EVOLUTION OF TEACHING

New England APS meeting Spring 2015

THIS WILL BE A BLENDED TALK

being a faculty member at a primarily undergraduate institution

Online Teaching

Active Learning

The ONE thing I have learned about teaching:

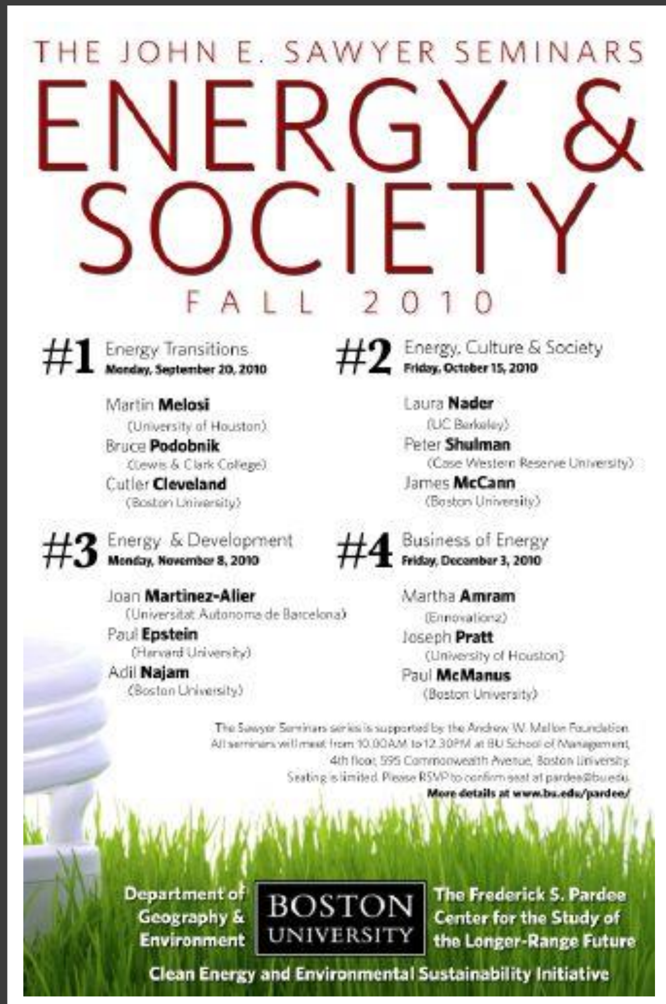
Key to teaching is getting the right blend of blended learning for both professor and students

