Hartford, 200 Bloomfield Ave., Department of Physics, Bloomfield, CT 06117; matloobha@hartford.edu

To promote interdisciplinary learning, the introductory physics students at several universities were encouraged to get involved in projects that were about application of physics concepts to their major of study. We were seeking to improve students' understanding of physics concepts by enhancing their empirical understanding and facilitating the visualization of abstract concepts. Thinking across disciplines informed students about many applications of physics and improved students' beliefs about relevancy of physics. In addition, integrating several perspectives provided more accessibility in physics. The projects were evaluated at the poster session that was held at the end of semester. In addition, the university provided few other opportunities such as scholarly programs and students were able to participate and present their work. Students elaborated on one of the physics concepts that we discussed in the class and emphasized its particular application in their major. Among the topics were bee's navigation systems in using polarization, measuring laminar flow using concave mirrors, Micelle formations, polarization of light angle of carbon fibers in electric fields, aerodynamic of dolphins, using fiber optics in architectural design to replace electricity solar power, fractasl and civil engineering, and using Doppler effect in measuring heart beats. In this paper we present a few examples of the students' findings.

IB03: 3:50-4 p.m. Using High Performance Computing in Cosmology in Undergraduate Teaching and Research

Contributed – Jan Michael Kratochvil, University of KwaZulu-Natal, UKZN, ACRU, School of MSCS, Westville Campus Durban, 4000 South Africa; kratochvilj@ukzn.ac.za

Using the example of cosmological simulations and astrophysics, I highlight how modern high-performance computing on computer clusters with thousands of cores using tens of terabytes of data can be included in undergraduate education and research. It is a field easily accessible with proper guidance and resources, where even second-year undergraduates can make valuable research contributions. The skills acquired by the students can be transferred easily to other disciplines in computer science and statistics, involving large clusters and the analysis of enormous petabyte-scale datasets which are becoming increasingly ubiquitous and for which special computing techniques have to be used. Acquiring the knowledge and first-hand expertise in this field makes our students very marketable across several disciplines in industry and academia.

Session IC: An Introduction to Physical Sciences Education Advocacy

Location: Grande Ballroom C
Sponsor: AAPT
Date: Tuesday, January 6
Time: 3:30–4 p.m.

Presider: Aline McNaull

IC01: 3:30-3:40 p.m. How Policymakers Work on STEM Education Issues

Contributed – Aline McNaull, American Institute of Physics, One Physics Ellipse, College Park, MD 20740-3843; amcnaull@aip.org

Scott Franklin, Rochester Institute of Technology

Tyler Glembo, American Physical Society

Noah Finkelstein, University of Colorado

This talk will provide an overview on the policy process and will describe how Congress and the Administration approach science, technology, engineering, and mathematics (STEM) education policy issues. Participants will learn how issues are introduced and debated on Capitol Hill and what steps occur as ideas become laws. Examples of arguments for and against funding for science education will be presented. The current Administration is very focused on STEM education and the talk will provide an outline of some of the STEM education initiatives and objectives. Also discussed will be how policymakers receive advice from the stakeholder community then work to implement suggestions as they address problems and seek to change regulations.

IC02: 3:40-3:50 p.m. Why and How to Get Involved in Advocacy

Contributed – Aline McNaull, American Institute of Physics, One Physics Ellipse, College Park, MD 20740-3843; amcnaull@aip.org

Scott Franklin, Rochester Institute of Technology

Tyler Glembo, American Physical Society

Noah Finkelstein, University of Colorado

This talk will discuss the rationale, purpose and mechanics of advocacy. What are some desired results of getting involved in advocacy? Some examples of recent advocacy efforts will be provided as a part of a discussion about how to communicate with policymakers. Resources will be discussed which will allow participants to understand how to setup and have successful meetings. Questions about appropriate messaging will be addressed in an interactive dialogue. Information on how to draft appropriate handouts will also be included and participants will gain an understanding of the resources available within the scientific society community.

IC03: 3:50-4 p.m. Current Topics In STEM Education Policy

Contributed – Aline McNaull, American Institute of Physics, One Physics Ellipse, College Park, MD 20740-3843; amcnaull@aip.org

Scott Franklin, Rochester Institute of Technology

Tyler Glembo, American Physical Society

Noah Finkelstein, University of Colorado

This interactive discussion will include critiques of current approaches to STEM education issues. As policymakers seek to address state and local education issues through federal policy decisions, they are faced with choices about regulations, providing guidance to States, and allocating appropriate funding. This talk will address how the stakeholder community can develop effective messages to participate in dialogues with policymakers. Examples will be provided and the audience will have a chance to practice crafting a message about science education policy issues. Session participants will be able to engage with others and ask questions about current topics in STEM education policy.

Session PST3: Post Deadline Posters

Location: Grande Ballroom A
Sponsor: AAPT
Date: Tuesday, January 6
Time: 3:30–5 p.m.

Persons with odd-numbered posters will present their posters from 3:30–4:15 p.m.; even-numbered will present 4:15–5 p.m.

PST3A01: 3:30-4:15 p.m. Is Angular Displacement a Vector Quantity?

