How to get your Students to Prepare for Every Class

Just-in-Time Teaching (JiTT)

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http://webphysics.iupui.edu/nfw_summer17/index.html

A few of your comments

- John: This assignment should not have been given at 6pm EDT on Friday and expect a response by 10pm EDT…
- Liz: I'm not sure I see a way to introduce e.g. vectors...
- RJ: How does one come up with the pre-class questions?
- Jayne Cobb: I would like to spent time on how to write "warmup exercises" for non-science majors.
- Also several questions about motivating students, grading policy, and desire for examples

Outline

- Introduction
- Implementation
  - **Aside: How to get great student evaluations**
- Getting started

Goals

- Give you a JiTT “experience”
- Give you a sense of why JiTT is effective
- Enable you to put JiTT into practice
- Introduce you to some resources

The (original) settings

- IUPUI: Large, public, urban university
  - **30,000 students, almost 100% live off campus**
  - **Most work > 25 hours/week**
- US Air Force Academy: Military College
  - **All students take physics, even history majors**
  - **All play sports, train for military**
- Davidson College: Small liberal arts college
  - **Highly selective**
  - **Small classes**

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What is JiTT?

- Jasmine: JiTT is a learner-centered teaching strategy to improve the efficiency of the classroom time by using web <u>pre- class assignment.</u>
- Joel: The instructor uses <u>pre-class assignments</u> to gauge student needs and preparation for material being taught in that days lectures….
- Saleem: A strategy used to <u>engage students before the class</u>. So that students are actively taking part in class activities…

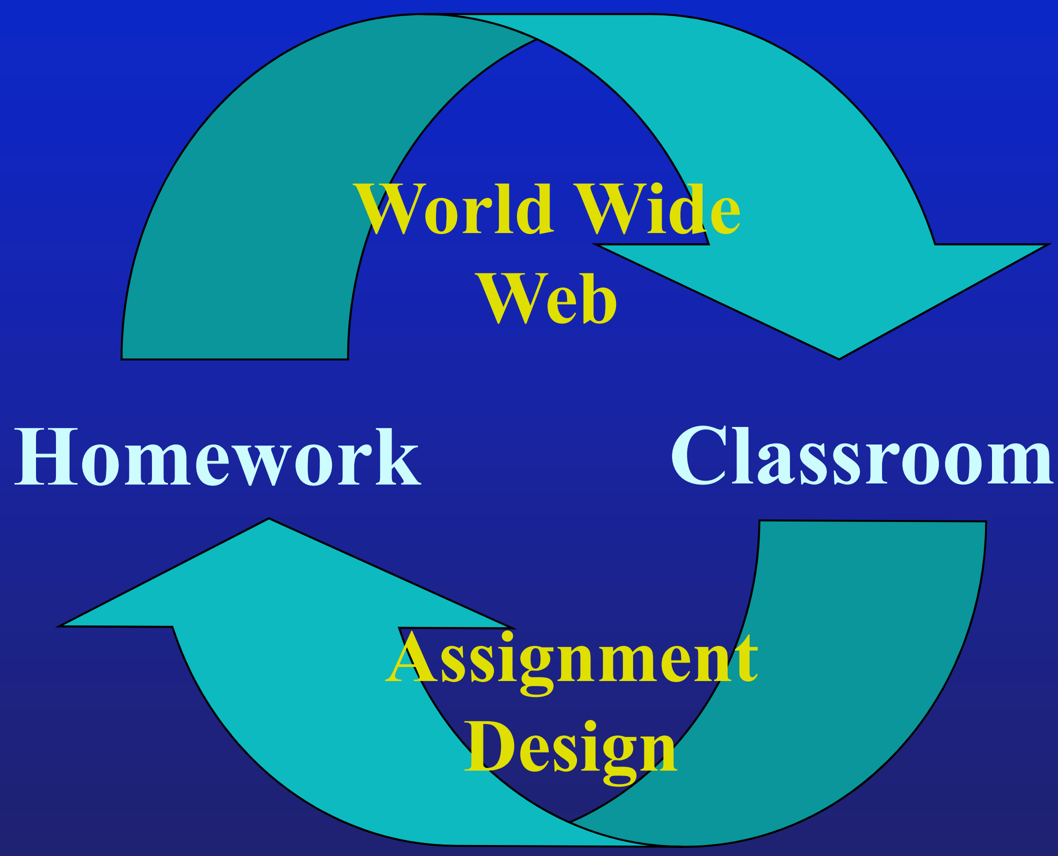
Digression

- JiTT described in your words
- "preview" of important concepts
- Jargon already familiar (JiTT, Warmup)
- Big idea (connect class to HW) already present

