

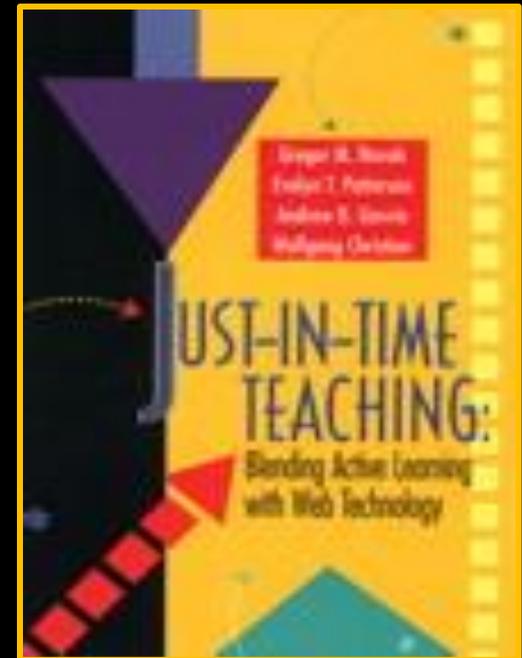
How to Get Your Students to Prepare for Every Class



Mario Belloni, Davidson College

How to Get Your Students to Prepare for Every Class

Just-in-Time Teaching:
Blending Active Learning
with Web Technology



Introductory Comments

- You are learning a lot of techniques, and hopefully very excited about using them. You should not, however, strive to use them all in every class. Pick 1-2 techniques that you think fits your style, your students, and your school the best.
- Whatever you do, “As you enter a classroom ask yourself this question: ‘If there were no students in the room, could I do what I am planning to do?’
If your answer to this question is yes, don’t do it.”
---Gen. Cubero, USAFA

Counter Example

[click me](#)

Outline

- Introduction
- Just-in-Time Teaching
 - “Theory”
 - Implementation
 - Aside: How to get great student evaluations
- Assessment
- Getting started
- Discussion (of What I Forgot/Left Out)

Traditional Instruction

- Classes designed for professors or “pre-professors”
- Problem: Students do not learn like we do
 - Not motivated to be experts
 - Need more time to think
 - Not as good at working alone
 - Not as good at judging their performance
 - Many under greater pressure
- See R. Felder references
(Learning Styles) on Gavrin web site



Technology

- ~~Can make our life easier.~~
- Can open up new ways to interact and communicate with our students.
- Can provide opportunities to ask new and interesting questions.
- Can level the “playing field.”

The (original) JiTT Settings

- IUPUI: Public, urban university
 - 30,000 students, almost 100% live off campus
 - Most work > 25 hours/week
- United States Air Force Academy: Military
 - All students take physics, even historians
 - All play sports, train for military
- Davidson College: Liberal arts college
 - Highly selective
 - Small classes

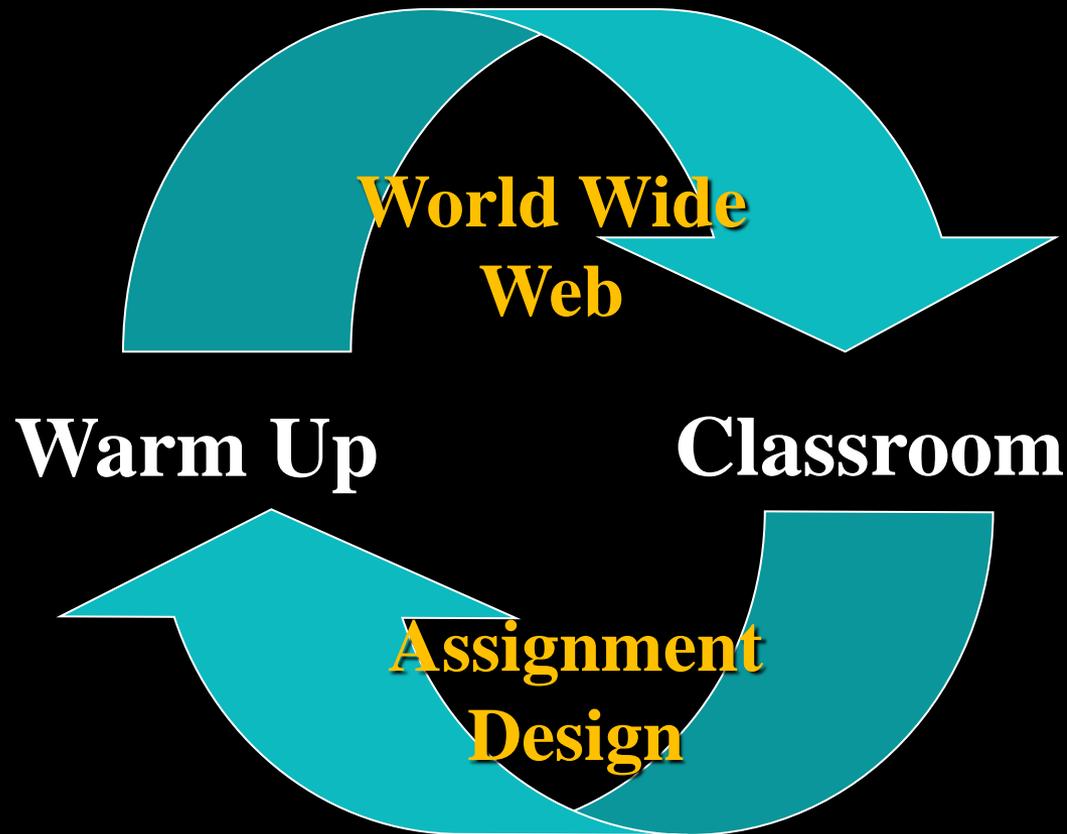
What is JiTT?