Poster – William A. Dittrich, Portland Community College, SY ST 312 PO Box 19000, Portland, OR 97219; tdittric@pcc.edu

A fundamental aspect of rotational motion has been found to be false. This casts the entire subjects of rotational kinematics and dynamics into doubt unless the mistake is corrected. The vector nature of angular velocity, acceleration, torque, and angular momentum are then in jeopardy of becoming scalars, which would have disastrous effects on the entire structure of physics. A new vector definition of angular displacement is introduced, preserving the vector nature of all quantities mentioned above. From this new definition, all subsequent rotational kinematic and dynamic equations can be derived, and it improves and completes the symmetry between rotational and linear equations. This new definition of angular displacement is the subject of a submitted paper to *The Physics Teacher,* and will be described and discussed at this poster session.

PST3A02: 4:15-5 p.m. Bouncing Ball Lab Introduces Models and Foreshadow Future Physics Concepts

Poster – Lee S. Trampleasure, Carondelet High School, 690 Athens St., San Francisco, CA 94112; lee@trampleasure.net

In my high school physics classes (both AP and college prep), I begin with a lab that challenges students to determine how high a ball will bounce if dropped from 1.5 meters, but they only have the ball and one meter stick. We develop procedures as a class, then they collect data, analyze it, and make their prediction. After testing their prediction, they all get greater than 90% accuracy, showing that physics experiments can work! But then they are asked to calculate how high the ball will bounce if dropped from 5 meters, and we test this from the second floor next to a stairway. Their accuracy tends to correlate to the density of the ball. This leads to questions, which foreshadow terminal velocity, air resistance, and energy concepts. When we address these topics in the future, we always return to the ball lab. My curriculum follows the Modeling Instruction pedagogy.

PST3A03: 3:30-4:15 p.m. Formscanner: Open-source Solution to Processing Bubble Forms

Poster Chadwick H. Young Nicholls State University P.O. Box 2022 Thibodaux, LA 70301 chad.young@nicholls.edu

Alberto Borsetta OverIT, Information Technology

Glenn V. Lo Nicholls State University

Kaisa E. Young Nicholls State University

The multiple-choice exam remains a staple for many introductory physics courses. Grading these exams typically involves a scanner enabled with optical mark recognition software. However, these tools are often inflexible and prohibitively expensive. Formscanner is a new open-source software--free and without advertising--created to process multiple-choice “bubble” forms. With just a few simple steps, faculty can scan, interpret, and analyze the results from multiple-choice exams.

PST3A04: 4:15-5 p.m. Exercises for Connecting Math Methods Topics to Physical Problems

Poster – Gary Felder, Smith College Clark Science Center, Northampton, MA 0163-0001; gfelder@smith.edu

Many physics curricula include a "math methods" course, a brief introduction to a variety of math topics that students will use in later courses. Under the auspices of an NSF grant, we have developed a set of "motivational exercises" connecting each mathematical topic to the physical topics where it is applied. For example, Taylor series are introduced with an exercise (for homework or in class) in which students write down the equation of motion for an atom in a crystal and recognize that they can't solve it. Then they are handed a linear approximation for the acceleration, plug in some numbers to verify that this new formula approximates the true acceleration well, and easily solve the resulting equation. At the end of the exercise they are told that in this chapter they will learn how to derive the approximation they just used. See http://www.felderbooks.com/mathmethods/motivating.html.

PST3A05: 3:30-4:15 p.m. International Cosmic Day Experience at Cowley College

Poster – Martin Shaffer, Cowley College, 125 S. 2nd St., Arkansas City, KS 67005; shafferm@cowley.edu

The 3rd Annual International Cosmic Day was held on Oct 8, 2014. This event, sponsored by DESY and Fermilab, invited cosmic ray detector users to collaborate in a worldwide event to conduct an entry-level investigation for students using their cosmic ray detectors. Cowley College in Arkansas City, KS, has participated for the last two years in this event. This poster presentation shows the final products of the investigations done and shared among the participating high schools, two-year colleges, and universities.

PST3A06: 4:15-5 p.m. Introductory Physics Workshops Enhance Student's Performance in Electricity and Magnetism

Poster – Adam T. Pullen, University of West Georgia, 1601 Maple St. Attn: Physics, Carrollton, GA 30118; apullen2@my.westga.edu

Ajith DeSilva, University of West Geargia

J. E. Hasbun, University of West Georgia

In the U.S., it is a common occurrence to teach introductory physics in a traditional format. We study the effects of one-hour optional workshops, which were offered outside the class, at the University of West Georgia. The workshops employed inquiry-based learning techniques that align with the lecture classes. Data, compiled since the workshops began in 2010, included D, F, and withdrawal (DFW) rates. Breakdowns of the letter grades were compared with and without workshops; the comparison-included pre-/post-tests scores on a conceptual survey in electricity and magnetism. The results showed that the DFW rate has fallen by 7% when compared to 10 years of institutional data without offering workshops. The pre-/post-tests results show that the workshops enhanced the students' understanding of related topics, and the process involved in the workshops increased the students' problem solving ability. The authors acknowledge the financial support from UWise (UWG Institutional STEM Excellence Initiative).

PST3A07: 3:30-4:15 p.m. Structural Features of Quantum Notations and Representational Fluency

Poster – Elizabeth Gire, University of Memphis, 421 Manning Hall, Memphis, TN 38152; egire@memphis.edu

Edward Price, California State University, San Marcos

Quantum mechanics is rich with different notational systems for representing quantum systems, including Dirac notation, algebraic wavefunction notation, and matrix notation. Mastery in quantum mechanics includes being able to coordinate these notational systems while performing computations. We identify four structural features of these notational systems: individuation, degree of externalization, compactness, and structural support for computation. We discuss how these structural features mediate students' reasoning when representing a particular quantum system and calculating the expectation value of the energy of that system. In particular, the structural features of Dirac notation support student reasoning and translating to other notational systems.