Lightning summary

- **Use Warmup exercises to**
  - **Motivate and improve preparation**
  - **Help faculty focus class**
- **WarmUp = Online, pre-class reading quiz:**
  - **Due few hours before class**
  - **A few open-ended conceptual questions**
  - **Cover that day's material**
  - **Provide "conversation starters"**

Just-in-Time Teaching (JiTT)



Example

- *Question: Is it possible to add heat to an ideal gas without changing its temperature? If it is possible, please explain how it is done.*
  - "It is not possible because the internal energy of an ideal gas only depends on the temperature.... the internal energy will increase when the temperature rises.…"
  - "If you add heat to a system while the system is doing the corresponding amount of work, the temperature will not change."
  - "It is possible to add heat to an ideal gas without it changing it's temperature by the gas receiving the heat, and the atoms of that gas getting excited enough to disperse that heat as fast as they receive it…"

More Examples

- In a few sentences, explain what an "impulse" is, and how it can be calculated.
- A ford Mustang weighs about 3500 pounds, and can accelerate from 0-60 MPH in about 5 seconds. What force is responsible for this acceleration? What is its approximate magnitude?
- In a sentence or two, please describe the difference between "gauge pressure" and "absolute pressure? When would you want to use each?

Impulse responses

- impulse is the change in momentum over time. it can be calculated by integrating force as a function of time
- …its the force integrated over the time period or the change in momentum in that time period.

- An impulse is a large amount of force that acts on an object of a short amount of time.
- An impulse is the moment at which two objects initially collide and exert enormous force upon each other.

What does the book say?

IMPULSE

When two objects collide, they usually exert very large forces on each other for a very brief time. The force exerted by a baseball bat on a ball, for example, may be several thousand times the weight of the ball, but this enormous force is exerted for only a millisecond or so. Such forces are sometimes called *impulsive forces….*

What makes a good Warmup?

- Raven: . There should be some kind of open-ended part of the question to encourage deeper thinking and so that the teacher can see what students are thinking.
- AS: Open-ended; thought-provoking; curiosity inducing; questions that will help the instructor get enough feedback to modulate the following class.
- Born-to-Teach: The "warmup exercise" should (i) be designed in such a way that it creates an interest in students, (ii) contain open-ended and thought-provoking questions and problems, and (iii) address the main objective of the lesson to be discussed in the class.

Online archive of Warmup exercises

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

- Introductory physics (2 semester sequence)
- Statistical/Thermal Physics (2 sets)
- Intermediate Mechanics (2 sets)
- Modern Physics, Quantum Mechanics
- Intermediate E&M (2 semester sequence)
- Mathematical Methods
- Optics, Intro Astronomy
- Needed: Condensed matter, other specialties…

Test drive

- Write one warmup question you can use.
- Target the course you will likely teach next
- You have three minutes, go!

Choosing and using student responses

- Always say something positive
  - **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?**
  - **This is correct, but the reasoning isn't quite right…**
  - **This has a great beginning, but more could be added…**

Choosing and using student responses

- Peer Instruction/Think-Pair-Share
  - **Question 3 on the last warmup was pretty tough. Now that we've talked about it, let's do it again with clickers (or cards!)**
  - **Here's a clicker question based on the warmup**
  - **Here are three answers to last night's warmup, which is the best?**

Choosing and using student responses

"A student gives a warmup response that is seriously incorrect, indicating a deep misunderstanding of the topic. In your opinion, the best thing to do is to…"

a. Point out the mistake in class: 17
b. Contact the student by email: 5
c. Either, and give zero points: 0
d. None of the above: 19

Why?