- fusion of web based learning with in class learning
- JiTT is a technique derived from the fundamental idea that **improving communication** between students and teachers, especially with low latency and meaningful feedback, will improve learning.
- JiTT is a means to assess student understanding **before** class begins in order to **focus classroom time on content that the students struggled with**, making class attendance more meaningful and worthwhile for the students. JiTT also **encourages more faculty-student interaction**, which has been shown to improve student learning. JiTT can take many different forms, but the idea of any pre-class exercise is to **give students a chance to think about the material before they come to class**.

What is JiTT?

- JiTT is a mechanism that helps to 'invert' a classroom by asking students to complete a web-based assignment before lecture begins, allowing the instructor to use lecture time reacting to student performance on the assignment. JiTT appears to have the benefits of engaging students on their own time, providing the instructor with feedback about misconceptions and 'already mastered' concepts, and 'personalizing' the lecture time.
- Let students do some warm up exercise before class, the feedback to used to make classroom learning more efficient
- JiTT is about using classroom time not to lecture but to addressing the major issues confronted by students thereby making them a more involved participants in the class.

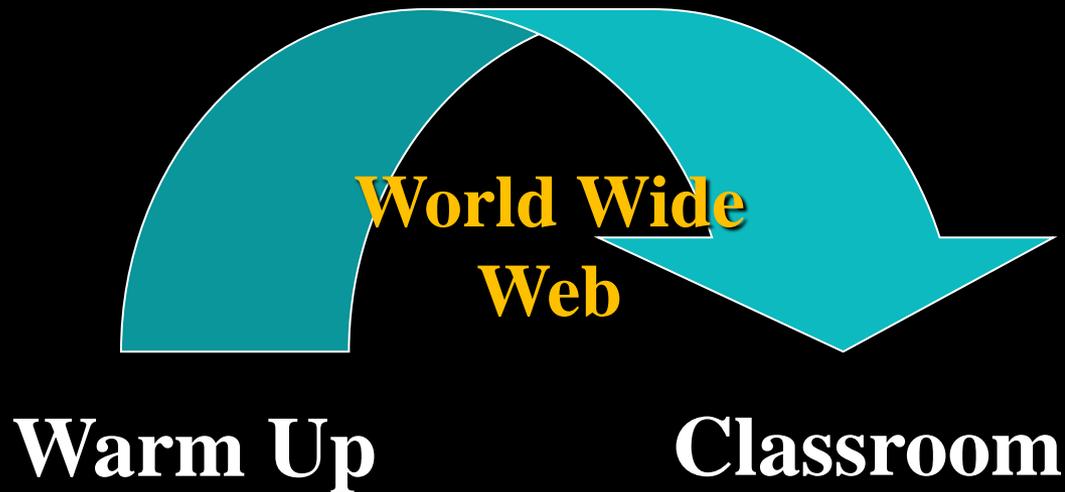
Just-in-Time Teaching (JiTT)



Just-in-Time Teaching

- Adaptable
- Combines “high tech” with “high touch”
- WarmUp Exercises = Online, pre-class “reading” quiz:
 - Due few hours before class
 - A few open-ended conceptual questions
 - Covers the upcoming day’s material
- Instructor looks at student submissions and crafts a lecture around them by:
 - showing selected student responses
 - spending more/less time on a topic
 - primed Peer Instruction