And never stop learning

Sorry the two things I have learned

And get paid extra if you can

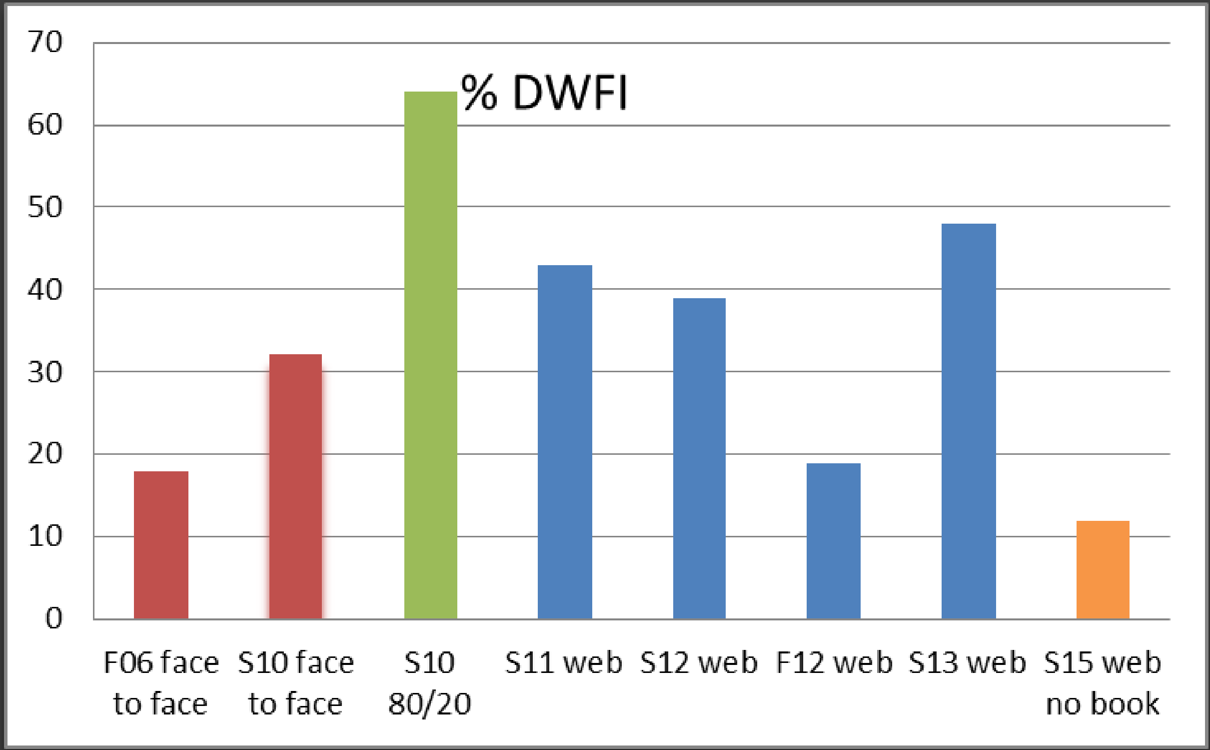
The three things…



Energy and Society course. For non-science students (general education requirement)

Did it in steps (with funding)
Face to face to 80/20 on-line to
100% on-line with book to
100% on-line no book

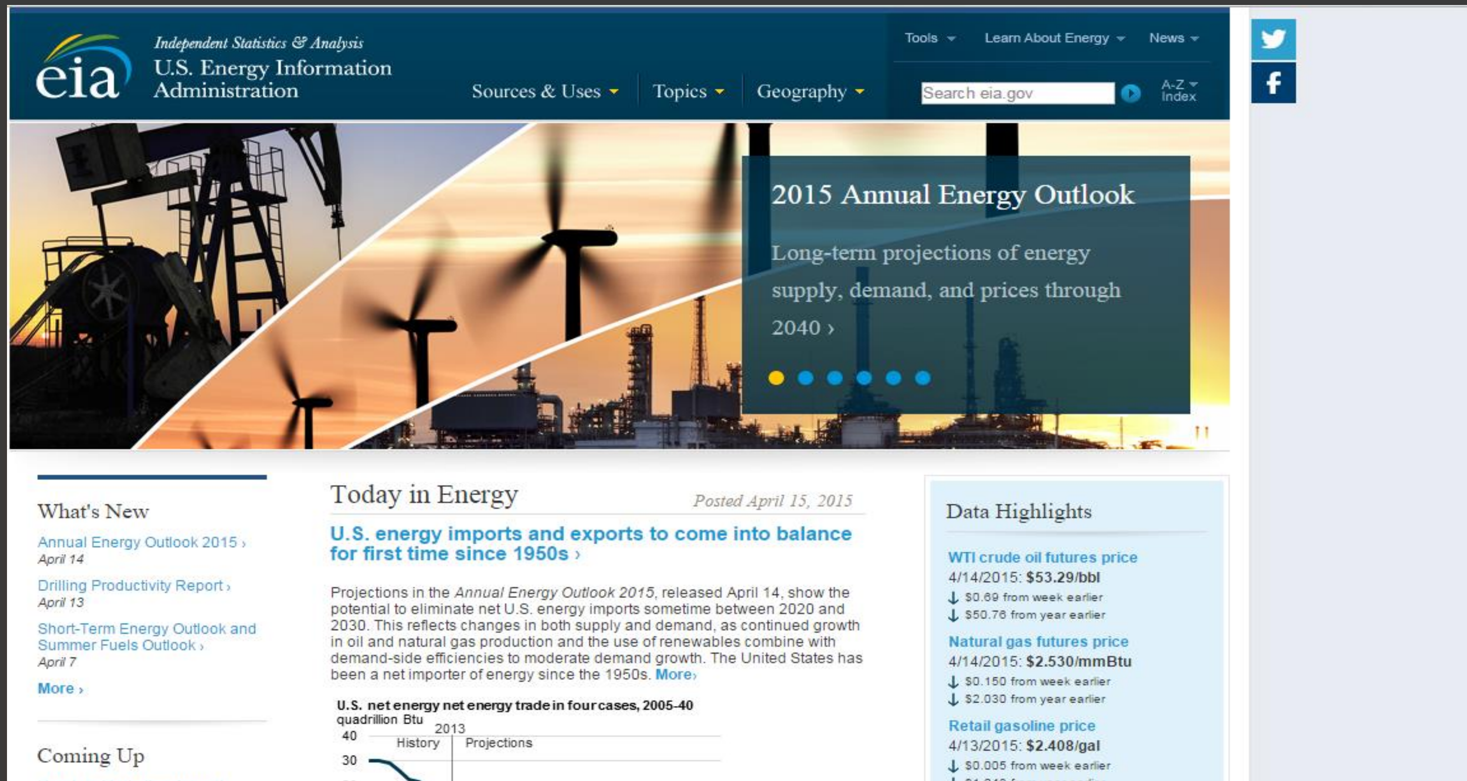
On-line teaching is a challenge. I find it difficult to motivate students compared to face-to-face. But this semester seems to be going very well.