PST3A08: 4:15-5 p.m. Demonstrating Phase with Binaural Hearing from Stereo Speakers

Poster – James G. McLean, State Univ of NY at Geneseo, 1 College Circle, Geneseo, NY 14454-1401; mclean@geneseo.edu

A relatively simple electronic circuit duplicates an audio signal shited by a variable phase difference. When these two signals are delivered to a pair of stereo speakers, the apparent sound source position can be manipulated. When teaching about waves, phase is often an abstract and difficult subject for students. This is partly because there are many situations in which phase is irrelevant; waves carry information and energy without reference to phase. Binaural hearing offers a case where phase matters. For frequencies below approximately 1000 Hz (that is, wavelengths longer than the width of a human head), directional hearing is primarily based on the phase difference (or time delay) between the sound reaching the two ears. Classroom demonstration of the effect offers an interesting, concrete phenomenon with which to motivate discussion of phase differences. Deeper investigation can illustrate limitations on stereo imaging based on interference patterns.

PST3A09: 3:30-4:15 p.m. New Physics Teacher Workshops - Southern California

Poster – James J. Lincoln, Southern California AAPT, 5 Federation Way, Irvine, CA 92603; LincolnPhysics@gmail.com

Bill Layton, UCLA - Retired

Frank Lee, Roybal Learning Center

SCAAPT has been offering free New Physics Teacher Workshops for the past four years with a very successful turnout and enthusiastic response from participants. Three times annually teachers meet to be trained in hands-on laboratory and lecture-based demonstrations. This poster session introduces the structure and individuals involved in the program that make it a success.

PST3A10: 4:15-5 p.m. Drop Tower Physics

Poster – William A. Dittrich, Portland Community College, Sy ST 312 PO Box 19000, Portland, OR 97219; tdittric@pcc.edu

A drop tower is a way to produce micro gravity for a short period of time by dropping a box and air shield for a distance of 100 m or more. The Dryden Drop Tower on the campus of Portland State University allows a micro gravity environment for 2.1 seconds. Drop Tower Physics is a discussion of how basic physics demonstrations like a pendulum, floating cork, mass spring oscillator, gyroscope and conical pendulum would behave if gravity suddenly went to zero. The resulting discussion is exciting and challenging to students in introductory physics courses, especially calculus physics. This is from an article published in *The Physics Teacher* in October 2014. What would a stack of coins do when dropped? The provided experimental videos might surprise you!

PST3A11: 3:30-4:15 p.m. Cheap Audio Tricks: Inexpensive Earbud-based Sound Experiments*

Poster – James Vesenka, University of New England, 11 Hills Beach Rd.,, Biddeford, ME 04005; jvesenka@une.edu

Joshua Allen, Alex Boucher, Dean Meggison, University of New England

A suite of economical sound laboratory experiments are described using "earbuds," inexpensive supplies and free software available for pcs or mobile devices. Two interference laboratories (beat frequency and two-speaker interference), two resonance labs and a Doppler shift lab are described. Typical data is provided along with supporting simulations. The resonance labs are inexpensive variations of the classic quarter and half wavelength tuning fork frequencies vests cavity length tube experiments. The half wavelength resonance condition can be easily detected by generating surprisingly loud frequencies through the use of free signal generator apps on a mobile device attached to earbuds. The Doppler Shift experiments detect the frequency shift of the earbud(s) spinning at the end of the cables near the pc's internal microphone. The captured audio signal is analyzed on free spectral analysis software. The slopes of many of the experiments incorporate the unifying theme of the speed of sound in air.

*Supported by NSF DUE grants 0737458, 1044154.

PST3A12: 4:15-5 p.m. Scientific Reasoning Skills in Physical Science Course for Non-Majors

Poster – Teresa E. Burns, Coastal Carolina University, PO Box 261954 Conway, SC 29528-6054; tburns@coastal.edu

In this poster, we will describe a semester-long study of the effect of incorporating explicit scientific reasoning training in a science course for non-majors. PHYS 103 is a physical science course for non-science majors that can be used to satisfy general education requirements and is a physical science choice for elementary education majors. For both of these populations, improvement in scientific reasoning is a desirable learning outcome. In this study, students are trained to construct scientific arguments using If-And-Then statements. Student performance on the Lawson Classroom Test of Scientific Reasoning is measured pre- and post-instruction, and compared to a section that received no formal reasoning instruction. Results will be presented and discussed.

PST3A14: 4:15-5 p.m. Developing New STEM Outreach with the Alpha Magnetic Spectrometer (AMS-02)

Poster – Kathryn Whitman, University of Hawaii at Manoa, 2505 Correa Rd., Honolulu, HI 96822; ktindiana@hotmail.com

Veronica Bindi, Mary Kadooka, Mike Nassir, University of Hawaii at Manoa

The Alpha Magnetic Spectrometer (AMS-02) is a state-of-the-art particle detector that was installed onboard the International Space Station on May 19, 2011. With the formation of a new AMS-02 group in the University of Hawaii at Manoa Department of Physics and Astronomy, we have begun to design workshops based on this exciting instrument. AMS-02 can be used as a focal point to explore technology, particle physics, astrophysics, heliophysics, electricity and magnetism, and more, lending itself to STEM EPO in many ways. AMS-02's primary science goals are on the forefront of particle physics and astrophysics and its design is a prime example of cutting- edge spaceborne technology. In this poster, we will detail science topics that can be explored with AMS-02 and present example curricula for student/teacher workshops.