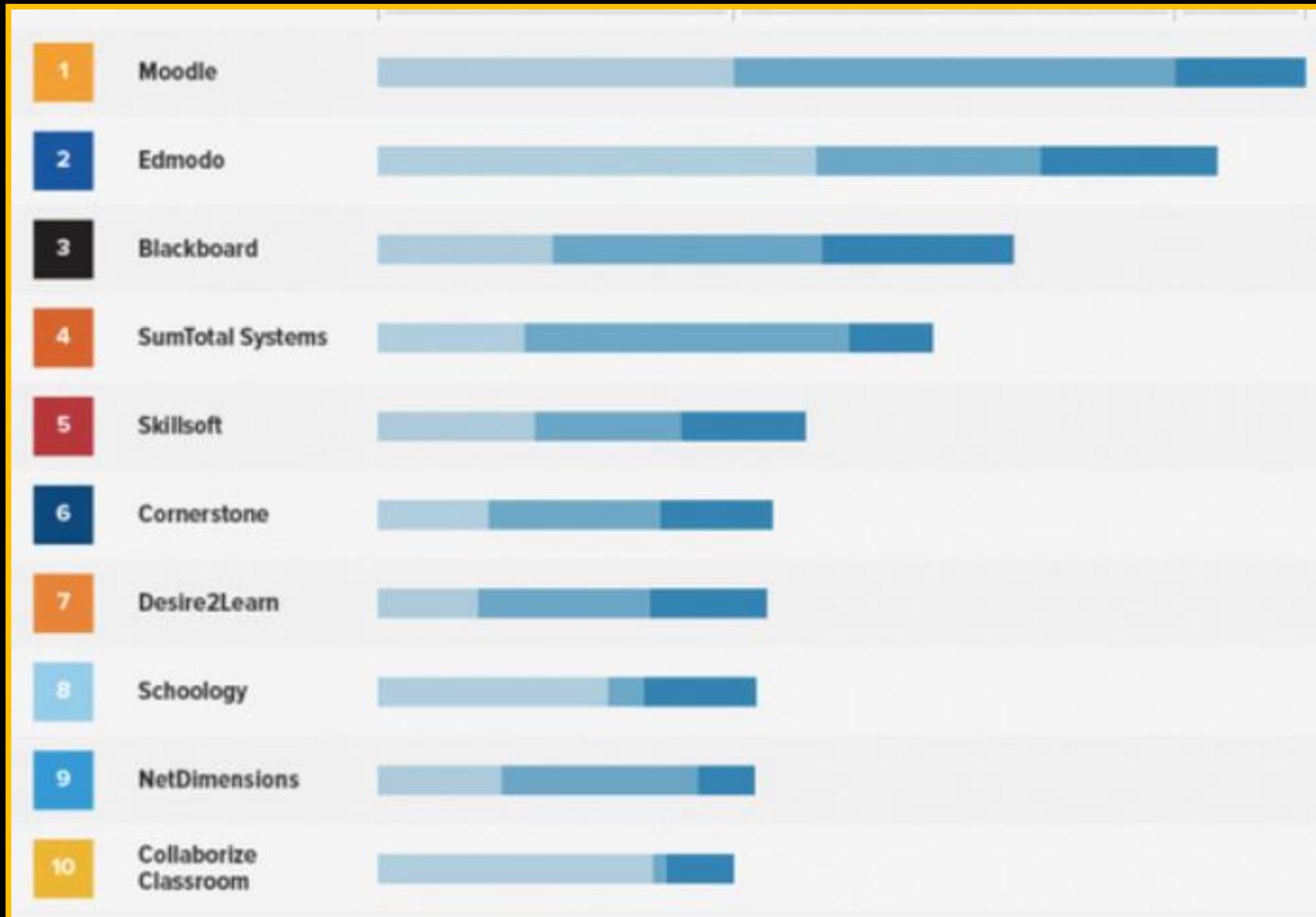
Implementation



Any Course Management System that has “quizzing”

- Blackboard
- Moodle
- WebAssign
- BQ Learning:
<http://bq.bqlearning.org/physlet/index.html>
- And many others....

Implementation



Implementation

June 2013 New Faculty Workshop

Blackboard	34%
Moodle	20%
WebAssign	14%
Mastering Physics	6%
Desire2Learn	4%
Stellar	4%

With one response for: SmartPhysics, SharePoint, Carmen, WESTERNONLINE, Quest, & I have no idea.

Just-in-Time Teaching (JiTT)

The assignments cover material that will form the core of the next lecture and are based on assigned reading or similar. These assessments enable the instructor to tailor the lecture to the comprehension levels of the class.