Why put a course on-line?

Money
Frees up your schedule
Always runs
New and interesting way to teach (never stop learning)

Advantages to not having a book
http://www.eia.gov/



Data on-line more up to date
And can play with it
Can find some fun stuff
Students find more fun stuff and good links you can use next time
No pressure to cover topics in a book ($)

Toss in some 2-D.

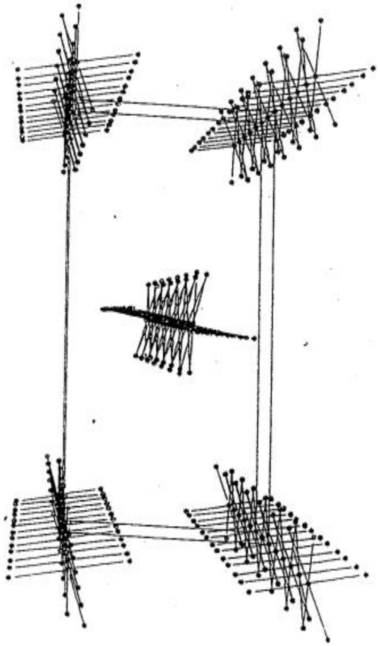


Figure 1.3 Three dimensional representation of the unit cell of $[((CH_3)_3NH)FeCl_3 \cdot 2H_2O]_n$. The chains along the *b* direction extend beyond the unit cell. Not all atoms are shown to emphasize the one dimensional and two dimensional character of the compound.