PST3A15: 3:30-4:15 p.m. Astrobiology Applications for Physics Classes

Poster – Mary Ann M. Kadooka, University of Hawaii Manoa, Institute for Astronomy, Honolulu, HI 96817; kadooka@ifa.hawaii.edu

Michael Nassir, University of Hawaii Manoa

Astrobiology, the search for life in the universe, has been a wonderful way to integrate learning all the sciences. This mystery has fascinated people throughout history. Is physics a part of this search? YES! Physics principles in optics, electromagnetic radiation, mechanics, and thermodynamics form the basis for so many investigations in astrobiology. Astronomers look for Earth-like habitable planets using methods based upon Doppler shift to light transits from telescope images. Physicists study cosmic rays and its behavior through planetary atmospheres so biologists can research its impact on life on other planets. They learn how electromagnetic radiation affects the Earth. Microbial oceanographers study bacteria living beneath the ocean floor in extreme temperatures, both very hot and very cold. Astrobiology national workshops conducted in Hawaii have shown science teachers how to motivate students to learn more physics as necessary background for all the other sciences.

PST3A16: 4:15-5 p.m. A Decade of ALI'I: Bringing Astrobiology into Science Classrooms

Poster – Michael A. Nassir, University of Hawaii at Manoa, Department of Physics & Astronomy, 2505 Correa Rd. Honolulu, HI 96822; nassir@hawaii.edu

Mary Ann M. Kadooka, University of Hawaii Institute for Astronomy

The young, interdisciplinary field of astrobiology—the intersection of astronomy, geology, chemistry, and biology, with special focus on origins—draws upon students' natural curiosity about the possibility of extraterrestrial life, and provides an exciting supplement to almost any science curriculum. Every summer from 2004 to 2013, the ALI'I (Astrobiology Laboratory Institute for Instructors) workshop, sponsored by the University of Hawaii's NASA Astrobiology Institute, introduced 15 secondary science teachers to astrobiology and ways to incorporate it into their classrooms. Professional development included daily lectures on current research by active UH scientists; field trips and lab tours; review of relevant background scientific concepts; demonstrations of hands-on activities and educational tools; and development of new astrobiology units tailored to participants' own classrooms. Participants were encouraged to return multiple years to become master teachers and lead their own ALI'I sessions, and to form a lasting network for sharing new activities and best practices.

PST3A17: 3:30-4:15 p.m. A New Way to Measure Student Engagement

Poster – Rebecca Lindell, Department of Physics and Astronomy, Purdue University, 2525 Northwestern Ave., West Lafayette, IN 47907; rlindell@purdue.edu

Francesca Polo, School of Engineering Education, Purdue University

Kathy Marrs, Department of Biology, Indiana University Purdue University Indianapolis

Andrew Gavrin, Department of Physics, Indiana University Purdue University Indianapolis

We know that engagement is important in any instructional setting; however, engagement in the classroom is often determined by the colloquial statement, "I know it when I see it." Instruments, such as the Reformed Teaching Observation Protocol (RTOP), focus on in-class observation and are thus limited to what occurs in the classroom. The question now becomes: are there other ways to measure student engagement outside of just observation. One such tool that we believe can be utilized to measure student engagement outside of the classroom is CourseNetworking (The CN), available at http://thecn.com. The CN is an academically focused social media platform with some course management capabilities. Unlike most CMS's that only transmit information, The CN encourages students to engage with the material and with each other. In this poster, we will give an overview of the software as well as discuss our research on how to measure student engagement.

PST3A19: 3:30-4:15 p.m. Engineering Practices in the Physics Classroom

Poster – Kathleen M. Agnostak, Rutgers University, 55 Laurel Drive, Fair Haven, NJ 07704; kagnostak@gmail.com

Jordan Back, Rutgers University

For our poster, we would like to address the idea of incorporating engineering into the physics classroom. The new common core standards have introduced the new standard of engineering design practices however, it can be difficult to incorporate these practices into the existing curriculum and how should the students be introduced to these ideas. We plan to propose some different engineering design projects that can be used in the classroom to teach physics concepts. Additionally, we will present an engineering design process that can be given to the students as a guide. This process is like the scientific method, but for engineering. It will be a guide for the students to use when engaging in engineering tasks.

PST3A20: 4:15-5 p.m. Lightning Physics from High-speed Video Observations

Poster – Marcelo Saba, INPE Av dos Astronautas, 1758 Sao Jose Dos Campos - SP, SP 12227010; marcelo.saba@inpe.br

Carina Schumann, Amanda R. Paiva. INPE

Most of what is known about the structure and time evolution of lightning was determined by high-speed photography. The first measurements were obtained using a two-lens streak camera, named Boys camera, after its inventor, in the beginning of the 20th century. In a streak camera a relative movement between the lens and the film is used to record the phases of a lightning discharge. Currently, robust and portable high-speed video cameras offer a wide range of frame rate and exposure options ranging from 1000 to over 300,000 images per second. With higher temporal resolution, processes that occur during a lightning flash can be visualized with detail. This work will show recent findings on negative cloud-to-ground lightning flashes, positive flashes, upward and bipolar lightning flashes.