Warm Up

Classroom



**Assignment
Design**

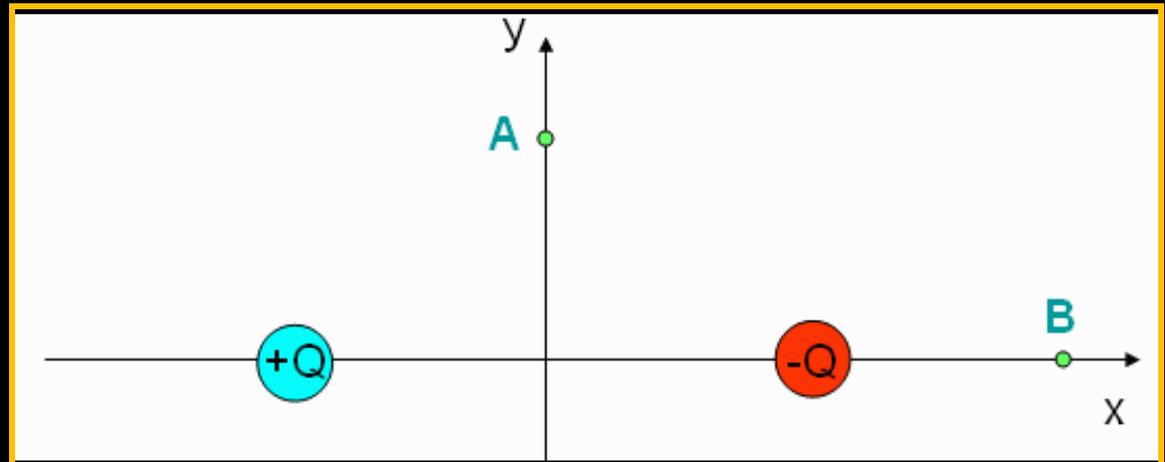
Pre-Flight/Warm-Up/Daily

- goes from basic concepts to more complex details.
the questions could test the level the student is at
and where the teacher can take over
- The questions should not have fixed answers,
instead should be open-ended / thought provoking.
- A good warmup exercise gets the student to start
thinking on their own about the material and to start
developing intuition on the subject.
- They should also try to address common
misconceptions in the field.
- provide the instructor information about where to
focus instruction

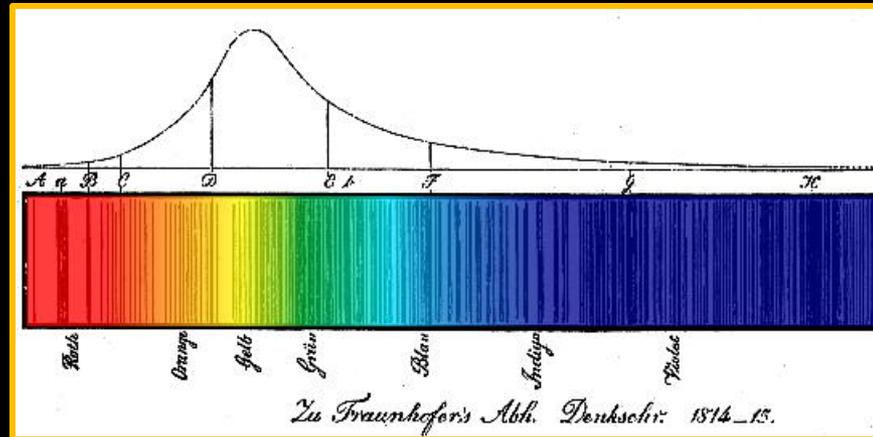
Example

1. Two equal, but opposite charges are placed on the x axis. The positive charge is placed to the left of the origin and the negative charge is placed to the right, as shown in the figure. What is the direction of the electric field at point A?

2. Explain your reasoning



Example



On Monday we will talk about how astronomers analyze light from different celestial sources. This discussion appears in your textbook in the figure on page 113 and the figure on page 106 and the box on page 107. Above is a drawing of the spectrum from an unknown object with a sketch of the relative intensity of each wavelength of light above the spectrum.

1. The unknown object exhibits a _____ (pick one: continuous / bright-line emission / dark line absorption) spectrum. Therefore, the object is _____ (pick one: a blackbody / a hot low-density gas / a blackbody with a cool low-density gas around it).
2. The object appears to be what color?
3. What is the approximate temperature of the unknown object? [HINT: look at page 106 of your book and use Wien's law].

Example

WarmUp Exercise #3, 8/31 (Assignment Due 9/2)

A plane wave in one dimension has the form

$$\psi(x, t) = A e^{i(kx - \omega t)}$$

where k is the wavenumber and ω is the angular frequency of the wave.

1. Can you normalize this wave function? If so, what is the normalization?
2. If x and $-i\hbar d/dx$ are the operators for position and momentum, respectively, is a plane wave an eigenstate of either x or p ? If so, with what eigenvalue?
3. If $i\hbar d/dt$ is equivalent to the operator for energy (it is), is a plane wave an eigenstate of energy? If so, with what eigenvalue?

Questions about WarmUps

- This thingy is weird and boring. I COULD BE WATCHING FRINGE OR ON DRAGON'S DEN.
- I'd like to hear some specific examples for upper level undergrads being taught that way and how much time it takes to prepare a semester worth of classes like that.
- How to engage quiet students who never talk / ask questions / give feedback?
- I'd like to hear a good bit on how to construct effective warm-up exercises.
- I would like to spend extra time on designing the questions for students.

Creating Warmups

How many planets are there?

A: 5

B: 6

C: 8

D: 9

E: 903

Convert to JiTT Warmup

Next 5 Minutes

- Create a Warm Up for one of your classes.
 - Share with your table.
 - Get feedback on how to improve.