Evolution of year long sequence for calculus based physics

Course prior to changes:

Two (TR) or three (MWF) lectures
for total of 3 hours per week
AND one three hour lab

What we changed

Six hours with professor and no LAB sections
Mini lectures
PAL and SLA sessions
Worksheets
Mini-Labs
Formal Labs
Lab Reports

2009 - planned to make transition with the new building (opening 2012)
designed classroom space, math department drops physics
Spring 2010 try some activities in class
Summer 2010 - STREAMS grant funds course development to us to begin redesign of 243/244
Fall 2011 – Started the course. (with another round of course development tightened the structure)

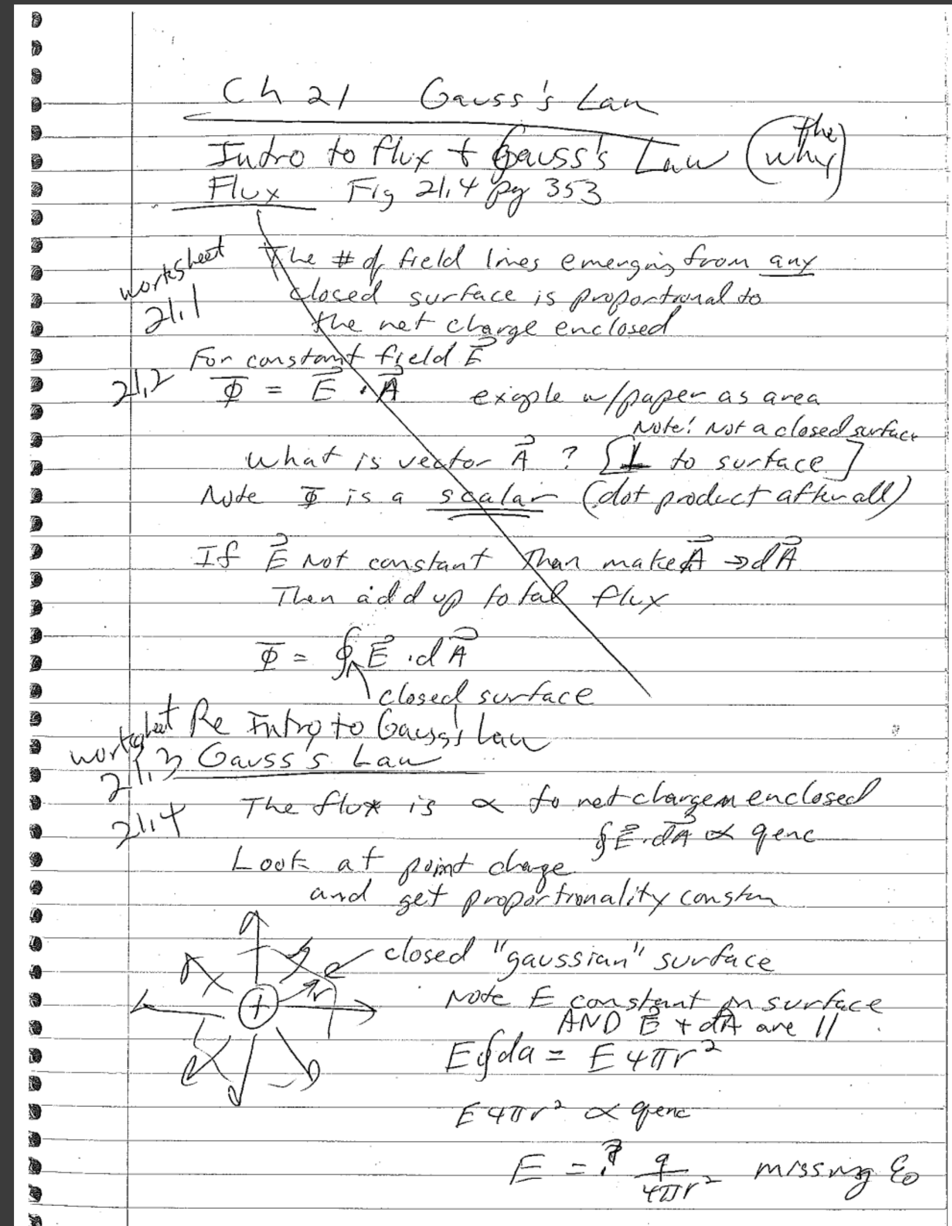
The course components

Course Component	Purpose / Learning Objective	Grade Percentage & Frequency	Collection or Grading Procedure	Assessment Collections
Student Questions & Review	Time to review harder material that comes up with the MP Homework, in SLA, in preparing for exams. Consolidating the main course learning objectives.	No grade, done every day	N/A	N/A
Mini-lectures	Content delivery, fast effort to familiarize students with the basic material of the day.	No grade, done every day	N/A	N/A
In-class worksheets	Student practice and modeling of simple problems, immediate assessment of students understanding in real time.	Together with mini-experiments, daily to weekly collection of materials for 10% of course grade. Worksheets every day.	Check / check-minus / absent style grading	Collect samples about 3 times per semester.
In-class mini-experiments	"See" the physics, model the equations. Allow students to develop a connection to the material with hands-on, experiential learning.	Together with in-class worksheets, daily to weekly collection of materials for 10% of course grade. Mini-experiments are daily to once per week.	Check / check-minus / absent style grading	Collect samples about 3 times per semester.

The course components (continued)

SLA Worksheets with PAL	**Peer-learning and problems solving that is guided by a PAL. Problems and conceptual questions are harder than in-class worksheets, but more guided than the MP Homework.**	**5% of course grade – either straight or as credit towards exam. Weekly assignments highlight main course topics.**	**Collect and grade the SLA worksheet work, or students have attended a session with the PAL.**	**Collect samples about 3 times per semester.**
