Physics RULE

Active Pre-Learning for 1000 students

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Our theme: active learning

- Before class – we get students to come to class prepared.
- In class – through clicker questions and worksheets, for instance.
- In discussion – through peer instruction techniques.

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RULE – Redesigning the Undergraduate Learning Experience

- Summer 2010 – successful pre-proposal ($10K)

- Focused on having students come to class prepared
- PY105 (algebra-based) – we made our own introductory movies, plus quizzes on WebAssign
- PY212 (calculus-based) – used the pre-flights created by the University of Illinois

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PY105/PY106 reforms this year

- Before class, students answer a short quiz on WebAssign – professors then review answers
- Quizzes have links to on-line movies and relevant chapter sections.
- New method: more class time devoted to questions, worksheets, and examples, and less to covering basic definitions (students do that on their own).

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Making movies

- Create a slide presentation in Keynote on the Mac.
- Record the presentation, including audio commentary, then export it as a movie.
- Upload the movie to BUniverse, which then automatically uploads it to YouTube

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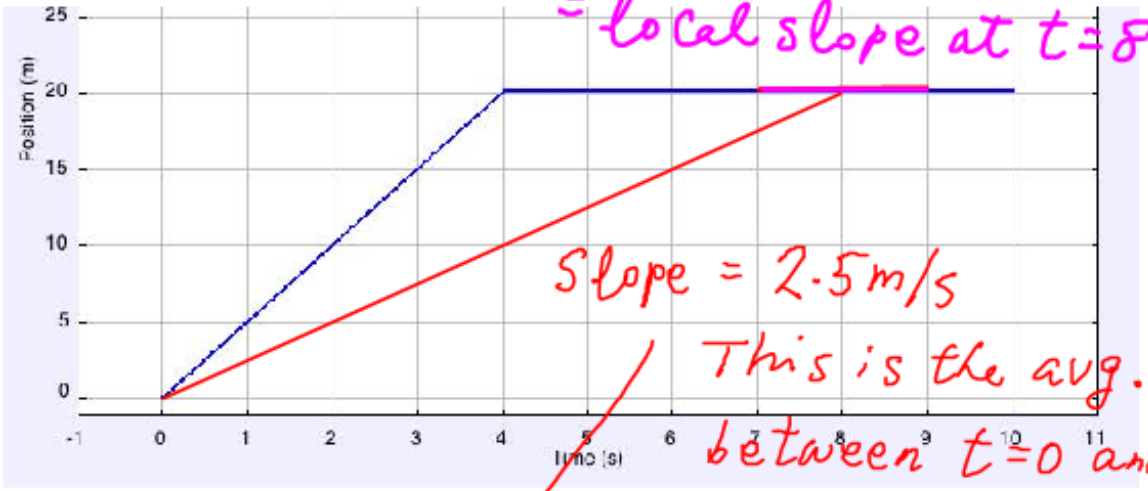
Pre-class student engagement in PY105/PY106
Introductory movie on BUniverse and YouTube followed by quiz on basic concepts worth 2% of grade

Pre-session Problem 2



instantaneous velocity = local slope at t=8s = 0 m/s

Slope = 2.5 m/s

This is the avg. velocity between t=0 and 8s

Consider the graph above, which shows the position vs. time for an object experiencing motion in one-dimension.

(a) What is the object's speed at $t = 2.0$ s? In case it is not clear, we're looking for the instantaneous speed at $t = 2.0$ s.

5.00 ✔ 5 m/s

(b) What is the object's speed at $t = 8.0$ s? Once again, we're looking for the instantaneous speed.