Online archive of Warmup exercises

- Introductory Physics (2 semester sequence)
- Introductory Physics Labs
- Statistical/Thermal Physics (2 sets)
- Intermediate Mechanics (2 sets)
- Quantum Mechanics
- Mathematical Methods
- Intermediate E&M (2 semester sequence)
- Introductory Astronomy
- Modern Physics

http://webphysics.iupui.edu/warmup/physics_archive.html

smartPhysics

- Calculus-based Mechanics, E&M
- Pre-lecture videos (~15min/class)
- Small, paperback text
- Integrated homework, “checkpoints”
- Authored at UIUC by Gladding, Stelzer, Selen
- Published by W. H. Freeman
- ~\$40/semester

<http://www.smartphysics.com/smartphysics/default.aspx>

Simulations: Physlets

So getting a little ahead of ourselves....Christian/Mason

- **Physlets:** WC / Since 1998 / Java based: Mac and PC

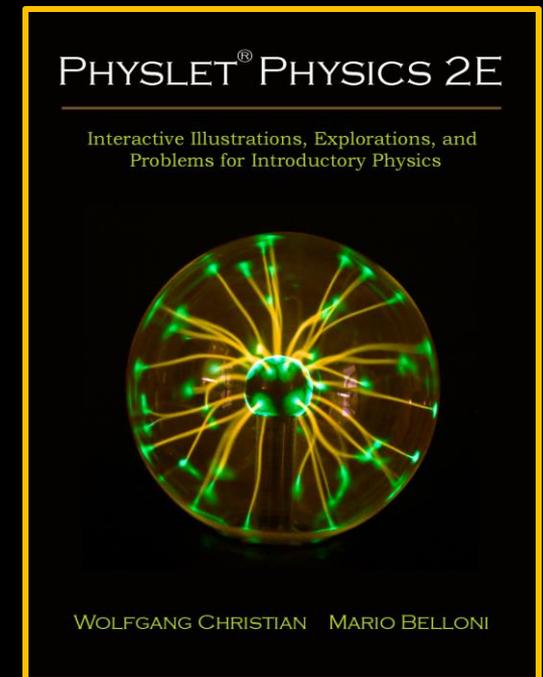
Physlet Physics 2E

- Intro physics (calculus/algebra): mechanics to optics
- 800 interactive exercises on ComPADRE
- >24 Astronomy specific
- By Wolfgang Christian, MB, and others
- Static links, not dynamic links
- One page / one idea / one concept

Physlet Quantum Physics 2E

- 200+ Modern to QM Exercises
- Soon on ComPADRE

<http://www.compadre.org/Physlets>



Simulations: Physlets



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Preface

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Physlet® Physics 2E

Interactive Illustrations, Explorations, and Problems for Introductory Physics

**Wolfgang Christian
Mario Belloni**

With contributing authors:

Anne Cox, Melissa H. Dancy, and Aaron Titus

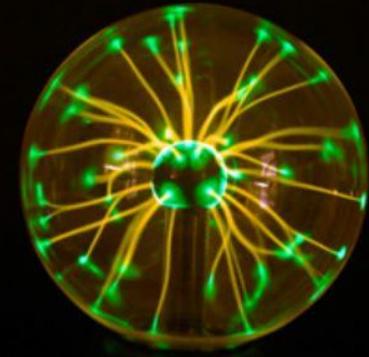
Exploration Worksheets by:

Thomas M. Colbert

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Interactive Illustrations, Explorations, and Problems for Introductory Physics



WOLFGANG CHRISTIAN MARIO BELLONI



Physlet Physics 2nd edition - Pre-release

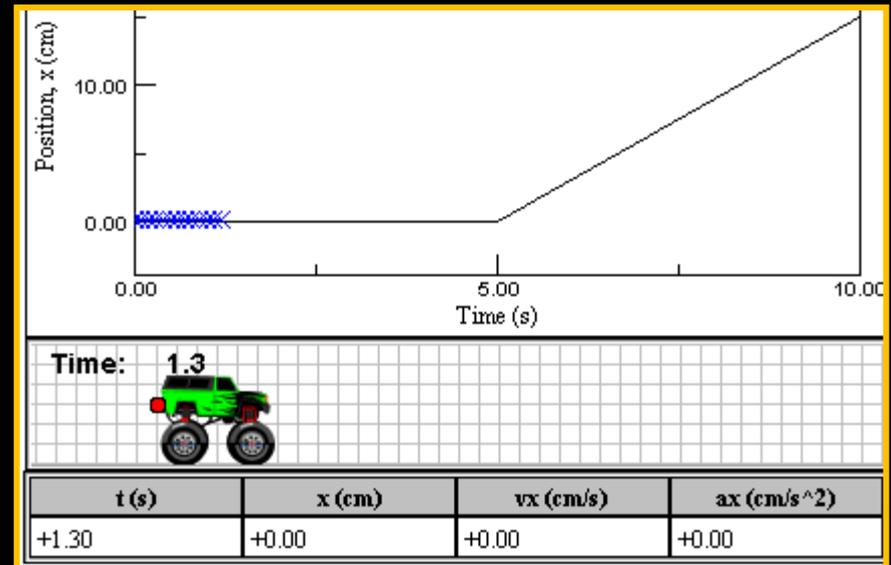
Hosted by comPADRE

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JiTT Example: Physlets

Use the mouse to drag the rear bumper of the toy monster truck (the red ball). The goal of this exercise is to match the position/velocity/acceleration vs. time graphs as shown in the animation (position is given in centimeters and time is given in seconds). There is some smoothing for the velocity and acceleration matching animations.