Mastering Physics (MP) Homework	Online homework that gives practice for problem solving. Due online about 3 times per week.	15% of course grade, due online about 3 times per week before classes.	Graded online by computer.	Look at use statistics and correlate with exam scores.
Formal Labs	Practice modeling skills, experimental lab skills, and writing skills (both notebook and report). Learn to apply physical reasoning to situations without a formal, known answer.	20% of course grade, three times per semester. In 243, we have 2 journals that are collect + 1 formal lab report. In 244, we collect 2 lab reports and one journal.	Collect and grade labs and journals.	Save all un-graded labs for formal assessment.
Exams	Assessment	50% of course grade. 3 to 4 semester exams and one final exam.	Graded as an exam.	Sample at least one mid-semester exam and the final exam each semester.

Lectures begin to be crossed off and replaced by worksheets



Ch 21 Gauss's Law

Intro to flux + Gauss's Law (the why)

Flux Fig 21.4 pg 353

worksheet 21.1 The # of field lines emerging from any closed surface is proportional to the net charge enclosed

21.2 For constant field $\vec{E}$

$\Phi = \vec{E} \cdot \vec{A}$ example w/paper as area

Note! Not a closed surface

what is vector $\vec{A}$? [⊥ to surface]

Note Φ is a scalar (dot product after all)

If $\vec{E}$ not constant Then make $\vec{A} \to d\vec{A}$

Then add up total flux

$\Phi = \oint \vec{E} \cdot d\vec{A}$

closed surface

worksheet Re Intro to Gauss's Law

21.3 Gauss's Law

21.4 The flux is $\propto$ to net charge enclosed

$\oint \vec{E} \cdot d\vec{A} \propto q_{enc}$

Look at point charge and get proportionality constant

closed "gaussian" surface

Note E constant on surface AND $\vec{E}$ + $d\vec{A}$ are //

$E \oint da = E 4\pi r^2$

$E 4\pi r^2 \propto q_{enc}$

$E =? \frac{q}{4\pi r^2}$ missing ε_0

Worksheet and mini-experiment

Gauss's Law

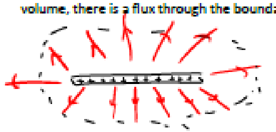
Gauss's law explains that the net flux of the electric field through a closed surface is proportional to the total charge inside the surface. Mathematically,

