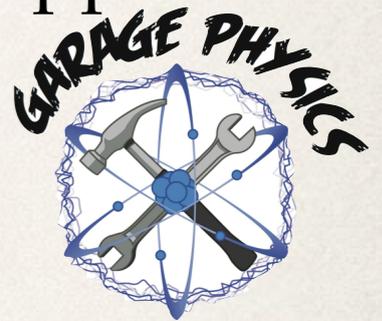


Outline of talk



- Innovation/entrepreneurship trends
- Student innovators and entrepreneurs
- UW-Madison Garage Physics: project-driven learning and support for entrepreneurs.
- Entrepreneurial ecosystem: UW-Madison example
- Program suggestions



Takeaways



- Entrepreneurship is increasingly visible nationally and globally.
- A successful entrepreneur and a successful scientist share many attitudes and skills.
- Physics departments can assist, even provide a home for, interdisciplinary student groups needing a space for research and development, and rapid prototyping.
- Physics departments can provide resources to students interested in exploring entrepreneurship.

Definitions: innovation, entrepreneurship, science, and technology

Mother

[muhth-er] -noun

1. One person who does the work of twenty. For free.

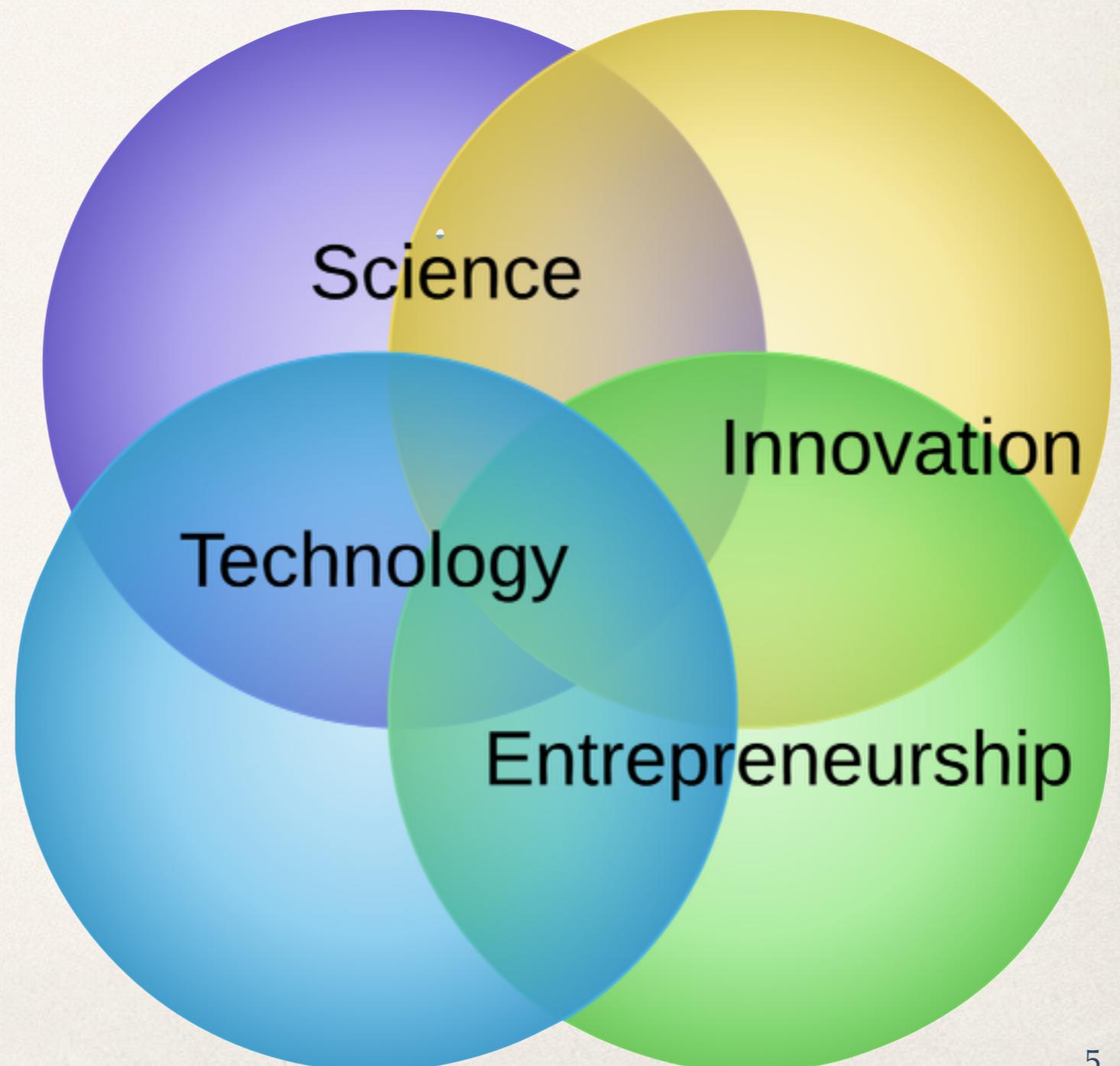
(See also: 'masochist', 'loony', 'saint'.)

JIBJAB

- *Entrepreneurship* is the process of identifying and starting a new business venture. (from Old French *entreprenre* to undertake)
- *Innovation* is introducing something new (from Latin *innovate* to renew)
- *Science* is the intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment.
- *Technology* is the application of scientific knowledge for practical purposes. (from Greek *tekhnologia* 'systematic treatment', from *tekhnē* 'art, craft' + -logia.

Synergy yields growth

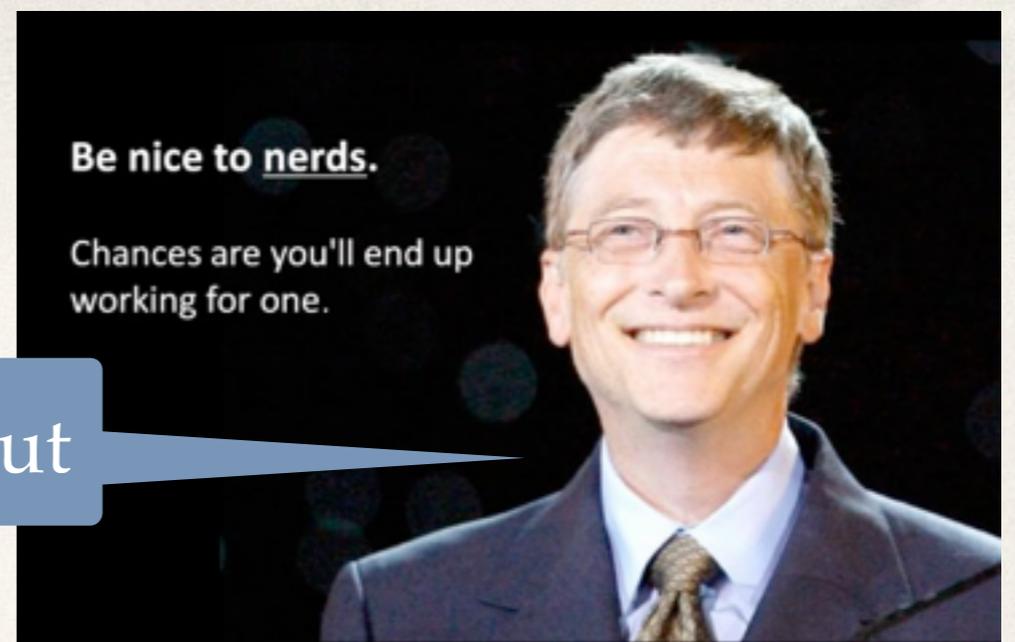
- Science, innovation, entrepreneurship, and technology work together in driving socioeconomic, intellectual, and cultural growth.
- Think camera, motor, radio... transistor, computer, mobile phone, DNA chip...



Famous contemporary entrepreneurs, a variety of backgrounds

- 📍 Elon Musk, SpaceX, Tesla Motors, PayPal (BS **Physics** U.Penn)
- 📍 Jack Dorsey, Twitter (left NYU without degree)
- 📍 Larry Page, Google (BS Comp. Eng. U. Mich, MS CS Stanford)
- 📍 Sergey Brin, Google (BS Math U. Maryland, PhD ABD CS Stanford)
- 📍 Mark Zuckerberg, Facebook (left Harvard)
- 📍 Reid Hoffman, PayPal (BS Cognitive Science Stanford)
- 📍 Sarah Blakeley, Spanx (BA Communications Florida State)

Dropout



Physics



Communications



Entrepreneurs in the U.S.

Global Entrepreneurship Monitor

<http://www.gemconsortium.org/docs/2804/gem-usa-2012-report>

- 13% of adults of all ages (not just millennials) active; 7 women/10 men.
- 3/4 start a business to pursue an **opportunity** rather than out of necessity.
- Industries: business service 33%, transforming 22%, consumer 41%
- 69% nascent at home, 82% self funded
- ~half adults will be unemployed/self-employed at some point.
- Funding challenges and fear of failure plague the youngest and oldest entrepreneurs most.



Federal support for entrepreneurship

"Entrepreneurs embody the promise of America: the idea that if you have a good idea and are willing to work hard and see it through, you can succeed in this country. And in fulfilling this promise, entrepreneurs also play a critical role in expanding our economy and creating jobs." — President Barack Obama, January 31, 2011



- Federal support for small businesses is long standing. **SBIR** bridges advanced research generated innovations. New White House programs **Startup America** and **Presidential Ambassadors for Global Entrepreneurship** support entrepreneurship nationally and globally.
- Recent recognition of the role of higher education in entrepreneurship is illustrated by NSF **I-CORPS** (research spin-offs) and **IGERT** (graduate student e-training and assistance) programs.



Presidential Ambassadors for Global Entrepreneurship



• Steve Case, Revolution; America Online, Williams Poli Sci

Technology

• Salman Khan, Khan Academy, MIT Math, EE, CS

Education

• Helen Greiner, CyPhy Works; iRobot Corporation, MIT Mech. Eng.

• Daphne Koller, Coursera, Hebrew U

• Reid Hoffman, LinkedIn

Social media

• Hamdi Ulukaya, Chobani, Ankara Poli Sci

• Rich Barton, Zillow, Stanford, Eng.

• Nina Vaca, Pinnacle Technical Resources, Texas State Speech Comm.