- Blazar: If the mistake (or the misunderstanding represented by the mistake) is widespread, would attempt to construct a guided exercise or example that leads students to "discover" their misconception.
- SoxFanDresden: Not really individually "point it out", but generally quote it as a means to highlight the importance of the underlying concept in lecture.

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 – use throughout session
- Must be routine. Don’t start/stop mid-semester
- Upper level students can handle more “exploratory” questions, connections to prerequisites
- Faculty cedes some control!

Results

- 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**

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How to get great student evaluations

- First five minutes are critical!
- 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.
- Earn trust—take time on the first day of class to explain what you are doing and why.
- Hold yourself and your students to high standards—if you work hard, they will too.

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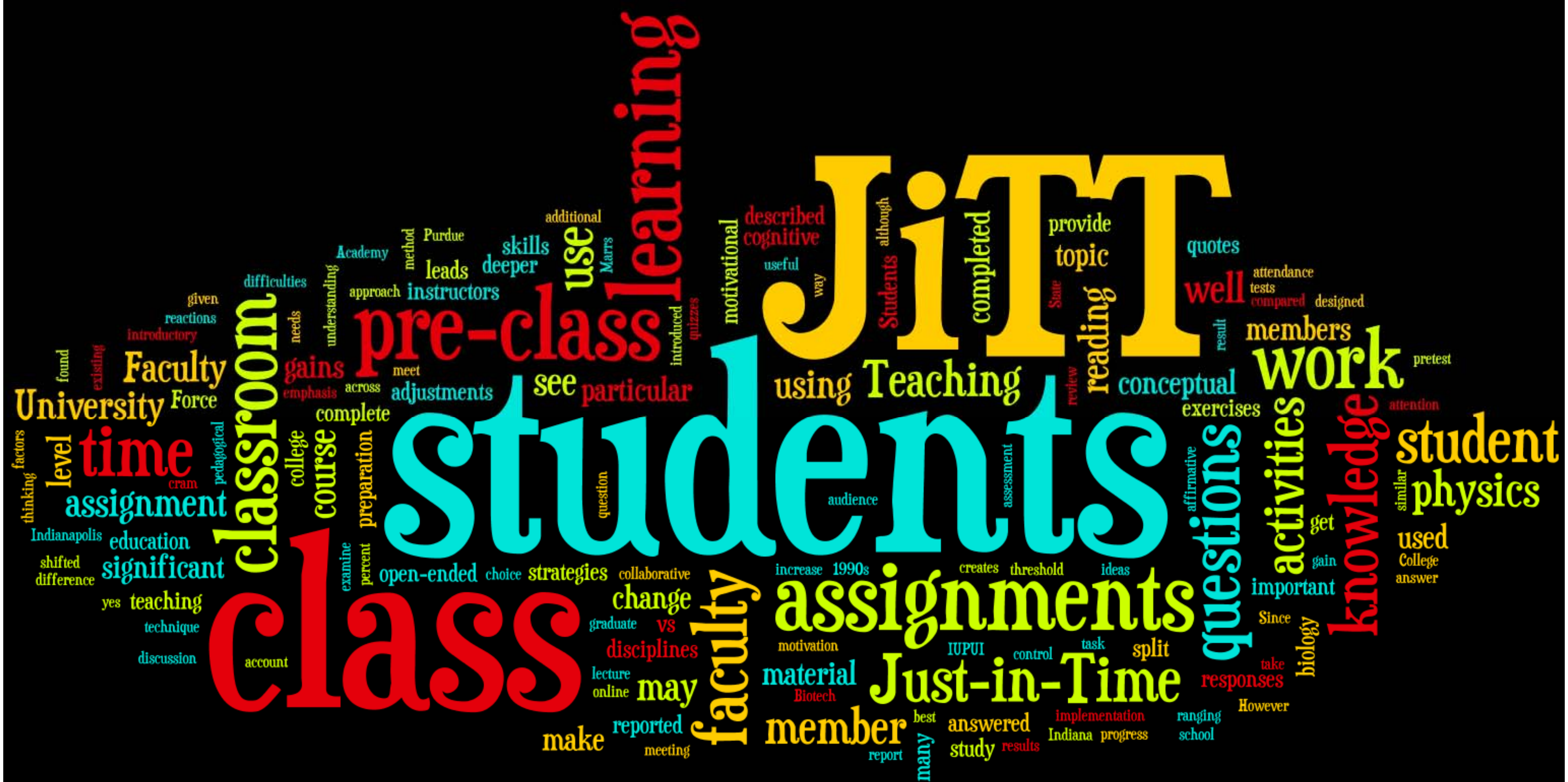
Getting started:

- **Use handout to write two more questions**
- **You have 5 minutes, GO!**

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


students
JiTT
class
learning
pre-class
assignments
Just-in-Time
classroom
faculty
questions
activities
knowledge
work
student
physics
time
Teaching
member
members
material
assignment
University
Faculty
significant
education
teaching
using
conceptual
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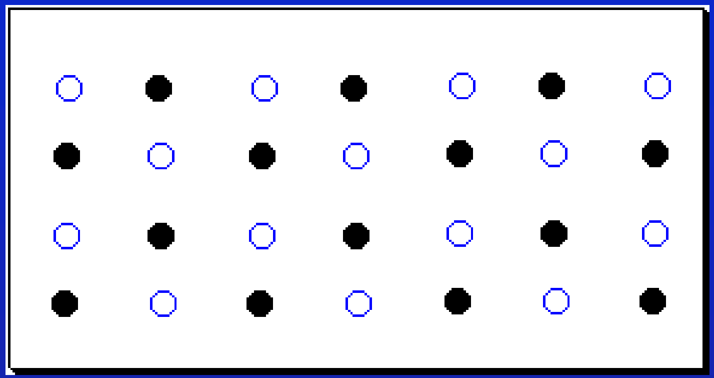
ideas
audience
assessment
affirmative
question
examine
percent
meet
across
emphasis
take

Chemistry example

This picture depicts matter at the submicroscopic level. Describe what you see and take a guess as to what the identity of the substance is.



- “The particles are well spaced out so I would guess the substance to be a gas. The substance is a gas composed of 2 elements that are in an equal ratio.”
- “After reading Chapter 1 in the book I would guess that the substance is water in the form of a solid because the atoms are in order. However, I could be wrong because I think the atoms in a solid might be closer together.”

Outline

- The Challenges ✓
- Just-in-Time Teaching ✓
  - Background ✓
  - implementation ✓
  - Aside: How to get great student evaluations ✓
- Assessment ✓
- Getting started

Study Habits (N=155, biology)

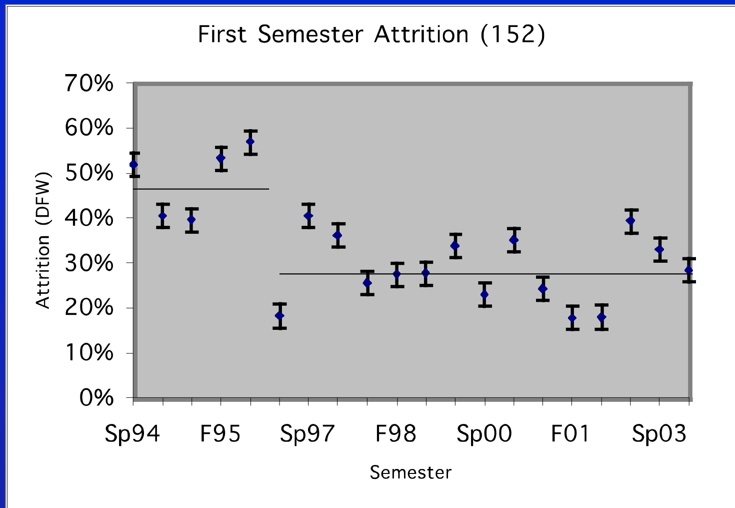
Q1 Do the WarmUps help you stay caught up?