2.50 ✘ 0 m/s

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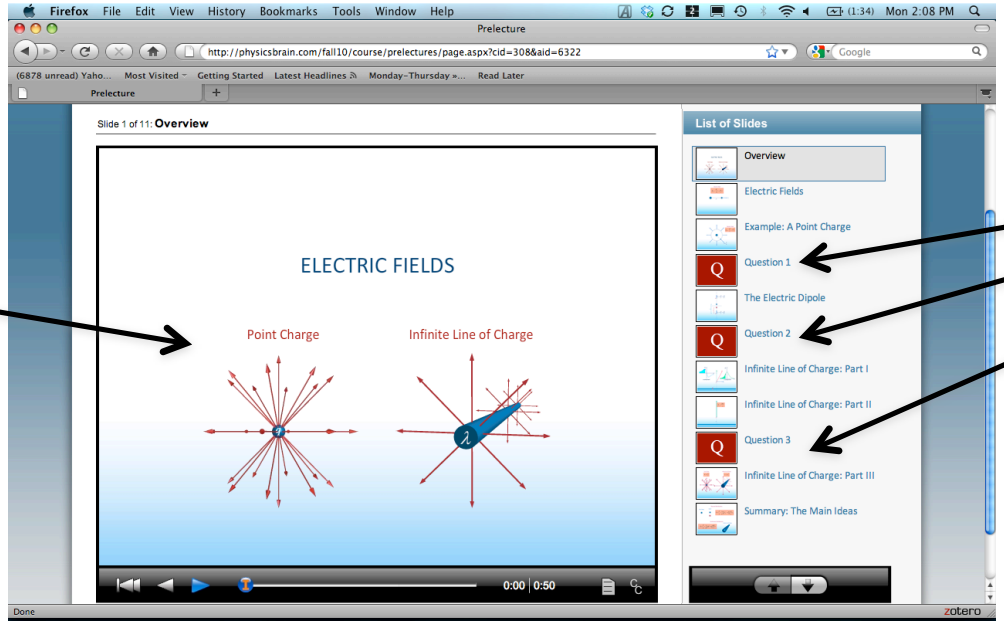
PY211/PY212 – Pre-lectures

Animations with voiceover



Questions interspersed

From UIUC (Smart Physics)

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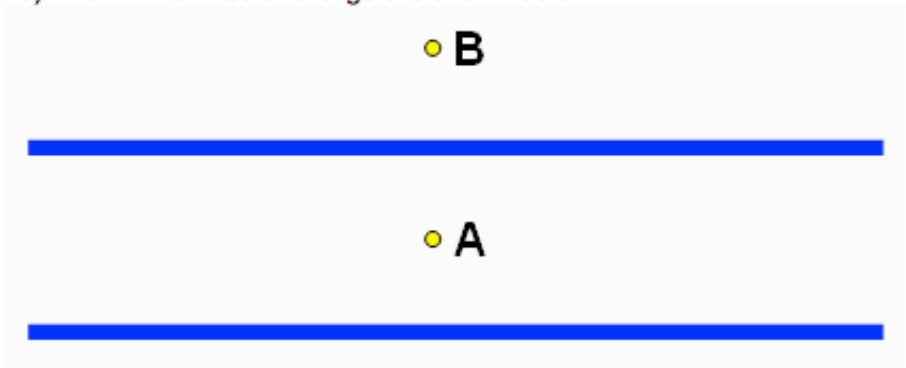
PY211/PY212 – Pre-flights

10) Two infinite lines of charge are shown below.

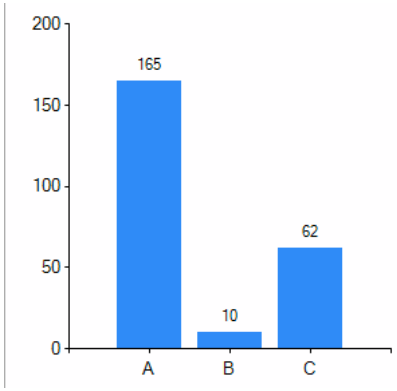


A series of directed questions, due by 7 am on class days

Both lines have identical charge densities $+\lambda$ C/m. Point A is equidistant from both lines and Point B is located a above the top line as shown. How does E_A, the magnitude of the electric field at point A, compare to E_B, the magnitude of the electric field at point B?

- ○ $E_A < E_B$
- ○ $E_A = E_B$
- ○ $E_A > E_B$

+ A (69.6%) $E_A < E_B$
B (4.2%) $E_A = E_B$
C (26.2%) $E_A > E_B$



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Just in Time Teaching

- Requires a greater time investment for each class (from students and instructors).
- Pays off in greater student engagement.