• Tory Burch, Tory Burch, U. Penn. Art History

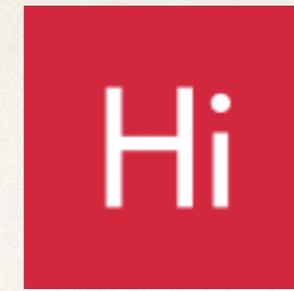
• Quincy Jones, Quincy Jones Productions,

Culture

• Alexa von Tobel, fLearnVest, Harvard psychology

University entrepreneurship and innovation programs

- Business schools increasingly offer academic courses in entrepreneurship, focused on business startups, typically at MBA or professional certificate level. Blank's *Lean Launchpad* and similar courses are online.
- Innovation centers, often an outgrowth of an engineering school, are increasing in number. Programs focus on innovation with applied technology.
- Attention now focusing on undergraduates. See NCIIA for support for your program.



Harvard
innovation lab



MIT Fablab



Transformative Learning
Technologies Lab

<https://tltl.stanford.edu/>



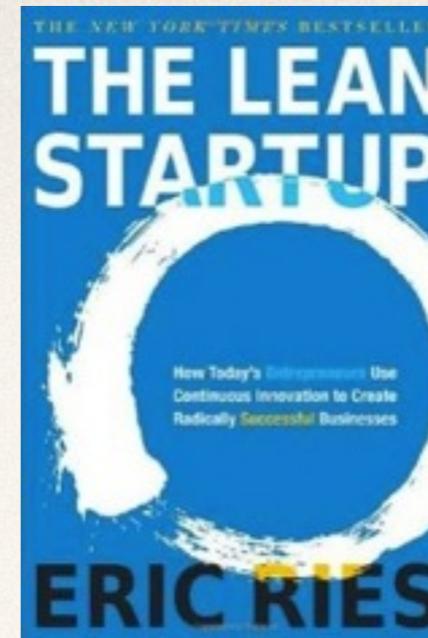
Duke
UNIVERSITY



INNOVATION
CO-LAB

Low new millennium startup barriers

- Lean startup models: Incubators and accelerators invest small amounts in and mentor nascent entrepreneurs, making many low-cost high risk investments, undercutting more discriminating and aggressive investing angels. Crowd source funding is represented by Kickstarter. *The Lean Startup* is a popular guide turning traditional biz dev. on its head: research, biz plan minimum viable product, trial, repeat. Touted as scientific method. Barriers to entry lowered.
- Space: Co-working office spaces / communities are sprouting up; the Makerspace / DIY movement, shareware culture, Fritzing with low-cost electronics, Fablab / 3d printing materials fabrication technologies all enable rapid prototyping of software and hardware. Barriers to entry lowered.
- Information: Patents, technical, science, social, and market information is a click away. Barriers lowered.
- Collaboration: A colleague is available by video conference on your mobile phone with one click. Sharing documents is a click away. Barriers lowered.
- Culture: Science, technology, innovation, entrepreneurship: the new sexy. APPLE and GOOGLE new models for success. Startup Weekend and TV show Shark Tank reflect popular interest in entrepreneurship.



Beyond the hype

- Thinking up a business is fun. Ideas are cheap. Exploring them is fun. Try a Startup Weekend!
- Launching a business poses many challenges: financing, legal responsibilities and liabilities, intellectual property, human resources, marketing, production, quality control, customer management. There are gotcha's and uncertainties. Nimbleness and open mindedness (ability to "pivot") valuable. The same can be said for running a physics research organization. Business is about experimentation.
- 10% "succeed." 30% end for personal reasons. 35% of startups end for lack of profitability.



Global
Entrepreneurship
Monitor 2013 Report

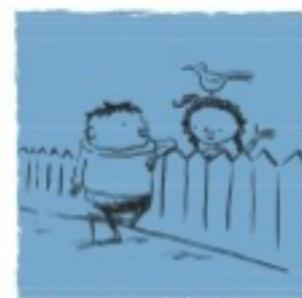
Higher education goals

- Ventures (scientific, social, or commercial) demand critical thinking, creativity, communication, and collaboration. Cultural and interpersonal skills are demanded.
- Technical training e.g. STEM is valuable also.
- Physics curricula typically focus on critical thinking via analytic problem solving, and exposure to fundamental principles and applications in their historical progression.
- Soft skills not a physicist's forte. Idealization/ simplification not complexity valued.

Preparing 21st Century Students for a Global Society

<http://www.nea.org/assets/docs/A-Guide-to-Four-Cs.pdf>

Today's students are moving beyond the basics and embracing the 4C's — "super skills" for the 21st century!



Communication

Sharing thoughts, questions, ideas, and solutions



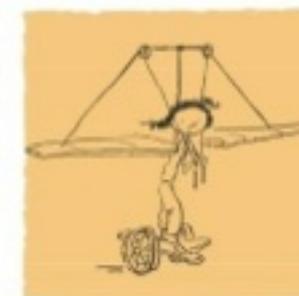
Collaboration

Working together to reach a goal — putting talent, expertise, and smarts to work



Critical Thinking

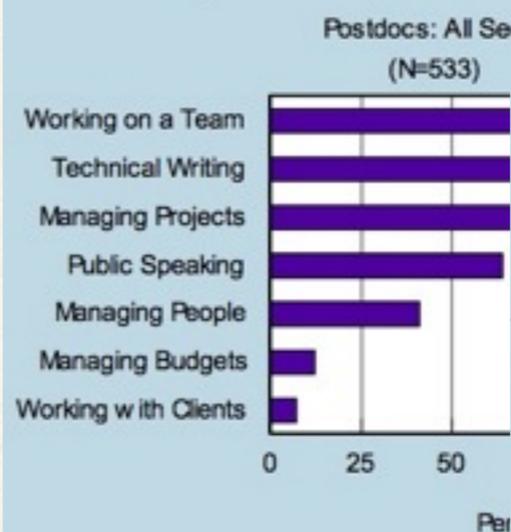
Looking at problems in a new way, linking learning across subjects & disciplines



Creativity

Trying new approaches to get things done equals innovation & invention

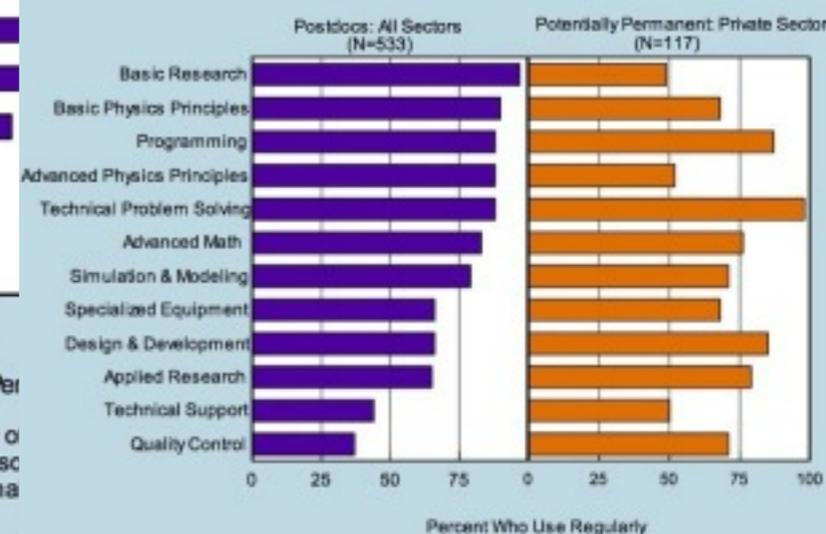
Interpersonal and Management Skills Regularly Used by New Physics PhDs, Classes of 2009 & 2010 Combined



Percentages represent the proportion of "monthly" on a four-point scale that also U.S.-educated physics PhDs who remain

<http://www.aip.org/statistics>

Scientific and Technical Knowledge Regularly Used by New Physics PhDs, Classes of 2009 & 2010 Combined



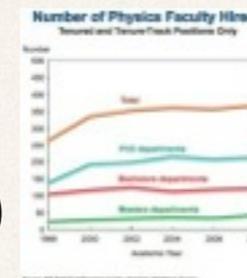
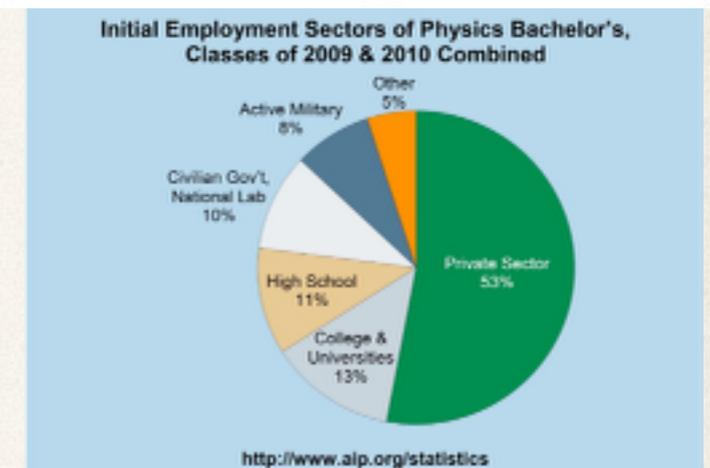
Percentages represent the proportion of physics PhDs who chose "daily", "weekly" or "monthly" on a four-point scale that also included "never or rarely". Data only include U.S.-educated physics PhDs who remained in the U.S. after earning their degrees.

<http://www.aip.org/statistics>

Physics students follow many tracks

- 6800 bachelor's degrees are awarded in the U.S. annually.
- 53% of physics majors are employed in the "private sector." (not .gov or .edu)
- 1800 PhD degrees (~half domestic) are awarded in the U.S. annually.
- 350 physics faculty are hired. (5% of bachelors)
- Physics majors follow many tracks in life. For most students, physics classroom and research experience does not lead to a physics academic or research career.

Total Physics Degrees Academic Year 2011-2012	
Bachelor's	6,778
Exiting Master's	801
Enroute Master's	992
PhDs	1,765



Don't Take Our Word for It!

Read Real Physicist Profiles



Curing Cancer
[Albin Gonzalez](#)



Healing Joints
[Marta McNeese](#)



Science Comedy
[David Cohen](#)



Policy Analysis
[Alison Binkowski](#)

The whole student; where entrepreneurship fits in physics ed

Social cultural knowledge: history of physics, physics as a community, natural philosophy, integrity

“Perspective”

Who am I?