$$\Phi_E = \frac{q_{enc}}{\varepsilon_o}.$$

The constant $\varepsilon_o = 8.85\times10^{-12} C^2 / Nm^2$ is called the permittivity of free space. When we express the electric flux as an integral, and we are using a closed surface, we write the integral with a funny circle on the integration sign – just to remind us that this is an integral that adds up the electric flux through all the little parts of a closed surface:

$$\Phi_E = \oint \vec{E}\cdot d\vec{A} = \frac{q_{enc}}{\varepsilon_o}.$$

There are a few ways to read an equation like Gauss's law. One way is to view the charge on the right hand side as the *source* for the electric field, and say that the meaning of Gauss's law is that charge can be a source (the thing that creates) the electric field. Another way to look at Gauss's law is to think about it as a rule that describes the shape of fields created by charges. The fields created by stationary charges diverge (spread out in a local volume of space), and so if there is a small net charge in some volume, there is a flux through the boundary of that volume.



A bar of short positive charge and some electric field lines created by the charges. The field *diverges*, and the net flux through the dotted surface would be positive.

In the end, what we do most often with Gauss's law is use it to *compute* or derive formulas for the electric field due to certain charge configurations. We'll explore that in the next worksheet.

Question 1: A single positive charge of magnitude, +Q = 3.2nC is inside a sphere. What is the flux through the sphere? (Give a number.)

Question 2: Two charges, one positive and the other negative, are inside a sphere: Q_1. = 2.1nC and Q_2 = -1.3nC What is the net flux through the sphere?

Question 3: A third charge, Q_3 = 1.9nC, is brought near the sphere, but kept outside it. What is the net flux through the sphere now?

We will start out by investigating the horizontal and vertical motion of a projectile moving in two dimensions.

In this investigation we will examine the horizontal and vertical motion of a basketball moving in two dimensions. You will open up a video clip of a student shooting a basketball and then use the video analysis feature in Logger Pro 3 to examine the motion of the ball frame by frame. First you will make some predictions.

You will use the Video Analysis tool to create a graphical representation of the motion you see in a movie. This is ideal for mathematically analyzing real world events.

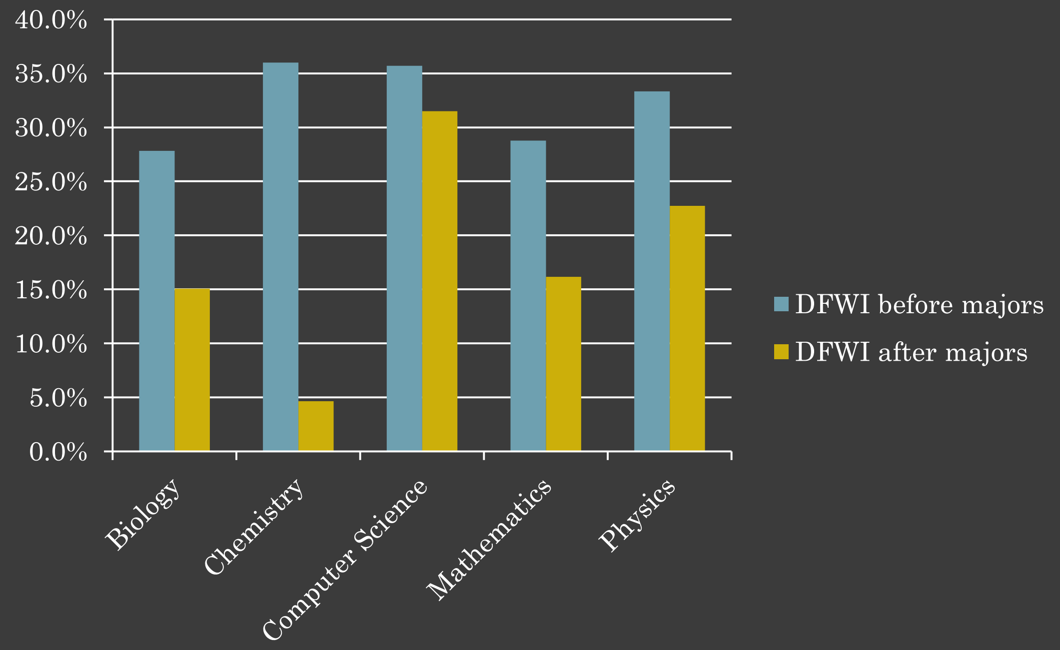
1. Open the file *BasketballShot.xmbl*. This will load up a file containing a video clip of a student shooting a basketball. If necessary, resize and move the clip to a desired position.