PST3A21 3:30-4:15 p.m. Physics Demonstration Seminar for Graduate Students

Poster – Marcelo Saba, National Institute for Space Research, Av dos Astronautas, 1758 Sao Jose Dos Campos - SP, 12227010; marcelo.saba@inpe.br

Monthly seminars on physics are presented for graduate students on various topics of classical physics (electricity, optics, thermodynamics, acoustics and mechanics) and modern physics. This seminar series has had a good attendance from graduate students and researchers from different areas of the Brazilian National Institute for Space Research - INPE. In each seminar physics demonstrations related to topics that are under research at INPE and some related scientific curiosities are presented. The idea is to show the physics behind topics that are being studied by graduated students of the institute. It is therefore an opportunity to see the physical phenomena as they appear in nature and not only in theory or in mathematical equations. Some graduate students have a very little background on practical physics and sometimes have never seen an elementary demonstration. Therefore the demonstrations are focused on basic concepts that can be learned through a few demonstrations. Most of their learning was based on theoretical classes or just what is found in textbooks. Most have never had the opportunity (in high school or college) to visualize the formation of the rainbow, electrical discharges in gases or see different materials immersed in liquid nitrogen. In this presentation the content and style used in these seminars to grasp the attention of the attendants will be presented.

PST3A23: 3:30-4:15 p.m. Assessing Student Understanding of Measurement Uncertainty in Introductory Lab Classes

Poster – Ian L. Schanning, UCSD, 4091 Miramar St. Apt. F, La Jolla, CA 92037; ischanni@ucsd.edu

A simplified statistical approach for non-major lab classes is presented that still contains some important ideas from more rigorous statistics: data as a range with uncertainty, comparisons of different data sets, and propagation of uncertainties. Students were taught the techniques as a part of their physics lab classes and used them in written lab data analysis. Student understanding (pre- and post-instruction) of uncertainty is assessed via a survey containing estimation and comparison problems, including a short answer section. Student responses and self-reported justifications for them are categorized on a point vs spread basis.

PST3A24: 4:15-5 p.m. Calibrating Objective Scales for Knowledge Measurement

Poster – Emanuela Ene, Texas A&M Department of Physics and Astronomy, 4242 TAMU, College Station, TX 77843-4242; ene@physics.tamu.edu

An objective linear item-scale ranks a person's ability to operate with knowledge from a specific domain. The metric on the objective scale can be calibrated on a small sample. The scale may be used to compare learning gain across universities. The diagnose matrix may be utilized by instructors for choosing an optimal teaching approach and by students for remediation.

PST3A25: 3:30-4:15 p.m. DALITE: Asynchronous Online Peer Instruction

Poster – Nathaniel Lasry, John Abbott College, 128 Finchley Hampstead, QC H3X 3A2; lasry@johnabbott.qc.ca

Elizabeth Charles, Chris Whittaker, Sameer Bhatnagar, Dawson College

Michael Dugdale John Abbott College

Approaches such as Peer Instruction (PI) have resulted in improved conceptual understanding. PI engages students in discussion at the conceptual level and focuses their attention on explanation and reflection. The Distributed Active Learning and Interactive Technology Environment (DALITE) is a virtual learning environment, conceived from principles of PI. We report on this design experiment and the ongoing efforts to improve DALITE's functionality for instructors as well as its impact on student's conceptual learning.

PST3A26: 4:15-5 p.m. Examining the Impact of Assessment Format on Student Problem Solving

Poster – Andrew G. Reid, San Jose State University, 1713 Wade Ave., Santa Clara, CA 95051; agreid35@gmail.com

Katrina Roseler, Cassandra Paul, San Jose State University

Previous studies have determined that student performance on assessment measures in physics is dependent on the format of the question. Less is known, however, about the cognitive approaches students use to solve problems across different formats. In order to give educators better insight into how assessment format influences cognitive strategies chosen by students, a qualitative analysis of student problem-solving behavior is necessary. We interviewed students while solving problems in three formats: multiple-choice, free-response, and verbally stated. We present evidence suggesting that multiple-choice format encourages students to check each answer for correctness, but may unintentionally guide their reasoning process. The free-response format requires that students come up with their own answer, but does not necessarily encourage students to show their reasoning. In the verbal format, instructors get an opportunity to freely probe student thinking. We will discuss our findings in the context of differing student learning goals and outcomes.

PST3A27: 3:30-4:15 p.m. Investigating Student Responses to the Grading by Category Assessment Method

Poster – Annie Chase ,San Jose State University, 1 Washington Sq., San Jose, CA 95192-0001; annie.chase@sjsu.edu

Cassandra Paul, San Jose State University

Instructors who teach large courses have difficulty providing assessment feedback for students when using free-response questions because they take more time to grade than multiple-choice questions. Studies show that assessment feedback provided by the instructor is important for student learning. Instructor feedback helps students become better self-regulators (i.e., students who have the ability to create an effective learning environment for themselves). Students who have high levels of self-regulation perform better than students who do not self-regulate. However, little is known about how assessment feedback affects student academic performance. This research examines student performance on assessments and how self-regulation correlates with achievement on those assessments. We analyze student responses to instructor feedback and identify differences in student perceptions and achievement on assessments that occur between two feedback methods used in two introductory college-level physics courses. This method of individualized feedback may help instructors support students' self-regulation practices.