Scientific reasoning: physical laws, problem analysis, quantitative reasoning

“Skills”

Experiential learning: REU, internships, business, policy, finance, law, international

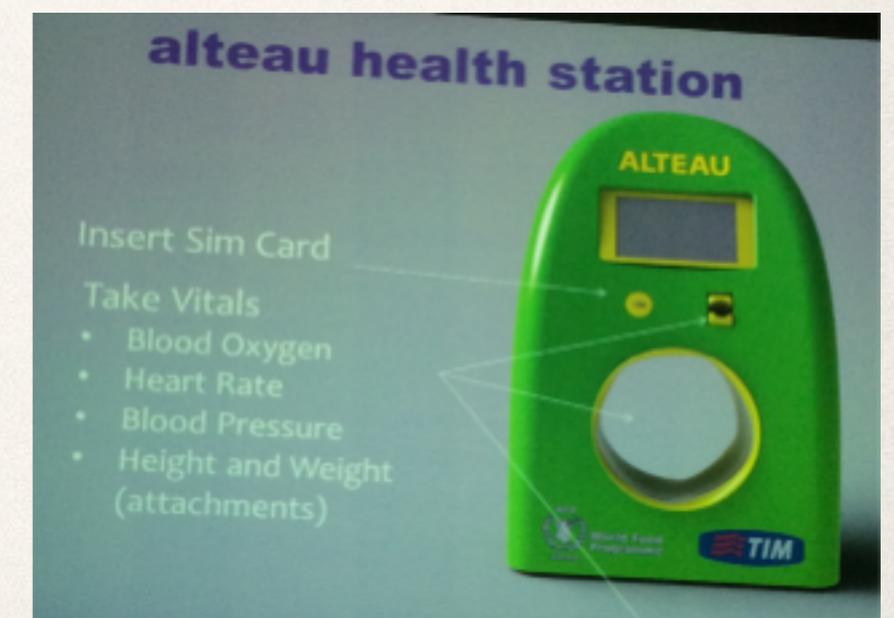
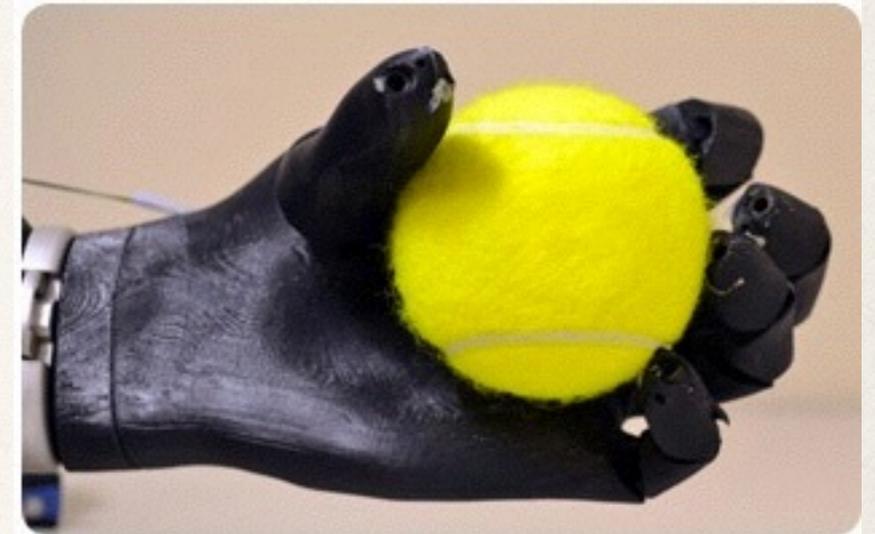
ENTREPRENEURSHIP

Communication skills: library, papers, lab reports, presentations and posters, collaboration



Model undergraduate entrepreneur

- UW undergraduate Eric Ronning, an engineering student in 2011 UW-Madison introductory physics.
- In 2011, Ronning 3d-printed a prototype prosthetic hand at local makerspace Sector67. In 2012, as a sophomore, Ronning launched **reprothetics.com**, and, in 2013, developed new pump mixer design. In 2014, assisted by Morgridge Institute for Research's medical devices group, Ronning competed for the \$1M Hult Prize, to develop a hardware and software system to address chronic, non-communicable disease in urban slums.
- *"Though health care is not within the scope of our studies as engineers, we think that our unique experiences of brainstorming, prototyping and problem solving will make for a successful and innovative result that tailors to the Wisconsin Idea of giving back," Ronning said.*



How to foster undergraduate entrepreneurship



HOUSTON	#3	undergraduate entrepreneurship
UCLA	#8	undergraduate entrepreneurship
	#16	graduate entrepreneurship

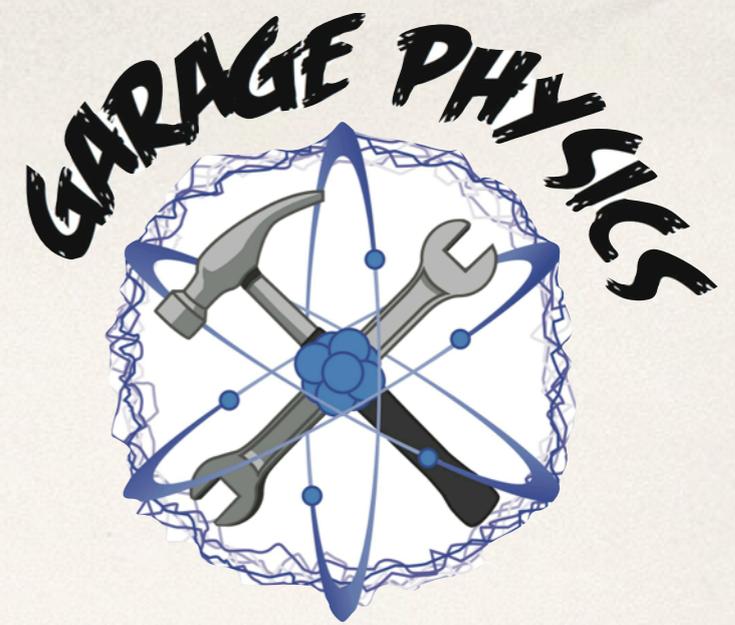
- ❶ Challenge students to identify, evaluate, and develop solutions to real world problems throughout the curriculum. Promote looking at/looking for problems as opportunities/challenges. (engagement, brain storming, wide and deep education, life long learning)
- ❷ Provide opportunities for just-in-time learning with existing technology (play time) and provide a chance to MAKE something that matters to them.
- ❸ Educate specifically in innovation through examples and opportunities throughout the curriculum, and provide scaffolding in rudiments of startup development.
- ❹ Connect to a community of peers, mentors, and role-models, both on and off campus. Invite entrepreneurs to classes, to give seminars. Value them.
- ❺ Provide space and financial support for student R&D, finding partners, mutual support.
- ❻ Provide support network for taking a venture idea to a competition, into startup and beyond.

Student motivation



- 🎧 “I am applying what I learn in physics class and can learn what I need when I need it.”
- 🎧 “I am taking charge of my learning, my life. Maybe my ideas are good ones.”
- 🎧 “I like the sound of CEO. If those students can do it, may I can!”
- 🎧 “If this venture comes to nothing, I have nothing to lose.”
- 🎧 “If this venture flies, I can pay for college and, gosh, dream big.”

Garage Physics: Innovation and entrepreneurship in an open maker-style laboratory



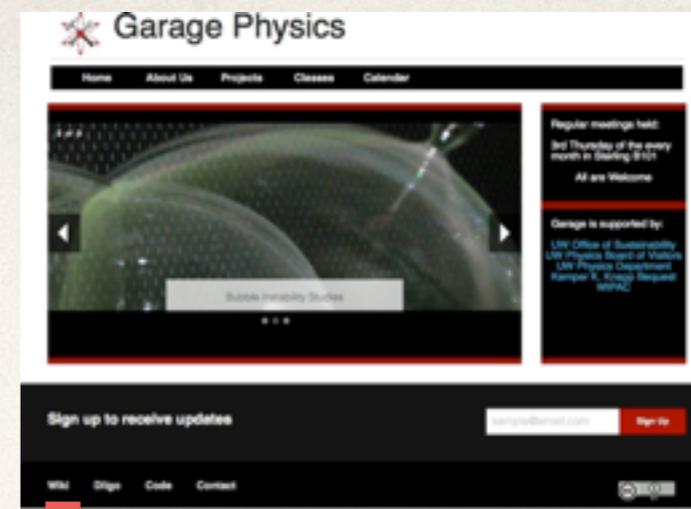
- Garage Physics is a new open lab for undergraduate research and project oriented learning at UW-Madison. The Garage supports research training, interdisciplinary innovation, and entrepreneurship in a maker-style environment.
- In 2013-14, independent projects included quadcopter construction, 3d-printing for recycling and food, and muography for archaeology.
- The Garage was also home to a class in sustainability, which has produced Arduino controlled hydroponic food production and grey water recycling prototypes.
- The operation of the lab, the graduate student mentoring model, and a potpourri of projects will be described.

Garage Physics operation

- Lab and surplus research equipment provided by Physics Department and faculty. Online basic safety training and buddy rule required for key access.
- 2013-14, Physics Board of Visitors Fund for Undergraduate Research supported projects. SIRE grant supported ECE379 graduate assistants (Ebert, Wisher, Graf, Lacy). In 2014-15, additional support from Kemper Knapp bequest.
- Instructional lab manager and two physics graduate students provide assistance and supervision. Undergrads in Physics Club provide office hours.
- Monthly formal projects meeting. Monthly informal pizza meeting.