Answer the following questions after trying to match the motion:

- Which of the graphs was the easiest to match and which one was the hardest to match?
- Why? Base your answer on physics and mathematics.

http://www.compadre.org/Physlets/mechanics/prob1_3.cfm

JiTT Example: Physlets

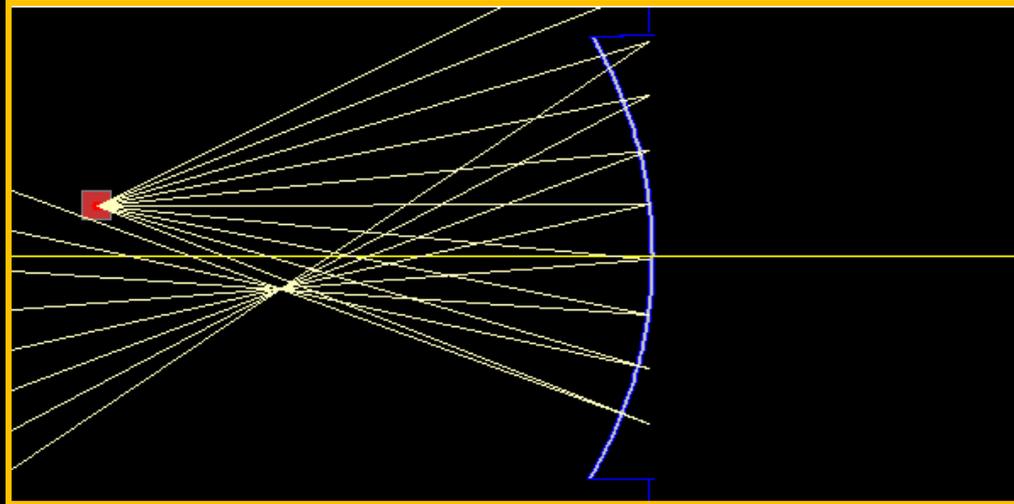


Four charged objects are shown on the screen along with vectors representing the forces on each object. You can click-drag on any object to change its position (**position is given in meters**).

- What, if anything, is wrong with the animation?

http://www.compadre.org/Physlets/electromagnetism/prob22_2.cfm

JiTT Example: Physlets

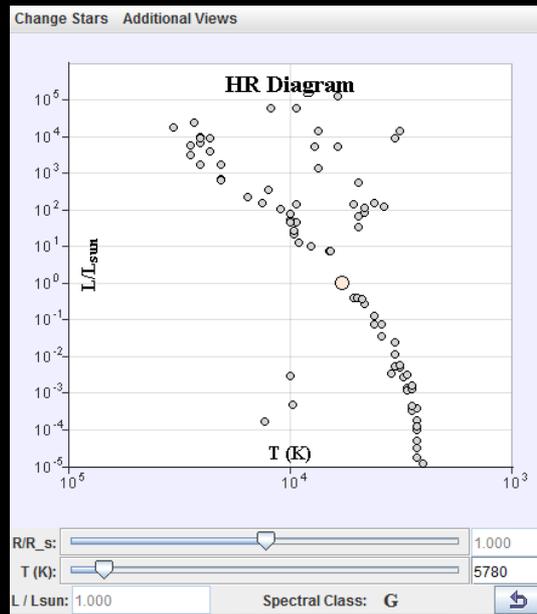
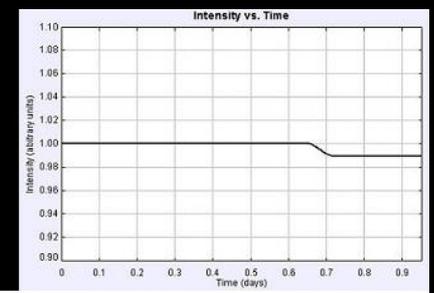
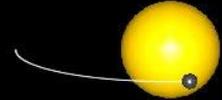
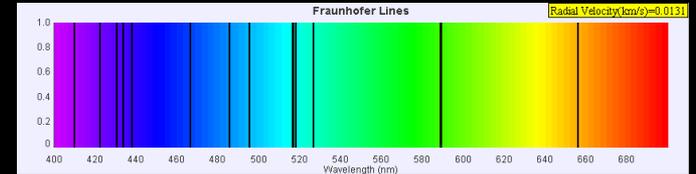


A point source is located to the left of a mirror. You can drag this point source to any position (**position is given in meters and angle is given in degrees**).