PST3A28: 4:15-5 p.m. Using the Student Participation Observation Tool for Faculty Professional Development

Poster – Cassandra Paul, San Jose State University, One Washington Square, San Jose, CA 95192-0001; cassandra.paul@sjsu.edu

Katrina Roseler, Celeste Ma, Stephanie Lorelli, San Jose State Univeristy

Cara Theisen, University of California - Davis

While educational research overwhelmingly indicates that interactive instructional techniques are superior to lecture for fostering student learning, the vast majority of higher education STEM courses are taught using a traditional lecture format. The Student Participation Observation (SPOT) tool was built to serve as a faculty professional development intervention with the purpose of catalyzing reform. SPOT is a computerized observation protocol that allows an observer to categorize and collect student actions in real-time. SPOT is: 1) Low inference (for users without formal training) 2) Illustrative (output includes color-coded plots) 3) connected to STEM best practices (i.e., student-centered, active). Use of the SPOT was implemented as a part of a professional development workshop series for STEM faculty, to determine how the tool impacted faculty reflection on teaching practice. Audio and video recordings of workshop meeting dicussions as well as pre- and post-workshop surveys are analyzed and preliminary results are discussed.

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Call for Nominations

The AAPT Awards Committee is seeking nominations for the following awards. All AAPT members are urged to review the descriptions of these awards on the AAPT website and then, following instructions available at a link on that website, to nominate individuals deemed worthy of consideration for any of these awards. The Nomination Form is at http://www.aapt.org/Programs/awards/.

Robert A. Millikan Medal

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Paul E. Klopsteg Memorial Lecture Award

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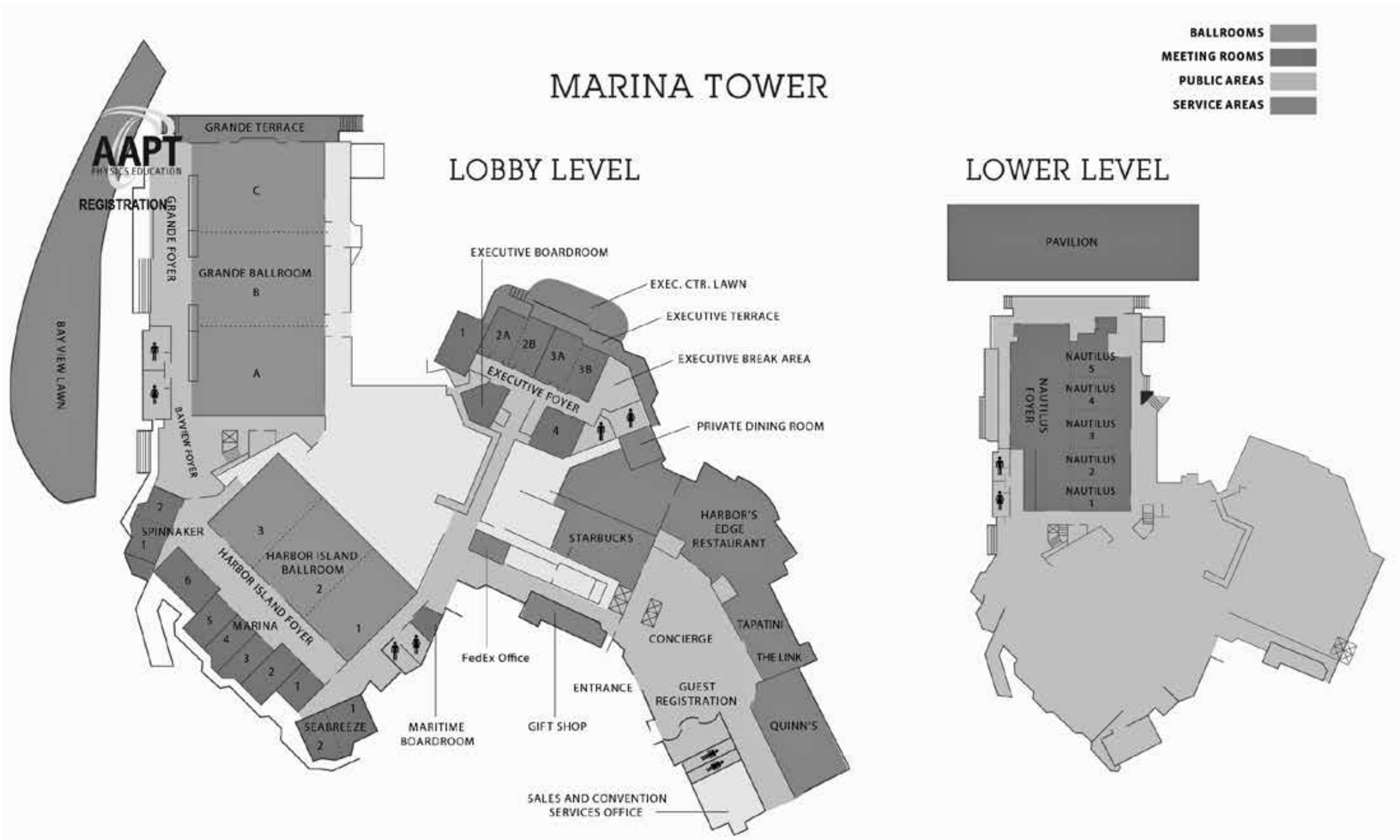
John David Jackson Excellence in Graduate Education Award

David Halliday and Robert Resnick Excellence in Undergraduate Physics Teaching Award