Garage Physics wiki



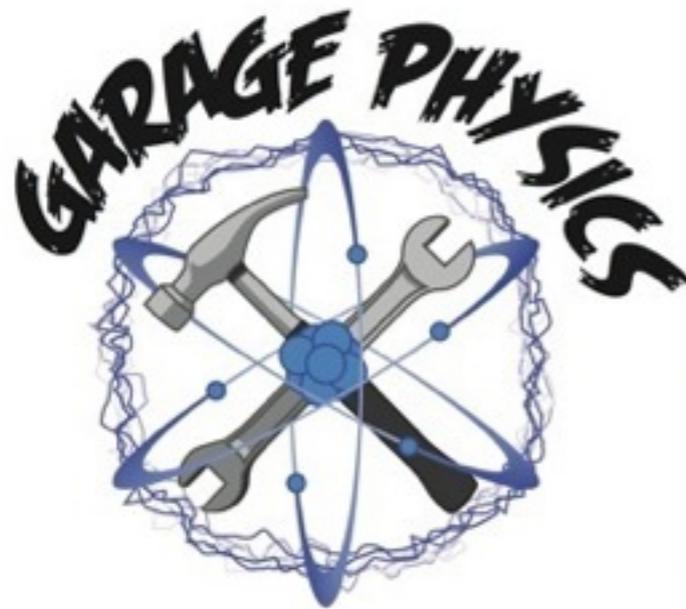
DuncanCarlsmith Settings Logout

Self: **FrontPage**

3D Food Printing » Awards » Projects » EEG » FrontPage

FrontPage RecentChanges FindPage SiteNavigation HelpContents

Edit (Text) Edit (GUI) Info Subscribe Remove Link Attachments More Actions:



Garage Physics

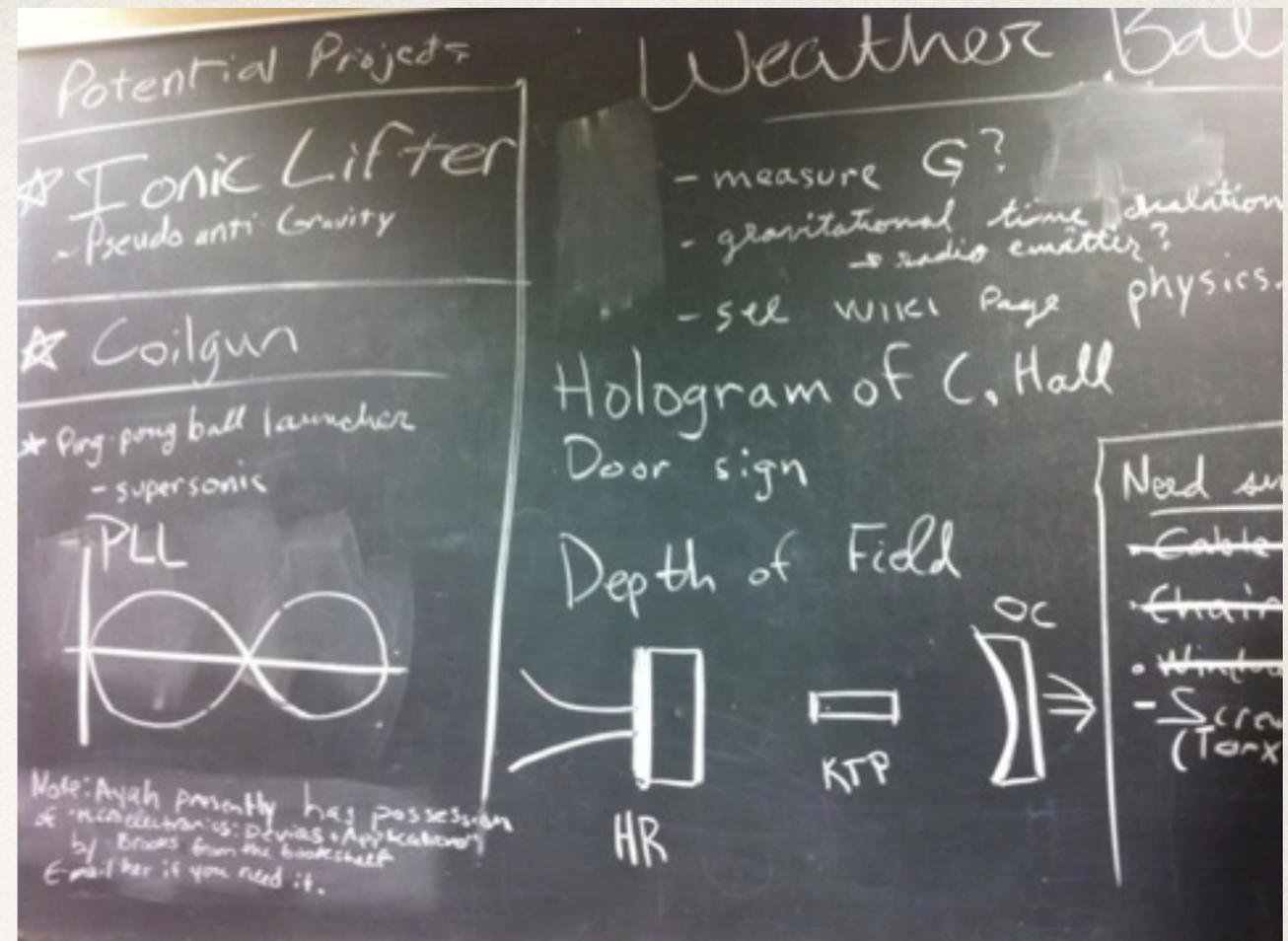
To learn about Garage Physics, visit www.physics.wisc.edu/garage.

What students do in Garage

- Take a mini-class in soldering or shop, SolidWorks CAD, Arduino, or 3d-printing.
- Join or launch a research project. Earn independent study credit or work “off the grid.” Undergrads and graduate students welcome.
- Connect with other physics majors and graduate students, with students and scientists outside physics, and with the business community.
- Explore entrepreneurship and applications of physics.
- Travel. Participate in Science Fair, Startup Fair, and business competitions.
- Learn about and practice teamwork and presentation skills and tools.

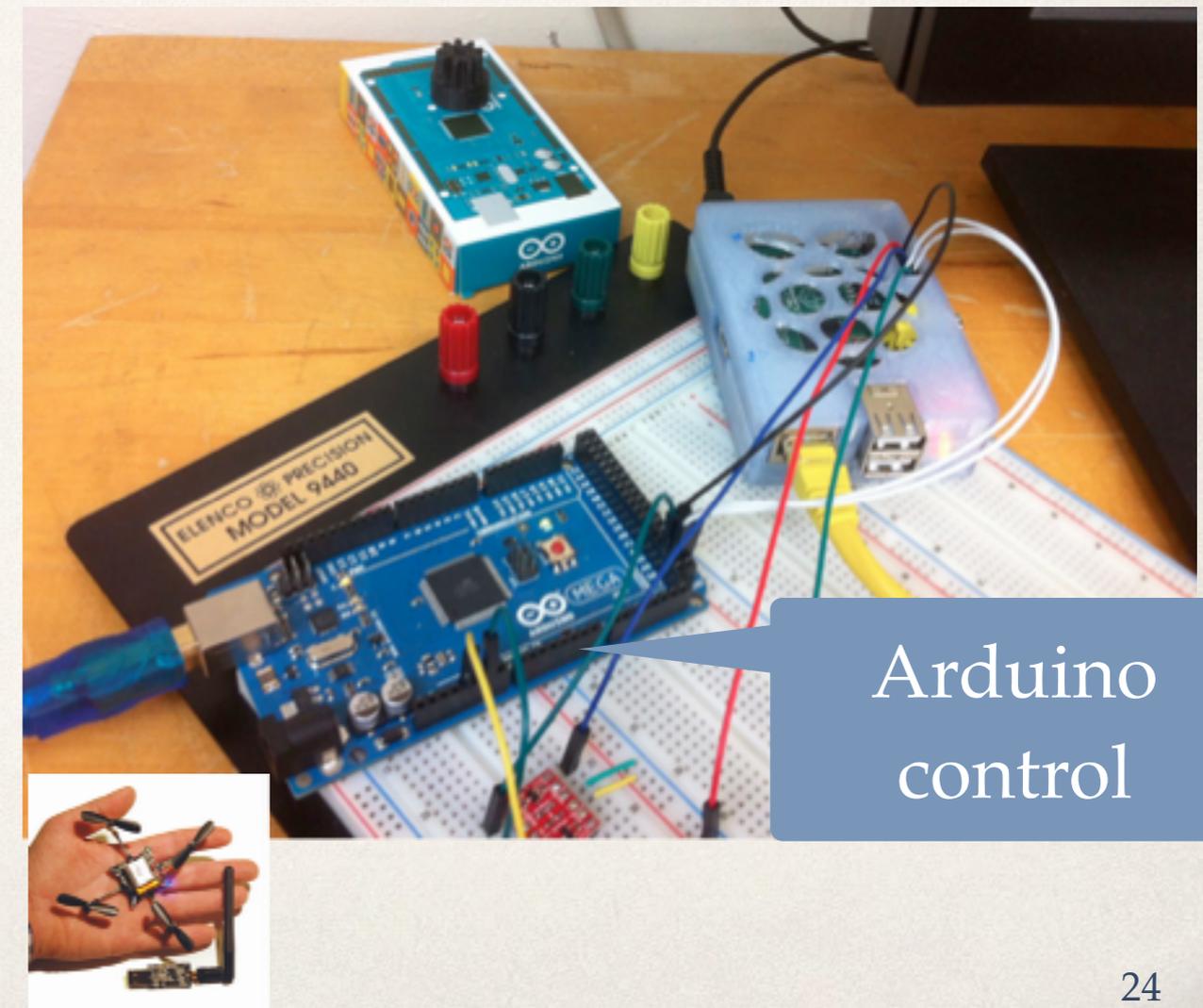
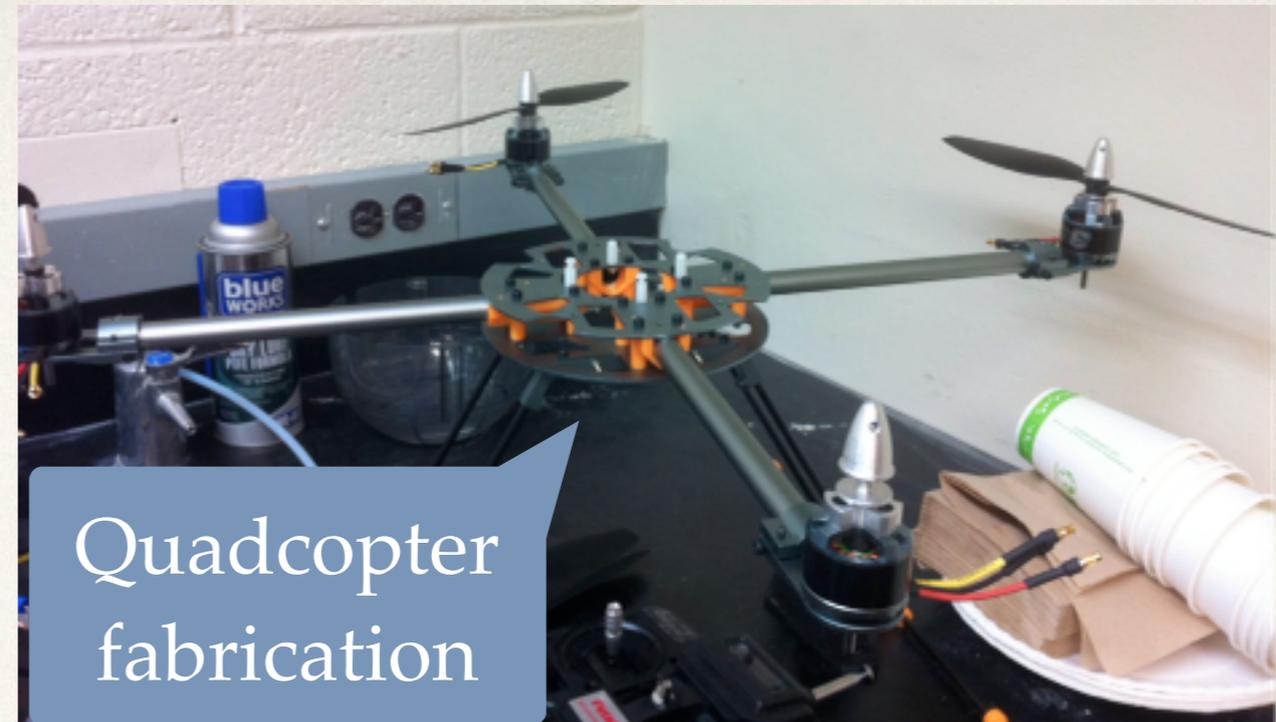
Project sample (2013-14)