1. Find the focal length of the mirror.
2. Describe the technique you used to determine the focal length.

http://www.compadre.org/Physlets/optics/prob33_1.cfm

JiT T Example: Astronomy



Over 50 simulations for JiTT in intro astronomy on OSP Collection (Wolfgang Christian) on ComPADRE (Bruce Mason)

Choosing and Using Student Responses

- Choose a few typical answers (correct/incorrect)
- Funny is OK (do not mock, but enjoy)
- Always say something positive (even if wrong, especially if a known mis-/pre-conception)
 - A lot of people think this, but it is not quite right.
 - This is true, but what if something else occurs simultaneously...
 - This makes sense, but something is missing...
 - This is a great response... how would we know how much heat to add?
- More phrases...
 - This is a good answer, but to a different question...
 - This has a great beginning, but more could be added...
 - This is correct, but the reasoning isn't quite right...

The “Interactive Lecture”

- Step 1: Synchronization
Read the students’ responses...
What do they understand?
- Step 2: Preparation
Select excerpts from students work,
adjust clicker questions, etc.
- Step 3: Execution
Class is a dialog based on student
excerpts and faculty notes

Outcomes

- **Students better prepared for class**
 - Familiar with jargon
 - Given thought to ideas
- **Faculty better prepared for students**
 - Misconceptions identified
 - Just in time adjustment to coverage
- **Class time spent more productively**
 - Students interact during class

Tips and Pitfalls

- Explain methods and purpose on first day
- **No need to review all responses before class; sample for “useful” quotes, grade later**
- Focus on students strengths, too, not just misconceptions and other problems.
- Use answers from many students: not favorites.
- Do not “isolate” WarmUps - scaffold lecture: cover the Warm-Up answer where it fits in class.
- Must be routine. Do not start/stop during semester
- Upper level students can handle more “exploratory” questions, connections to intro.

Tips and Pitfalls

Why is JiTT potentially helpful?

- Students must at least consider material before class.
- Students want to know the answer!
- It is harder for students to fall behind.
- Students see other students' responses.
- "Personalized" lectures.
- Students must think conceptually before mathematically.

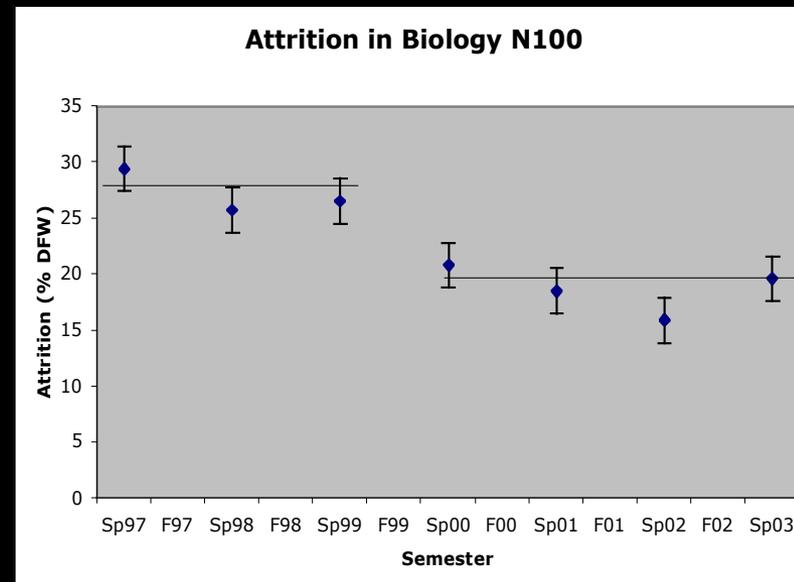
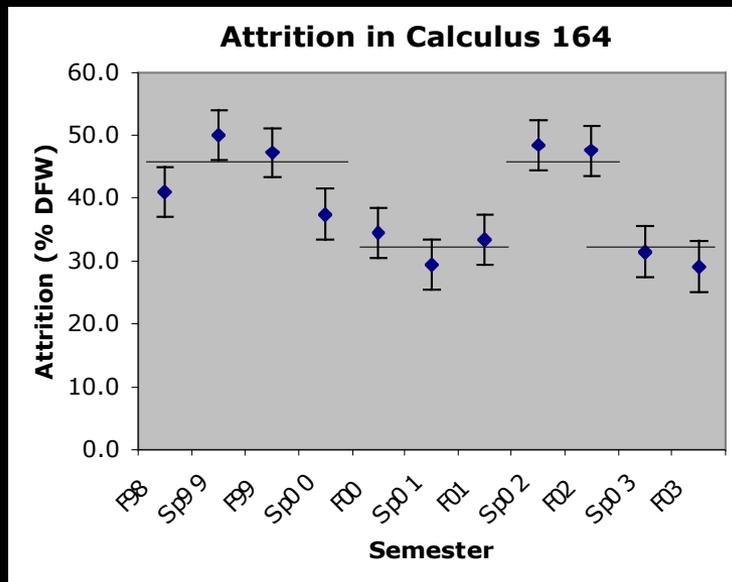
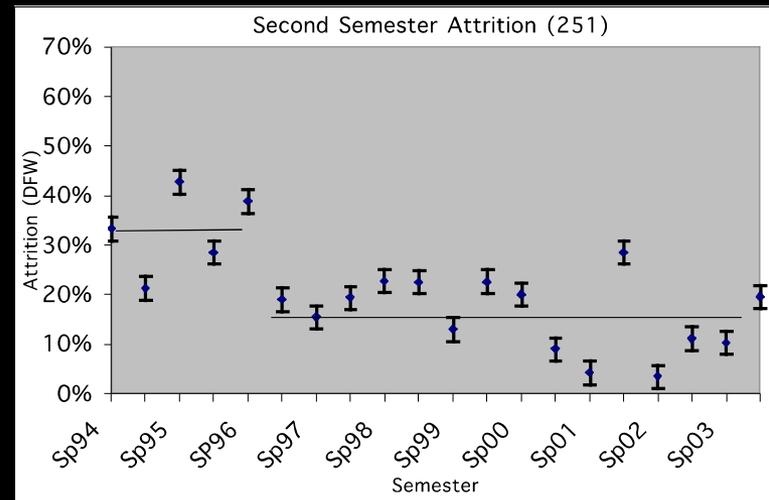
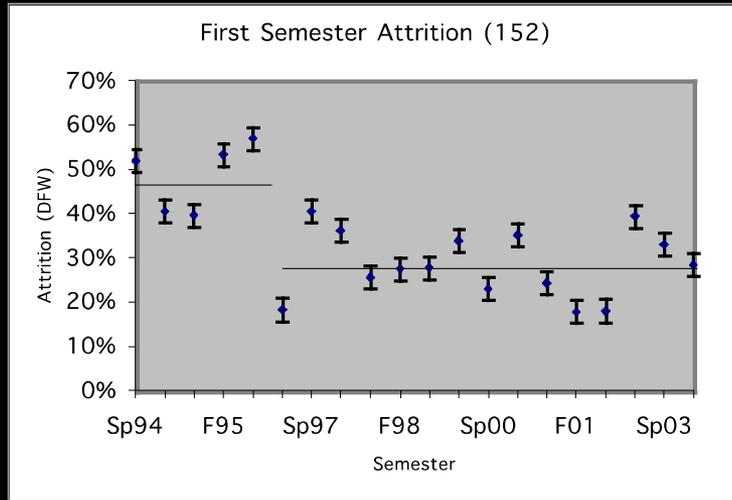
Why is JiTT potentially NOT helpful?