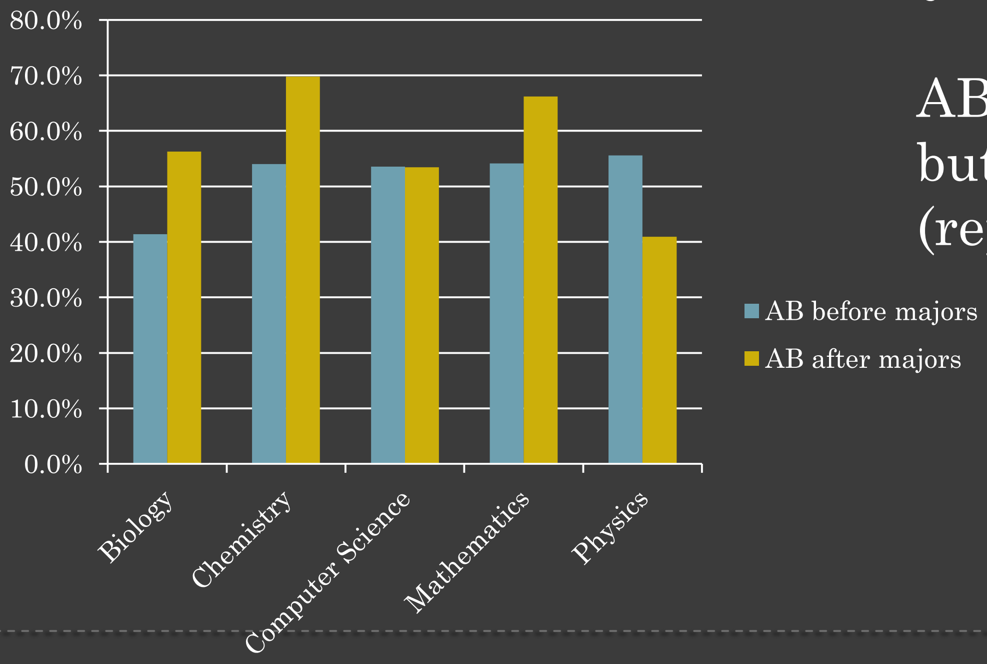
2. Click in the bottom right corner of the movie object to call up the Video Analysis Toolbar. A graph will also be displayed and a new set of X and Y columns will be added. By default, the graph will display both the x and y positions versus time. If necessary, resize and

Only do a few "formal labs" but a lot more emphasis on keeping a proper lab notebook. Followed up by taking experiment and writing lab reports.
Very important for our majors who are moving onto modern physics