- Quadcopters
- EEG brain computer interfaces
- Bubble membrane dynamic stability
- 3d printing recycling
- Sustainability initiatives
- Muon tomography, LIDAR, and photogrammetry for archaeology
- High altitude balloon

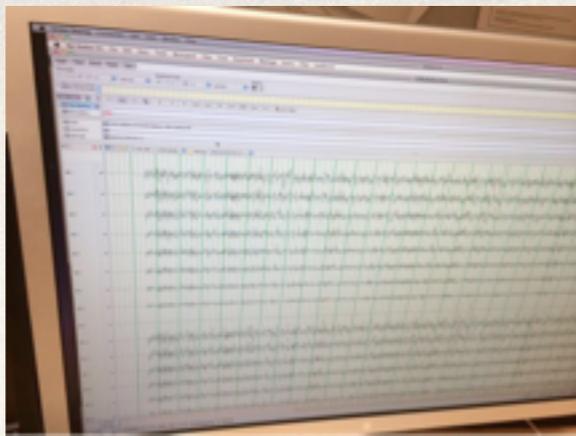


Quadcopter

- Drone/Unmanned Aerial Vehicles (UAV) platforms are a “ballooning” industry. A multi-copter is an electric powered multiple-rotor helicopter. Flight is controlled by varying rotor speeds independently.
- A UW-Madison/University of Copenhagen student collaboration constructed two quadcopters from scratch and collaborated on control by Arduino and Raspberry PI consumer-grade computers.
- Landmine detection? LIDAR? Swarm search and rescue? amazon.com?



EEG/BCI



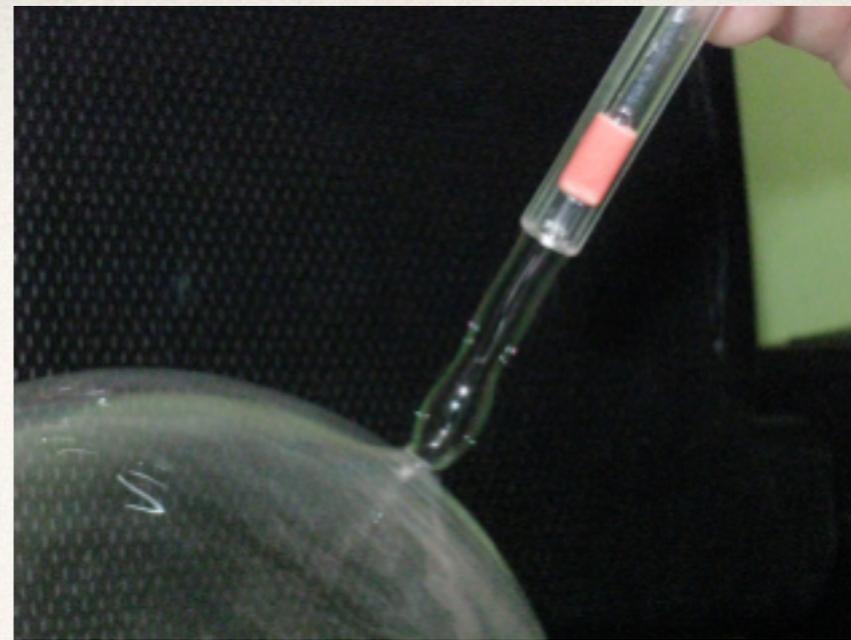
- Electroencephalography (EEG) records brain electrical activity.
- Brain computer interfaces (BCI) allow a person to control something like a robot with their thoughts.
- The goal of this EEG/BCI project is to use EEG to control a quadcopter and then the internet of things.
- HIVEMIND competed in Burrill Biz Competition.



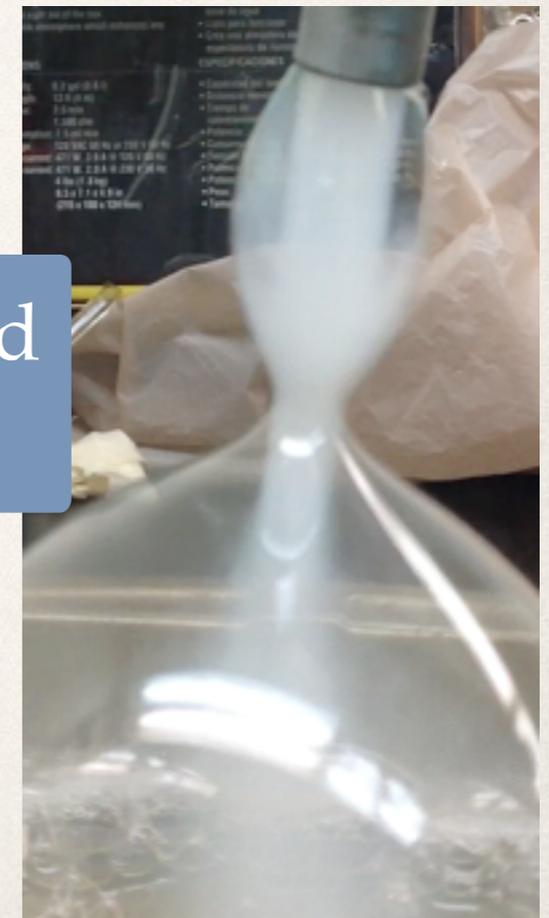
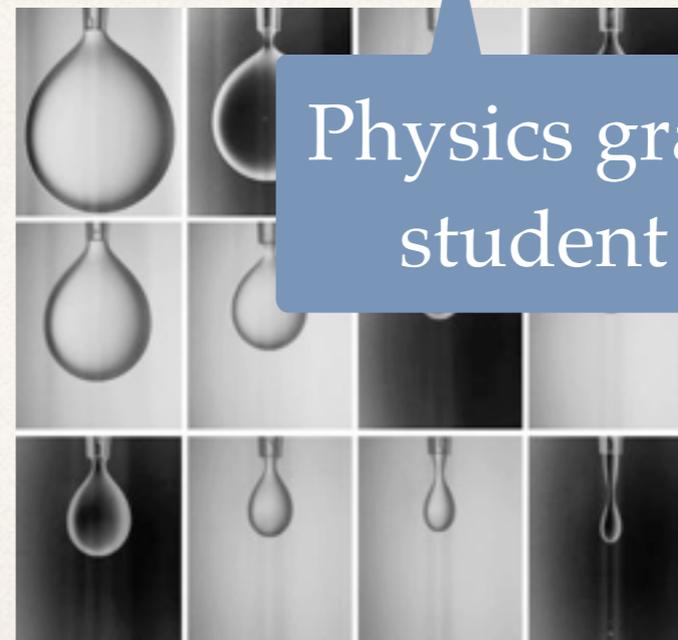
Business competition

Bubble stability

- If you blow a bubble with a straw, an oddly stable tube structure appears.
- The goal of this research project is to understand the stability and shapes, and the relation to the Rayleigh-Plateau instability in drop formation.
- Applications to microbubbles for drug delivery?



Physics grad student

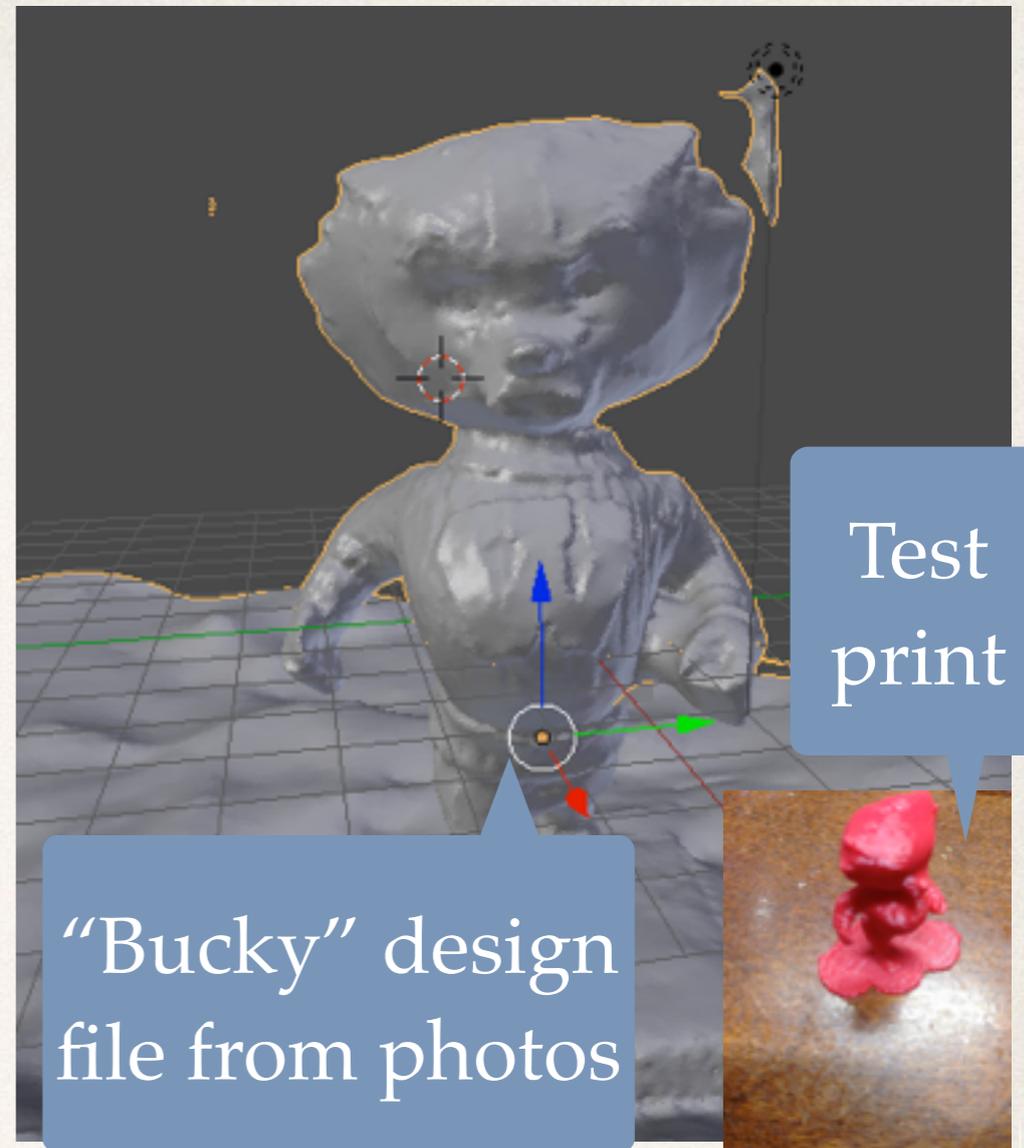


3d Printing recycler



1st yr research scholar

- A 3d printer such as the Makerbot in Garage “prints” a three dimensional object as a succession of layers.
- Many startups (one by UW graduate students) are marketing such printers.
- The goal of this project is to investigate “personal recycling” of plastic using 3d printers.