> *"I find the students in the 8am lecture more engaged than I have ever seen in PY212. Having to do the preflight, and having their conceptual issues addressed in lecture, is a real blessing."*
>
> – B. Lee Roberts

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Problem-solving based discussion

- Discussion sections were modified to emphasize problem solving in a peer-learning environment.
- Students prepare 4 homework problems in advance.
- Working in groups, students prepare and deliver a presentation on solving one problem.
- At the end, students take a graded quiz on a selected problem, individually and without notes.

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Problem-solving based discussion

Hello Professor,

This is [redacted] I would like to put a little of my input of how the discussion sections were organized this year. I thought it was really helpful that we were put into groups and assigned a question to work out together, because it helps reinforce what we learned in lectures and helps put the knowledge to practice. It also answers some questions that the other students might have, and it's good to see it from the perspective of a peer, so we can understand the problem in multiple ways. The quiz at the end was also very effective, because it helps put us in a environment similar to exams where we will only have our knowledge to work out the questions.

RULE – Redesigning the Undergraduate Learning Experience

- Fall 2010 – successful proposal ($60K+, over 2 years)
- The goal of Physics RULE is to increase interactive engagement, and department ownership
- In Fall 2011, we will have a studio section of PY105 (63 students)
- Starting in Fall 2011, we will be incorporating learning assistants into the instruction

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Studio Learning – what is it?

- An environment that merges lecture, lab, and discussion.
- Students learn many of the concepts in a hands-on format, by doing rather than listening.
- Used successfully at >50 institutions, SCALE-UP at NC State and MIT (TEAL)

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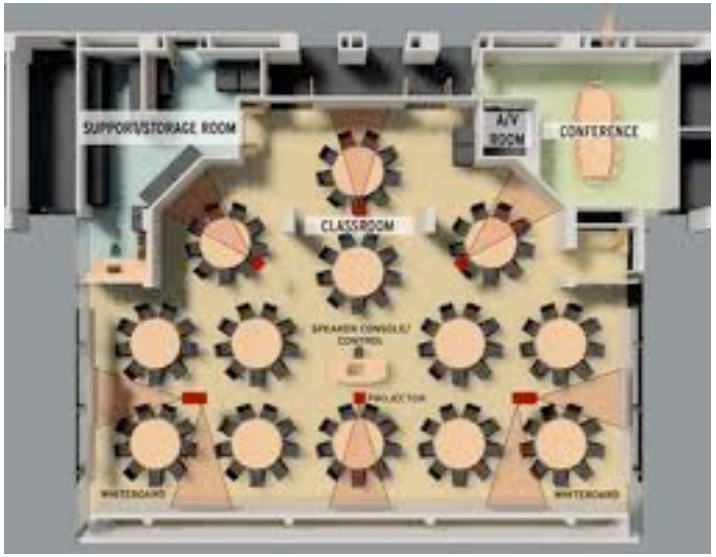
Studio Physics at BU

- Standard course → Studio course
  - 3 hrs lecture + 1 hr discussion + 3 hrs lab every other week → 6 hrs/wk combined in three 2-hour meetings
  - Lecture room → open classroom



Learning Assistants (LA's)

- Learning Assistants are trained undergraduate students who have taken the course before, and who work with graduate TA's in (usually) discussion sections to help students learn.
- LA's are used successfully in many departments at UC-Boulder – we're adopting their model.
- 11 LA's are having a very positive impact on student learning in Chem 102 this semester.

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Learning Assistants (LA's)

- Next fall, Physics, Chemistry, and Biology hope to be using about 15 LA's each.
- In Physics, LA's will be working in discussions as well as in the new studio section of PY105/106.
- In Biology, LA's will be working in the teaching labs for the intro Bio course.
- LA's receive about $800 per semester.

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Learning Assistants (LA's)

- LA's commit to 10 hours per week.
- 3 hours attending class, 3 hours in discussions, 1 hour in a prep meeting, 1 hour prep on their own
- Two hours/week, they are in a two-credit SED course, SC521, designed specifically to train LA's in how to teach their peers.