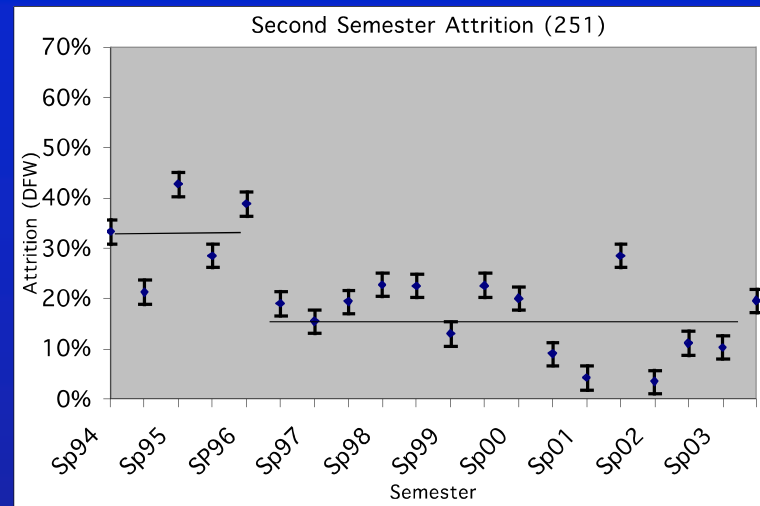
Q2 Do you "Cram" before tests in this course?

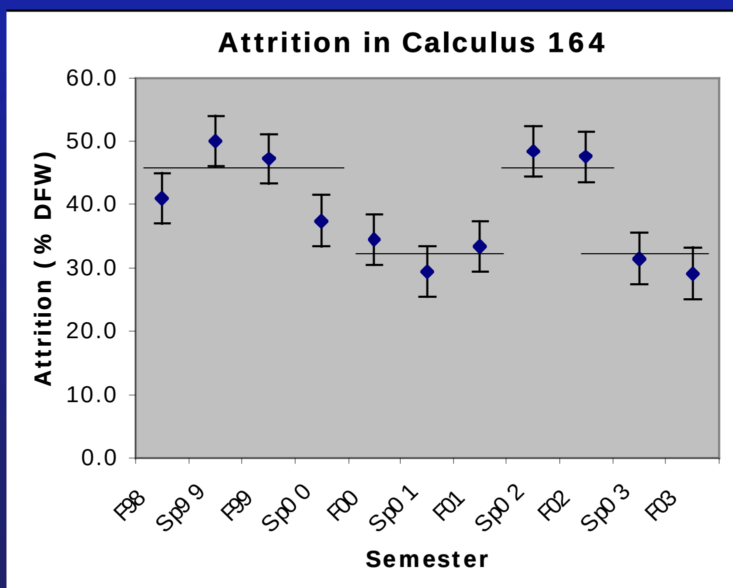
Q3 Do you "Cram" in your other courses?

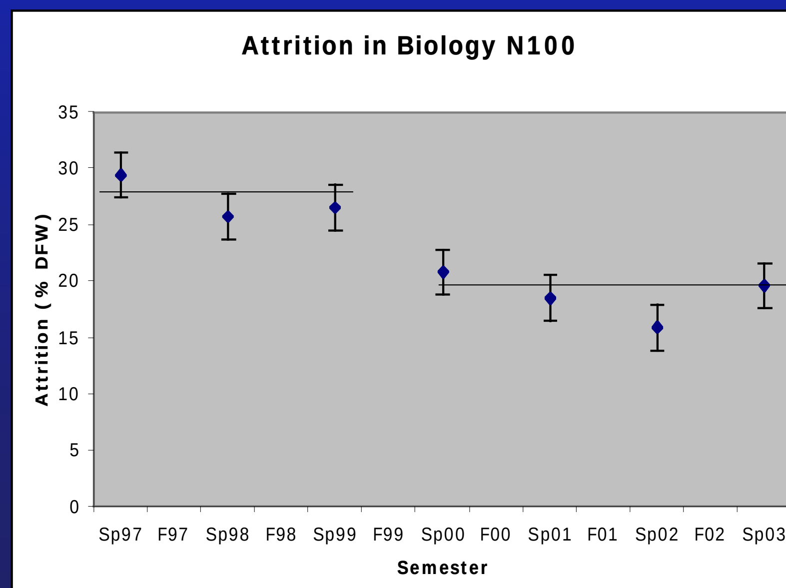
	1- Yes	2- Yes	3- Yes
"A" students	85%	14%	43%
"B" students	89 %	39%	61%
"C" students	89%	47%	68%
"D" students	84%	68%	68%
"F" students	92%	58%	58%