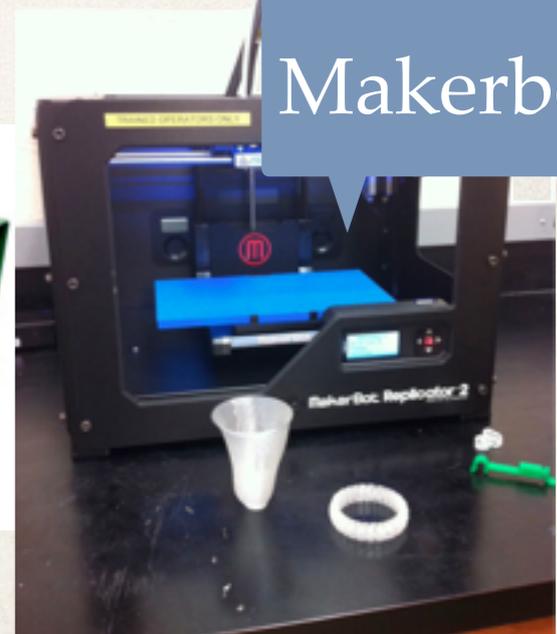


Test print

“Bucky” design file from photos



Filabot



Makerbot

3d food printing

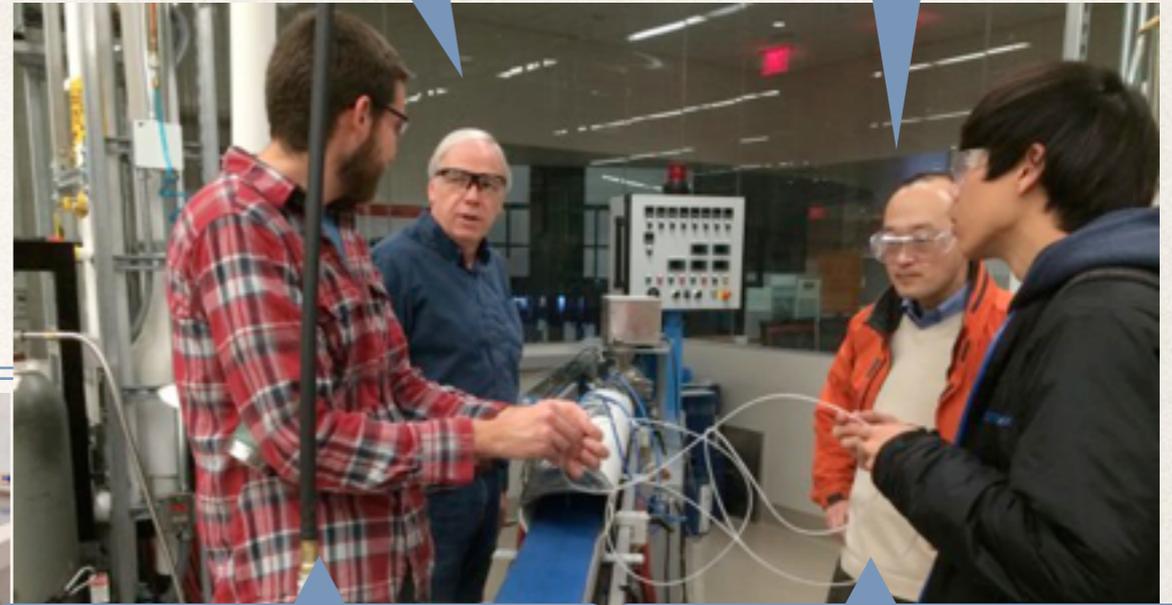
The goal of this project is to 3d print foods that could not be made with conventional techniques.

Fractal cake anyone?

New tastes?

Lab manager, artist

Fac., Food Sci



Senior, landscape arch

1st yr research scholar



Powder bed 3d printer



Living pantry

One student group in a Garage-based interdisciplinary class WI Make Sustainability prototyped in Fall '13 an Arduino-controlled LED-lit hydroponic food production appliance.

Living Pantry V2 competed in 2014 Ag. Innovation Competition (\$100,000 1st prize)

Markets: consumer, restaurants, K12, food deserts, space.

The Living Pantry
Kelly Kayser, Sarah Murphy, Nathan Little, Matt Stumpf
The University of Wisconsin-Madison

PROJECT GOALS AND OBJECTIVES
Recently September '13 WI Sustainability, a new engineering course at UW-Madison, after being discussed surrounding sustainability, we created groups and set out to design a sustainable invention. We decided to tackle a household technology system.
We wanted to build a low-energy structure that could be used to provide fresh produce to the population. By building a low-maintenance, highly automated system to provide water, lighting, and fresh air to various plants, we hoped to create a system that was simple enough for anyone to use. We also wanted to have a lot of variety in the types of plants that a user would be able to grow.
CURRENT FOOD SYSTEM ENERGY USE
The transportation and processing for food products accounts for a substantial amount of energy consumption throughout the world. "Although specific statistics for the percentage of overall transportation used for food distribution are not available... the food sector made up 18 percent of U.S. energy consumption, with transportation accounting for 11 percent of the food sector's energy consumption" (Shriver, 2008).
In recent years, the divide between the consumer and producer has grown. American food analyst Barbara Specter argues, "The distance between the little knowledge about the production processes used in creating their food and the impact of these practices on their health or the environment" (Shiv, 2007). Our hope is to bridge this distance and allow many people and families alike to produce at least part of their meals within their homes.
LED AS GROW LIGHTS
A relatively new source to the world of indoor grow systems, whether the system is hydroponic or otherwise, is the use of LED lighting as a grow lamp. Recently, NASA has conducted their own experiments to see if LEDs would be a reliable source of light. They found in the past that LED lights were not suitable, but as technology has advanced, the output has increased, making them a very useful and versatile source of light.
LED light have proven themselves to be quite sustainable as well, since they required less energy to create more light for the plants to use. These LED lights can give you just the specific wavelengths that the plants require (in blue and red/orange), they do not waste the energy it takes to create all the other colors in the white light that an incandescent bulb would produce.

PERSONAL EXPERIMENTS WITH LED AS GROW LIGHTS
According to many sources that we studied in our research, green lights were the greatest way to specifically distance from the plant for optimal light exposure. To implement this in our prototype, we would need to design a pulsed system that turns the light up as the plants grow. Determining that this would be a large amount of work, we decided to complete our own experiments to determine if distance affects light fluxes measurements.

Our test involved using a silicon photodiode to measure the fluxes, or light intensity, of the panel of LED grow lights we purchased for our prototype. Our first test measured the intensity at the center of the panel as well as the edges. As seen in the graph above, the edges receive significantly smaller amounts of light, especially as the distance increased. Once we added a reflecting aluminum side, the fluxes at the edges remained constant as the distance increased. All of the values have been normalized to one.
The results from our experiment allow us to eliminate the need for a pulsed system to vary the height. This rule depends on the amount of automation and coordination programming that needs to occur within the greenhouse. The addition of the reflective surface allows for the plants to receive more light as the distance increases on the top.

ARDUINO PROGRAMMING AND AUTOMATION
From the beginning, we developed a goal of creating an automatic, low-maintenance greenhouse. In order to achieve this goal, we utilized an Arduino microcontroller. According to the manufacturers, "Arduinos can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators" (www.arduino.cc).

In our design, we used the Arduino board to control the light schedule, as well as the watering schedule. While our prototype is still in the development stage, we are optimistic about the ability to control many of our systems with this small, inexpensive device.
To use the Arduino, we created a specific code that allows the panel to communicate with other aspects of the greenhouse. This code can control when the lights turn on, when the pump begins, and when the sensors turn on. Using this small device, we are able to create a relatively self-sufficient greenhouse that requires little attention from the user. It is our hope that we can make this discussion an ongoing process, so we would like to see this product in schools to teach children about hydroponics in an interactive setting.
IDEAL FINAL PROJECT AND FUTURE RESEARCH
The ideal final product for the Living Pantry would be a product that can be manufactured on a large scale and could be used either as a learning tool for elementary and middle school students or used as a source of fresh produce in homes or urban areas. The focus of this product would be to create a self-sufficient, self-watering system that would be contained within the container, out of sight. Additionally, the product used in other areas would be much more automated, and would handle panel control on its own and produce more energy-friendly systems for themselves at their homes. The use of low-cost sensors would be a key feature that is in these systems that would allow the user to monitor the environment. We hope to see the implementation of the product in the future.
We also plan on further reducing the cost to use this product. We hope to create a prototype that would result in the product cost being able to be made for less than \$100. We are currently working on ways to reduce the cost of the product, and we will research ways to improve the efficiency. To create a product that consumers will want to use, we need to be low enough that it is more attractive than the alternatives in the market. We hope to see the implementation of the product in the future.