Paul W. Zitzewitz Excellence in K-12 Physics Teaching Award

AAPT Homer L. Dodge Distinguished Service Citations

Sheraton Hotel and Marina Map



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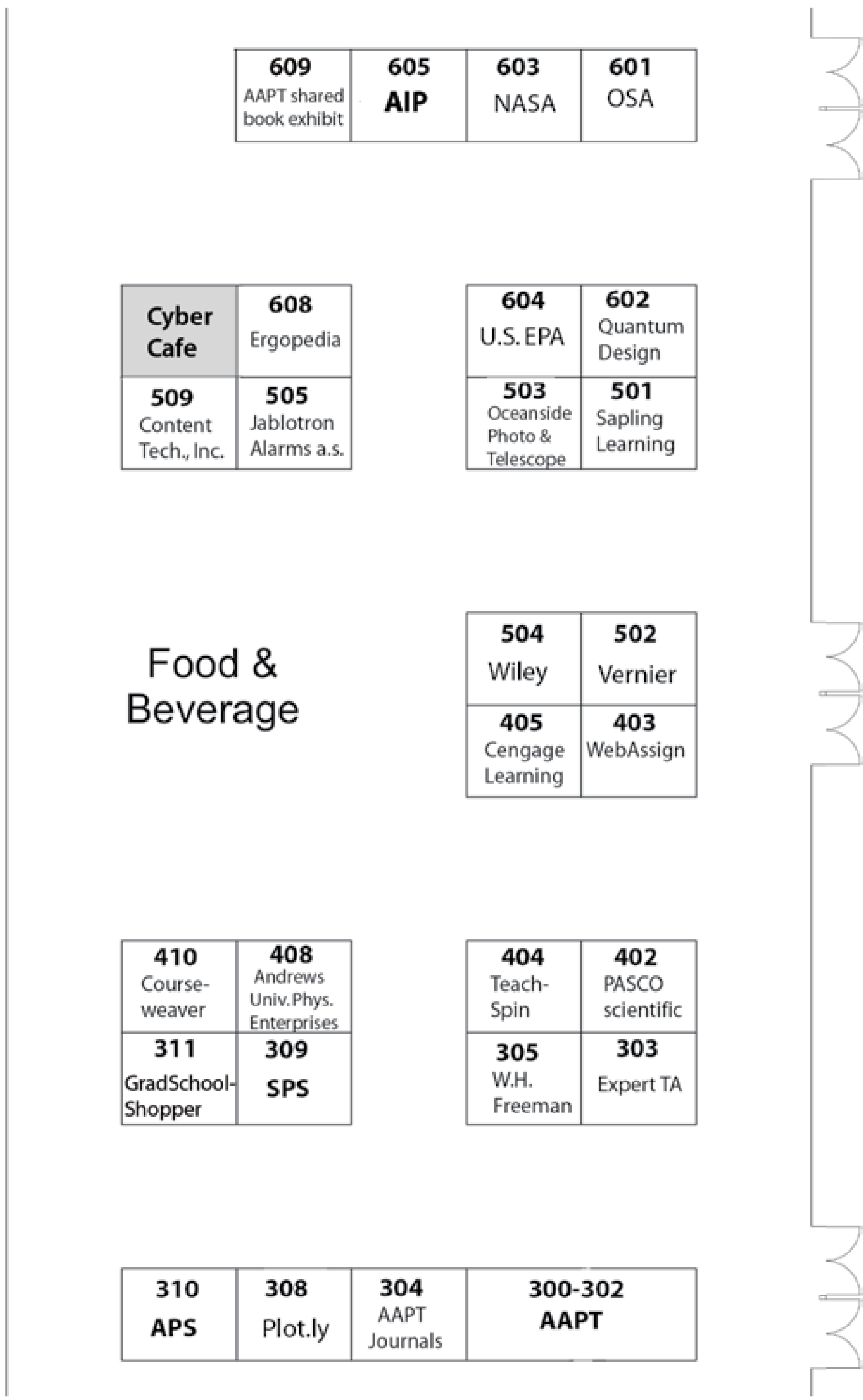

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Download Steps:

1. Download the app by going to https://crowd.cc/s/4uMA, or search the "Apple" or "Google Play" stores for AAPT, American Association of Physics Teachers, WM15, 2015 AAPT Winter Meeting.

2. Open the app and tap on 2015 AAPT Winter Meeting (WM15).

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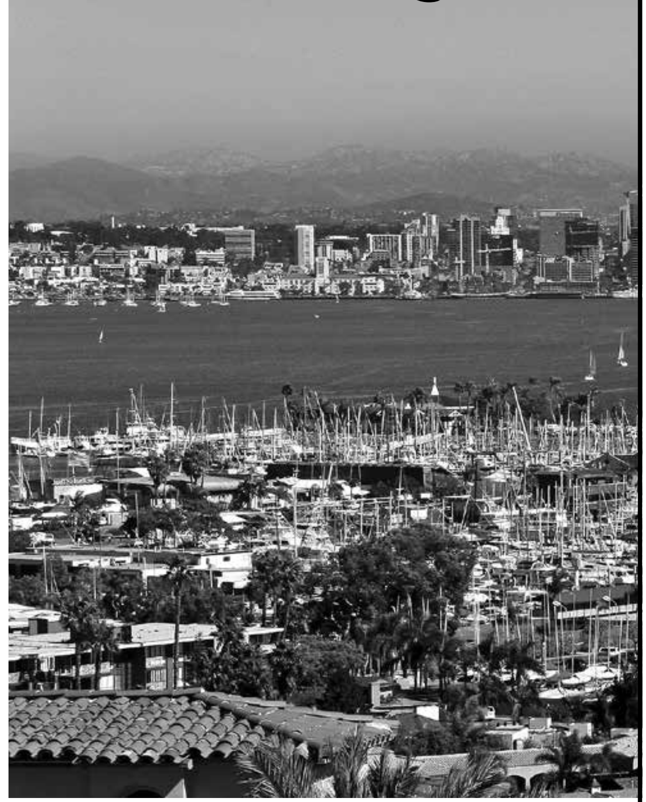
CALL for UNIVERSITY HOSTS for 2018 and 2019 National Meetings

AAPT is in search of Physics Departments of Colleges and Universities interested in hosting national meeting workshops and pre-conference meetings in 2018 and 2019. This is a great opportunity to support AAPT national meeting and showcase the physics program at your university.