Retention (N~80-150/semester)









Cognitive (biology, N~200)

Final exam questions tied to…	**% Gain** **(Post%-pre%)**	**Average Normalized Gain**
no interventions	%G = 15% (25%-10%)	<g> = **0.16 7**
additional homework problems	%G = 17% (35%-18%)	<g> =**0.20 7**
WarmUp **or** cooperative learning questions	%G = 45% (59%-14%)	<g> = **0.51 1**
WarmUp **and** cooperative learning questions	%G = 56% (68%-12%)	<g> = **0.63 6**

Affective (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

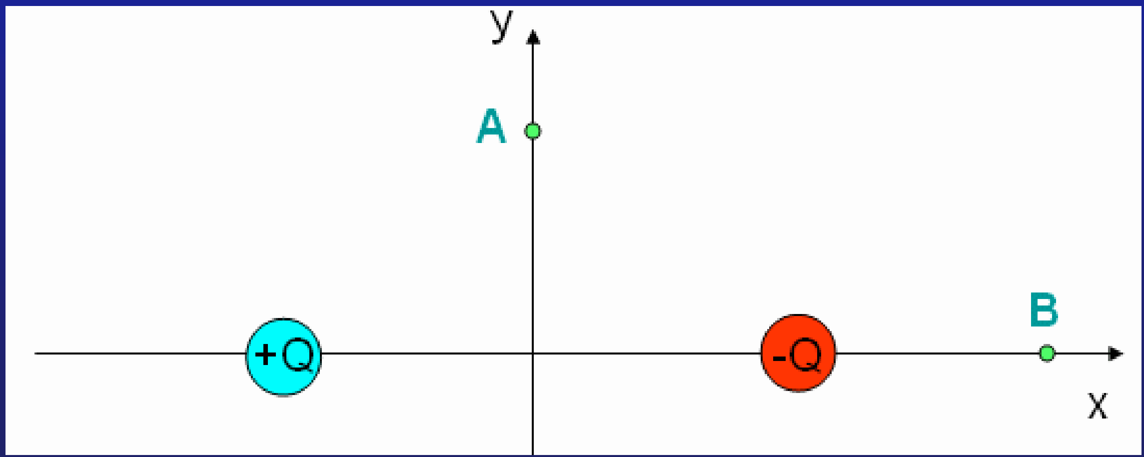
- “This was a fantastic course. It was the hardest course I’ ve taken yet, but also the most fun.”
- I think the WarmUps are a good idea because they give students a chance to think about the material prior to lecture.
- "This course was very well structured. It was obvious that a lot of time was spent in preparation for it.”
- "152 & 251 have made me reach more than any courses I have taken.”
- Don’ t tell anyone, but I think I will greatly miss my physics class.

smartPhysics checkpoint

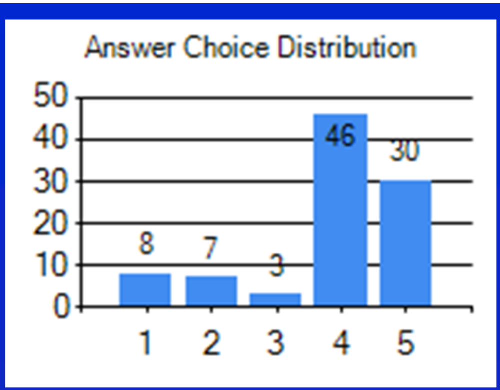
1. Two equal, but opposite charges are placed on the x axis. The positive charge is placed at to the left of the origin and the negative charge is placed to the right, as shown in the figure. What is the direction of the electric field at point A?

a) up b) down c) left d) right e) zero

2. Explain your reasoning



smartPhysics output



Aaron (aaron@iupui.edu)

1) 4

2) the field from Q+ points up and to the right, while Q- points down and to the right therefore when adding them together it points to the right.

Beatrice (beatrice@iupui.edu)

1) 4

2) point A is equidistant from each charge and they would therefore cancel out

Ada (ada@iupui.edu)

1) 2

2) The charges will cancel out so the direction of the force will be down

Ahmed (ahmed@imail.iu.edu)

1) 4

2) the field is toward the negative charge and away from the positive charge which makes the direction to the right