SKILLS OBTAINED WITH PROTOTYPE PRODUCTION
• Design a circuit for the prototype
• Calculate materials needed and the total cost of project
• Knowledge of the use of LED lamps as grow lamps
• Use of 3D modeling software to create a digital model
• Basic testing and problem solving
• Development and understanding of hydroponic growth systems

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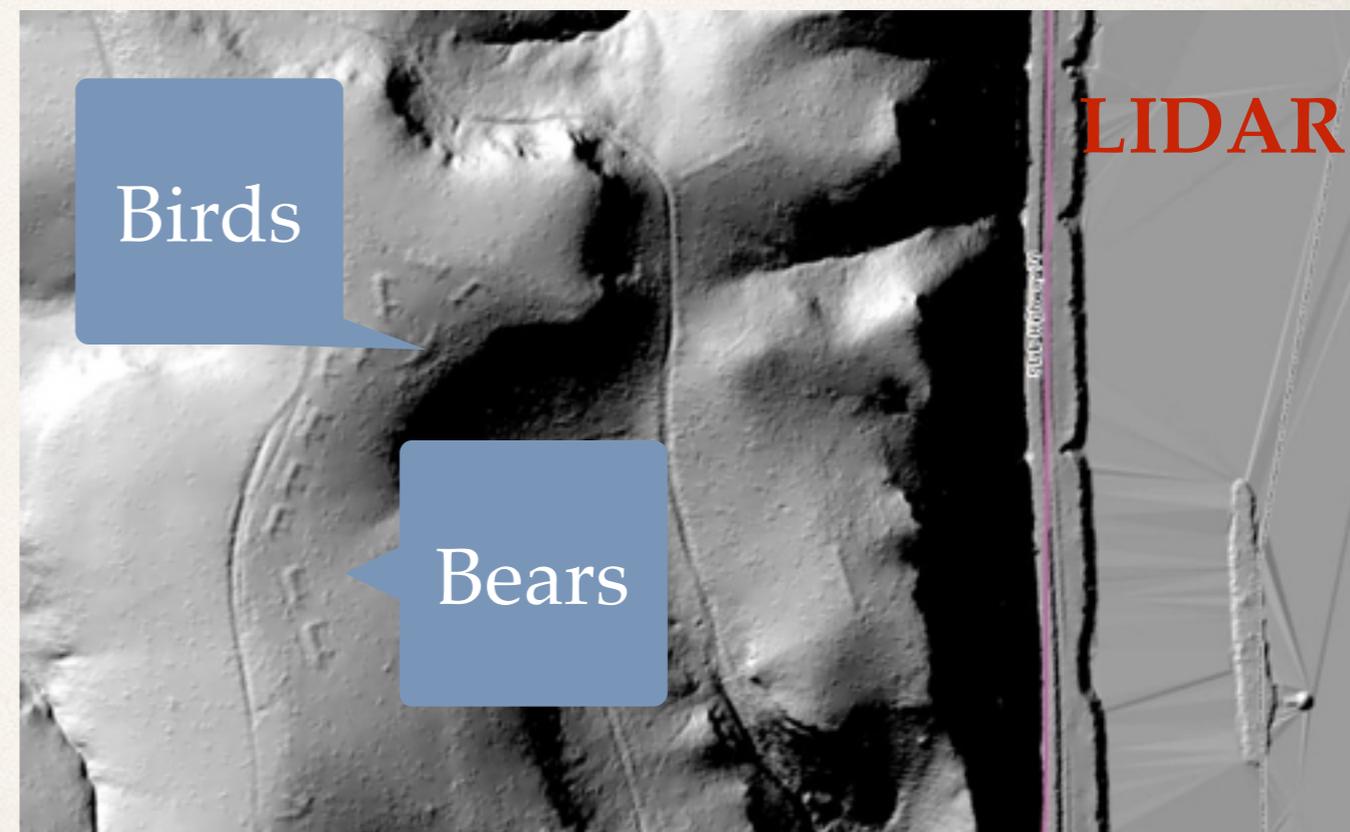
ACKNOWLEDGEMENTS
We would like to thank the UW-Madison Office of Sustainability for the opportunity to create this prototype and research. We would also like to thank Professor Christine Corbett and the Physics Garage staff for providing us the space and tools to create this product. Lastly, we would like to thank Professor Dan Vandenbrink and Professor Tracy Robinson for creating this course that has allowed us to further explore sustainability.



3rd year CS major

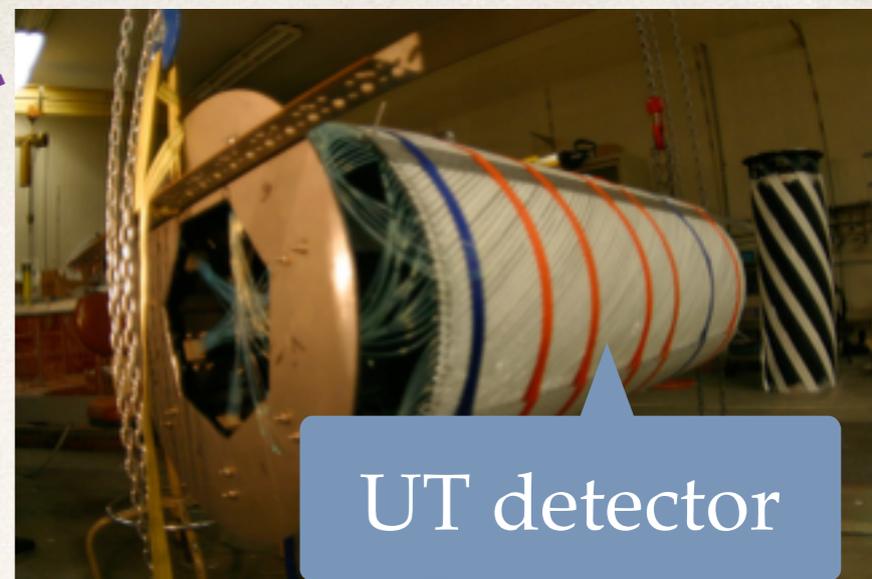
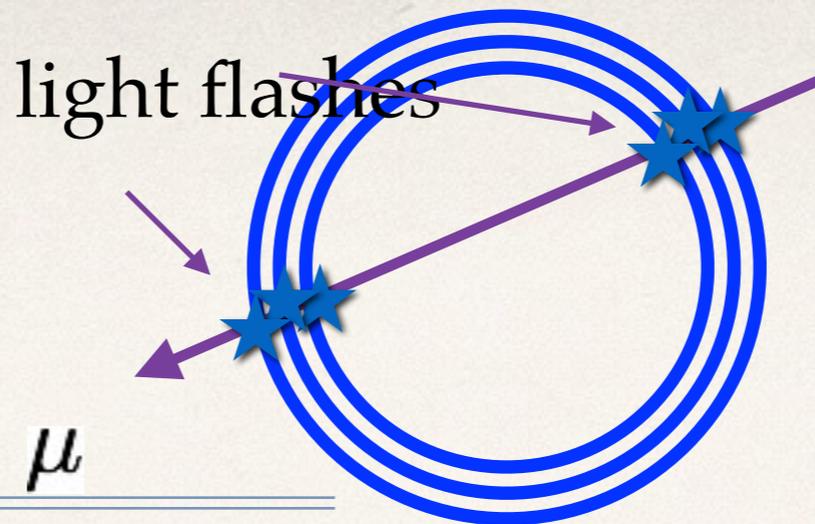
LIDAR

- This project uses public laser Light Detection and Ranging (LIDAR) data to "see through the foliage" for archaeological survey.
- Human occupation in Wisconsin dates back at least 12,000 years. Goal is to find all mounds through digital pattern recognition.
- Applications to agricultural and geological survey.



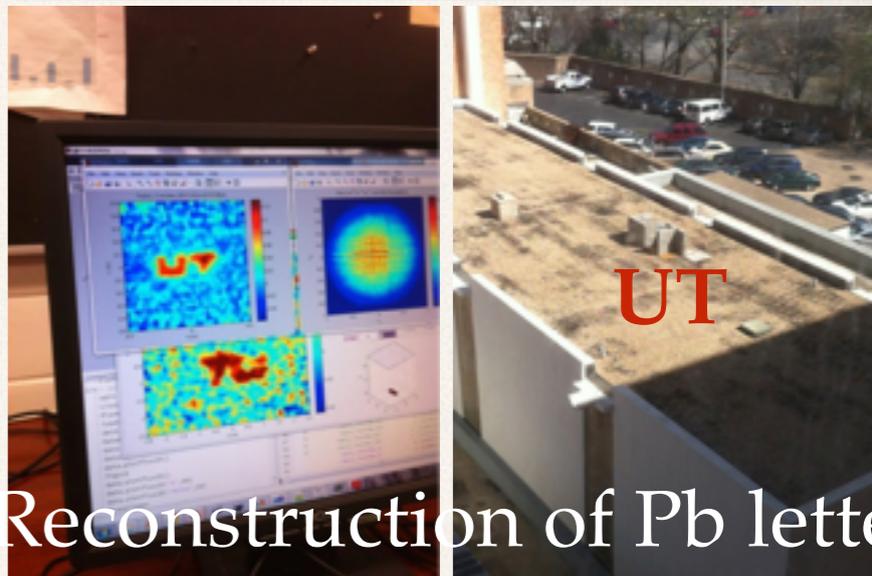
LIDAR-based digital elevation model of effigy mounds in Midwest.

Muon tomography



UT detector

Two UW-Madison undergraduates with support from Garage Physics and a Wisconsin Space Grant in collaboration with the UT-Austin Mayan Muography group study muon tomography feasibility through GEANT simulation and analysis of UT-Austin data and participate in applications in Belize and at Troy.



Reconstruction of Pb letter

Now undergraduate research fellows at Wisconsin Institute for Discovery.



2nd yr, Physics



2nd yr, Physics



Fac. Classics



High altitude balloon

- Student designed helium balloon with GPS tracker system and mobile phone camera payload and radar reflector. All street legal. Airport approved launch.
- Flew from Madison to ~100,000' and landed near Poynette.
- We are hiring a professional tree-climber to recover the payload. Collect spores next time?



Entrepreneurship in Garage

- Entrepreneurship resources in WIKI. Diigo, email, personal, and instructional encouragement.
- Visits / presentation by directors of Ag. Innovation Prize, by Orbitec business development director, and by Dane County Regional Development Association. Student Business Incubator judges of projects.
- Garage students participated in Entrepreneurship Certificate program and summer crash course, Startup Weekend, Hackathon, Startup Fest (gathering of students and local entrepreneurs), local accelerator events, local co-working space.
- Three Garage groups entered business competitions without success but learned loads. Two nascent student companies applied to use Garage.

Partners in the ecosystem

🎧 Garage Physics connects to a variety of campus and community partners supporting student research and entrepreneurship.

🎧 An entrepreneurial “ecosystem” is recognized as paramount in nurturing entrepreneurship.