- Students can become frustrated with JiTT exercises.
- Students may not feel they are getting proper feedback.
- Students may still use novice problem-solving approaches even though they are ineffective.

How to get great student evaluations

- First five minutes are critical!
- Be honest, and direct – take time on the first day of class to explain what you are doing and why.
- Be a leader – college is hard, and students look to you for motivation, don't disappoint them.
- Build a team – let students know that you and they are working towards a common goal.
- Hold yourself and your students to high standards – if you work hard, they will too.

Retention (N~80-150/semester)



IUPUI: Effective (E&M, N~60)

1. Do you feel that the warm-up assignments helped your professor make good use of the classroom time?	Yes 47 87%	No 7 13%
2. Do other professors have better ways to determine how class time should be used?	Yes 14 26%	No 40 74%
3. Do you feel that the warm-up assignments helped your professor focus on important topics in class?	Yes 49 91%	No 7 13%
4. Do your other professors have effective methods for focusing on important topics in class?	Yes 33 61%	No 21 39%
5. Did the warm-up assignments help your professor get a good feel for what the students know?	Yes 42 81%	No 10 19%
6. Do your other professors have effective methods for getting a feel for what their students know?	Yes 20 38%	No 33 62%
7. Do you think the warm-up assignments help your professor get students involved during the lecture?	Yes 37 70%	No 16 30%
8. Do your other professors have effective methods for getting their students involved in lecture?	Yes 23 43%	No 31 57%

Student Comments

- Don't tell anyone, but I think I will greatly miss my physics class.
- They help me stay on track in my work. they are not too consuming. They are just about right. Physlets help me because I am a visual learner.
- Daily problems (a) do help me stay on track (b) are just about right and help reinforce lecture and HW problems
- I really like the lectures which I think is really surprising for me. I am usually cognizant of what is going on because I have done the daily problems and become familiar with the concepts and also because there are so many visuals that help to make the concepts clear.
- I struggle with the daily problems. I support the idea of getting us thinking, but I don't think that it's fair that I be graded on a concept the professor has not even discussed.

Summary

- JiTT is based on feedback between homework and classroom
- WarmUp exercise: a pre-class, online reading quiz
- Improved study habits, retention, content knowledge, morale.
- Instructor knowledge of student difficulties
- Easily adopted and adapted

Getting Started:

- Use the book and handout to read a bit more on JiTT.
- Use handout to find additional exercises that can be used as starting points for your courses.
- Start developing warmup exercises for the course you are most likely to teach next fall.