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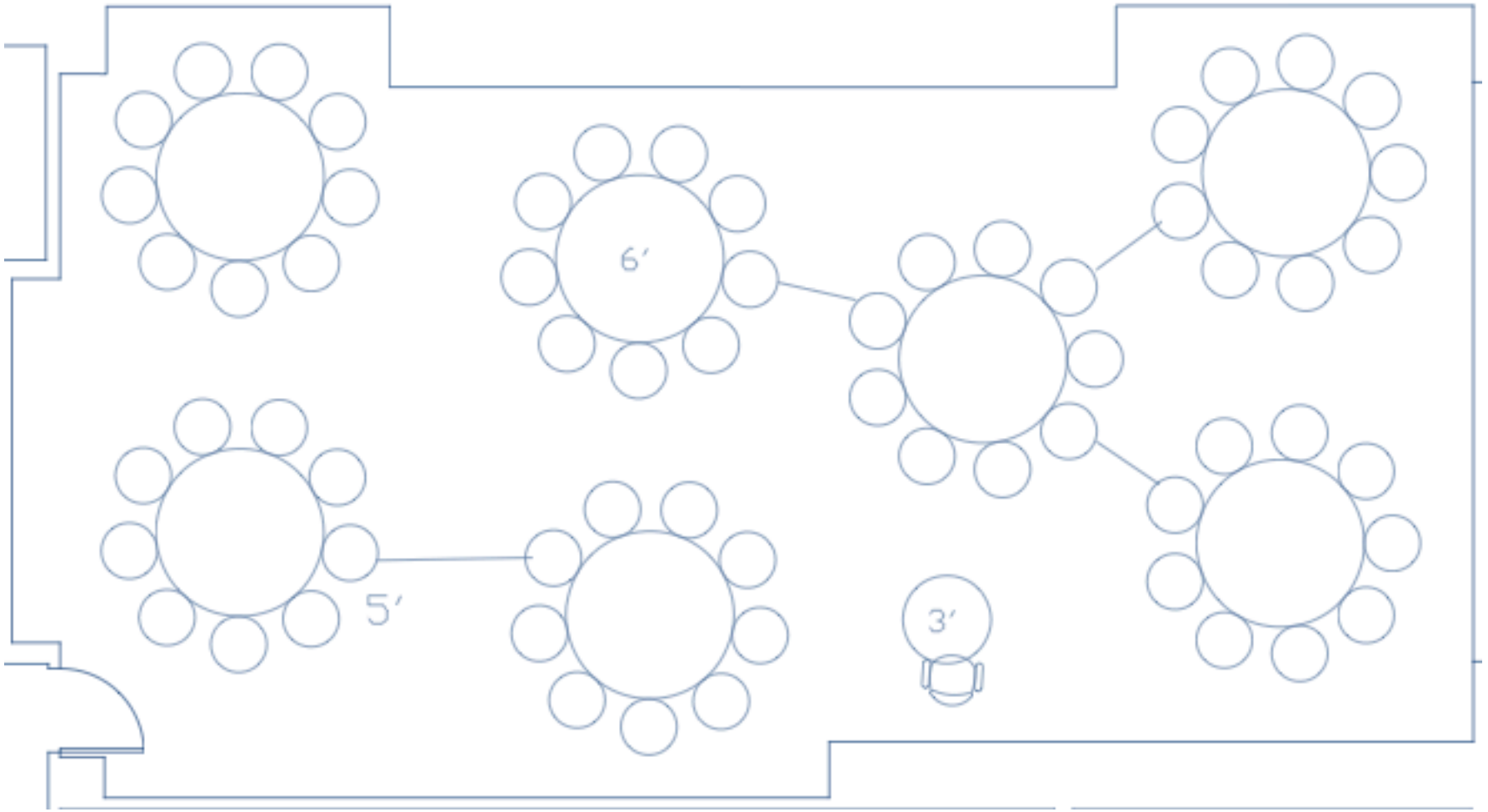
Studio Physics for 63 students



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