Wisconsin School of Business Certificate in Entrepreneurship	http://bus.wisc.edu/bba/academics-and-programs/majors/certificate-entrepreneurship
Weinert Center for Entrepreneurship	http://bus.wisc.edu/centers/weinert
Entrepreneurial Residential Learning Community	https://www.housing.wisc.edu/erlc
Undergraduate Symposium	https://www.learning.wisc.edu/ugsymposium/
UW-Madison Educational Innovation	http://edinnovation.wisc.edu/
Morgridge Institute	http://discovery.wisc.edu/morgridge/
Discovery to Product	http://d2p.wisc.edu/
Wisconsin Institute for Discovery	http://wid.wisc.edu/
MERLIN mentors	http://merlinmentors.org/
Advocacy Consortium for Entrepreneurs (ACE)	http://inwisconsin.com/entrepreneurs-and-innovators/launch_blog/uw-madisons-ace-program-for-entrepreneurs/
Wisconsin Alumni Research Foundation	http://www.warf.org/
Wisconsin Center for Education Research	http://www.wcer.wisc.edu/
Wisconsin Delta Program	http://www.delta.wisc.edu/
Capitol Entrepreneurs	http://www.capitalentrepreneurs.com/
Accelerate Madison	http://acceleratemadison.org/
UW Madison Student Business Incubator	http://uwmadsbi.com/
100State	http://100state.com/

Important UW ingredients

- Entrepreneurial Residential Learning Community (1st year)
- Student Business Incubator
- Innovation Center(s) and access to diverse campus physical and human resources
- Academic scaffolding and business competitions
- Connections to community networks and resources.

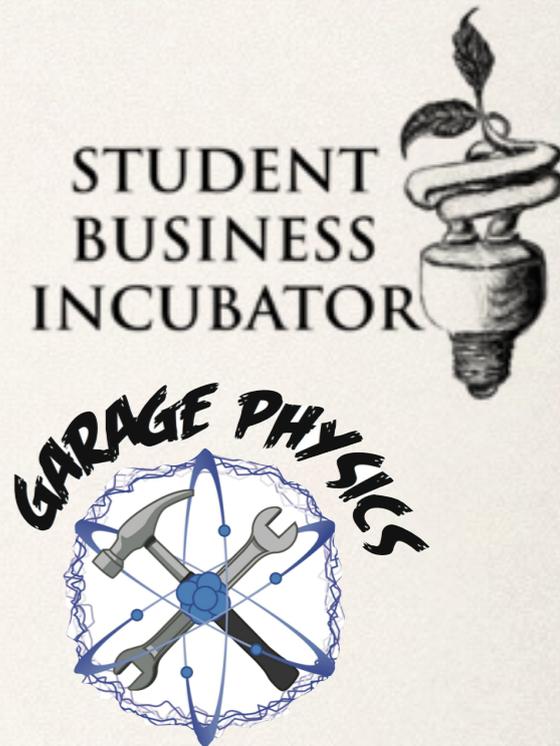


Required Foundation Courseswork (3 credits)

- MHR 322 - Introduction to Entrepreneurial Management (Fall/Spring) restricted to non-business majors
- MHR 422 - Entrepreneurial Management (Fall/Spring)

Wisconsin School of Business - Advanced ESHIP (choose at least 3 credits from list)

- GEN BUS 310 - Fundamentals of Accounting & Finance for Non-Business Majors (Non-business students are highly encouraged to take this course OR Accounting 100 OR 300 before OR concurrently with MHR 422. Prior to fall 2010, GEN BUS 310 was GEN BUS 365.)
- MHR 434 - Venture Creation (Fall/Spring)
- MHR 427 - Entrepreneurial Growth Strategies (Spring)
- MHR 441 - Technology Entrepreneurship (Spring) (Prior to fall 2011 was MHR 365)
- FIN 457 - Entrepreneurial Finance (Fall)



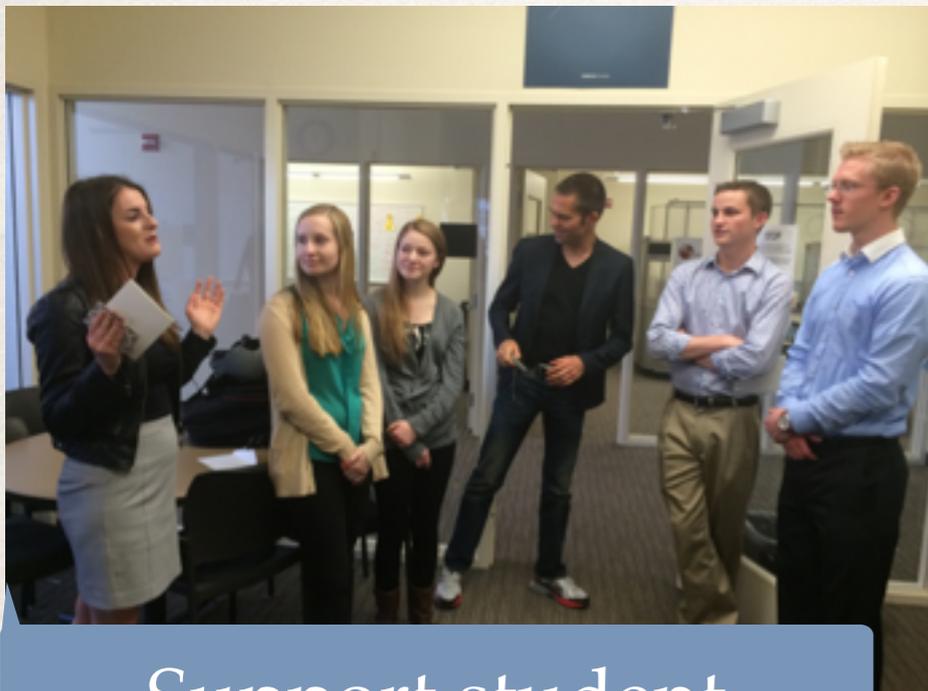
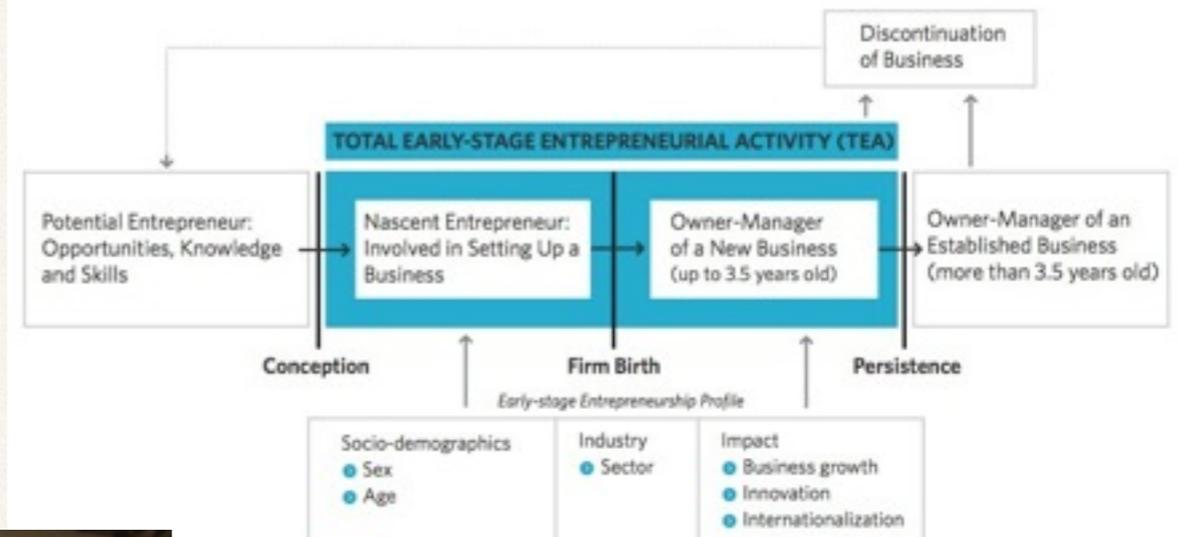
The entrepreneurship process

Global Entrepreneurship Monitor 2013 Report

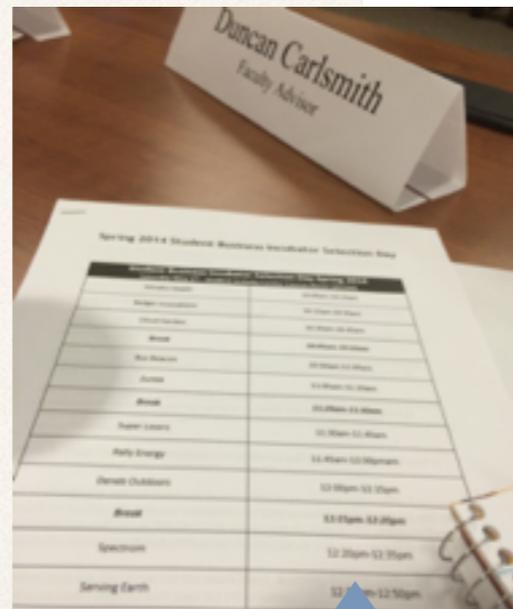
Many factors influence success.

Faculty interest is extremely important!

FIGURE 1.1 THE ENTREPRENEURSHIP PROCESS AND GEM OPERATIONAL DEFINITIONS

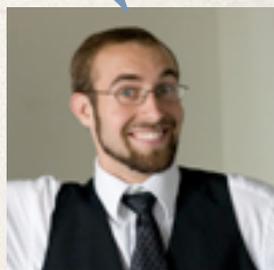


Support student entrepreneurial orgs



Get involved as a judge and advisor

Justin Beck, Perblue CEO, UW intro physics with Carlsmith



Stay in touch with students

Steps you can take

- Learn about and support your campus and local entrepreneurial ecosystem, especially a Student Business Incubator and business competitions. Support participation in national level competitions and events. Investigate funding sources such as NCIIA.
- Encourage your university to offer entrepreneurship classes to all undergraduates, preferably 1st year, and encourage physics majors to take one, or to study entrepreneurship on-line and act on it independently.
- Create an open innovation lab. Staff it with physics graduate students. Connect to other faculty, scientists, staff. Encourage all disciplines.
- Connect yourself and students to alumni and build community.
- Keep track of your students. They might just be immensely successful and reward you.
- See Reinventing the Physicist: Innovation and Entrepreneurship Education for the 21st Century <http://www.aps.org/programs/education/conferences/innovation.cfm>

Takeaways



- Entrepreneurship is increasingly visible nationally and globally.
- A successful entrepreneur and a successful scientist share many attitudes and skills.
- Physics departments can assist, even provide a home for interdisciplinary student groups needing a space for research and development, and rapid prototyping.
- Physics departments can provides resources to students interested in exploring entrepreneurship.

Thank you for your attention