The following meetings are in the process of being vetted, and priority will be given to locations where Local Hosts show support.

- **2018 Summer Meeting** host site would be in the Mid-Atlantic and Northeast areas.
- **2019 Winter Meeting** host site would be in the southern part of the country.
- **2019 Summer Meeting** host site would be on the West Coast.



General information for Local Hosts to consider:

- National Meetings typically occur in January/February (winter) and July/August (summer).
- Average attendance: 800–1,000 (winter), 1,000–1,200 (summer).
- 30–40 Half-and Full-Day workshops occur on Saturday and Sunday.
- Smaller tandem meetings prior to and following the AAPT National Meeting ranging from 40 to 150 people are planned annually and will be supported by Local Hosts.
- A mix of campus and local hospitality community engagements will be required for a successful National Meeting.
- Local Hosts will need to submit a letter of support to AAPT prior to a site visit being planned and be a part of showcasing the area.
- A final presentation to the Meetings Committee shall take place either during a summer or winter meeting prior to a meeting being awarded.

All interested universities will be properly vetted; however, those that have the support of the hospitality community and resources (hotels, restaurants, distance to airport, activities, etc.) to fully manage the group will be considered for a site visit.

Meeting elements to be considered prior to deciding to become a Local Host:

1) ***Proximity to Airport.***
2) ***Sleeping Rooms*** – Dorm rooms (summer meetings only) and proximity to nearby hotels.
3) ***Meals*** – Mostly on own – Proximity to a variety of restaurants during workshops.
4) ***AAPT Workshops*** (Saturday and Sunday only): a minimum of 10 Lab rooms at University.
5) ***PERC*** – Physics Education Research (PER) group begins their "mini" conference for 240 participants, including 50 poster boards, plenary room and five breakout rooms.
6) ***PTRA*** – Possible Physics Teaching Resource Agents (PTRA) meeting for approximately 40 teachers one week prior to Summer Meeting. Will require additional dorm/hotel rooms.
7) ***Additional Pre-meeting Workshops*** – the possibility of an Advance Laboratory Physics Association or Two Year College Workshop would be held during a specific year. Additional information required.

To receive detailed requests for proposal, contact the Programs and Conference Department via *programs@aapt.org* or 301-209-3340.

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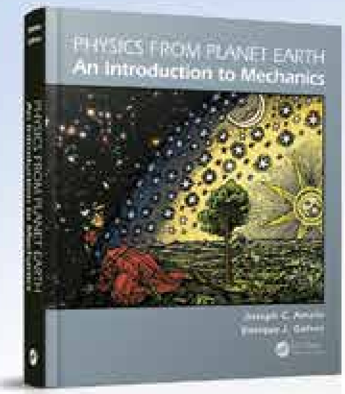

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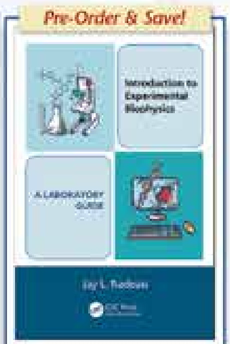

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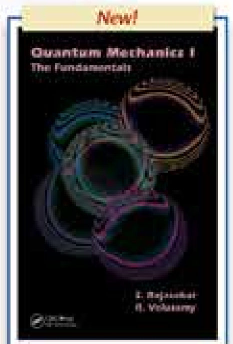

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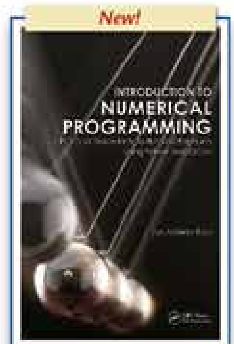

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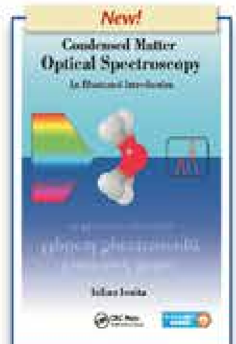

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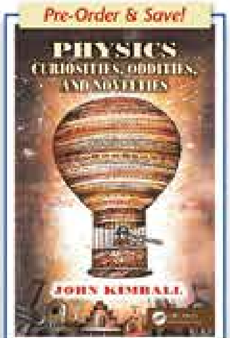

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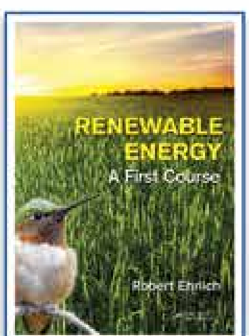

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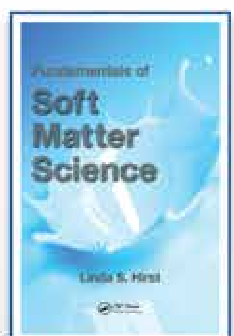

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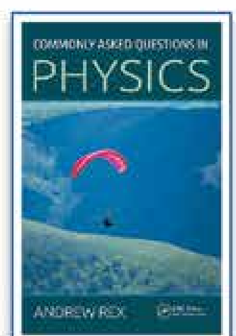

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