https://my.bridgew.edu/departments/Physics/SitePages/Home.aspx

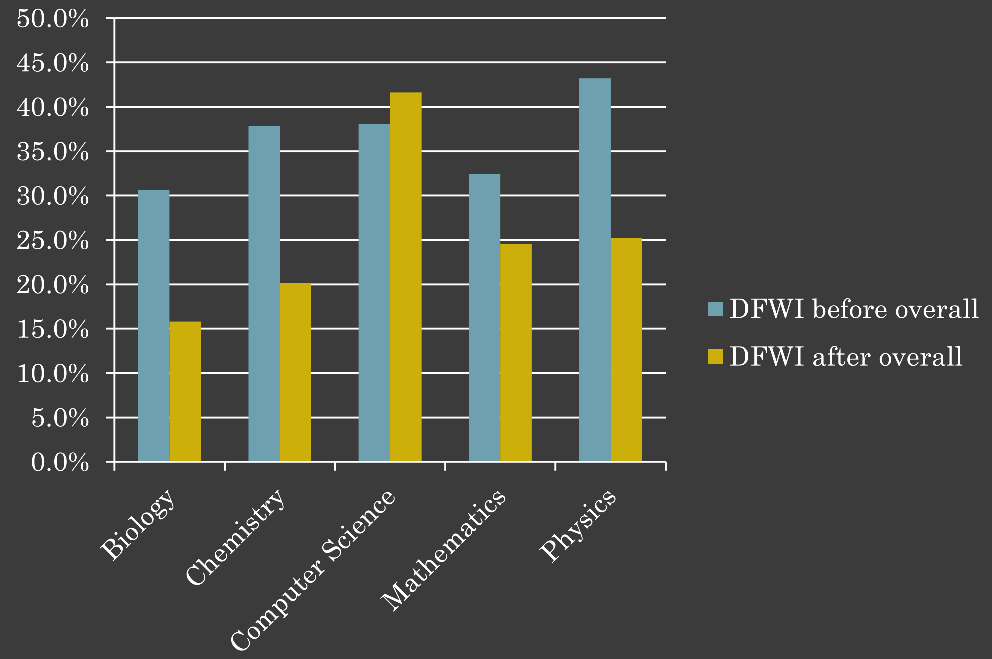
DFWI rates for Majors went down

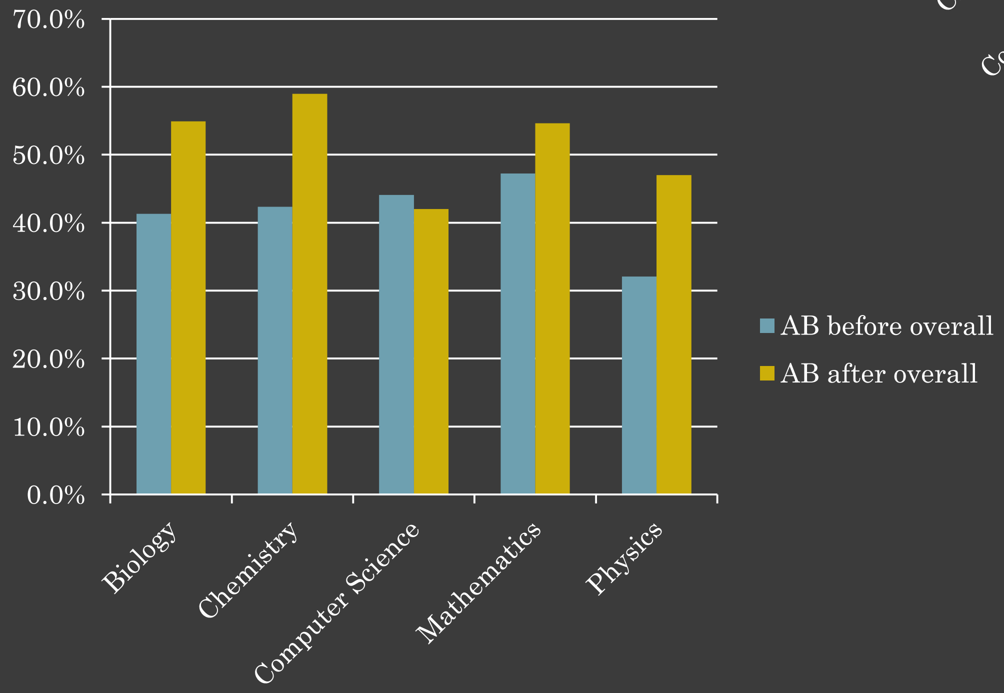




AB rates for Majors went up
but not for physics
(represents less than one student)

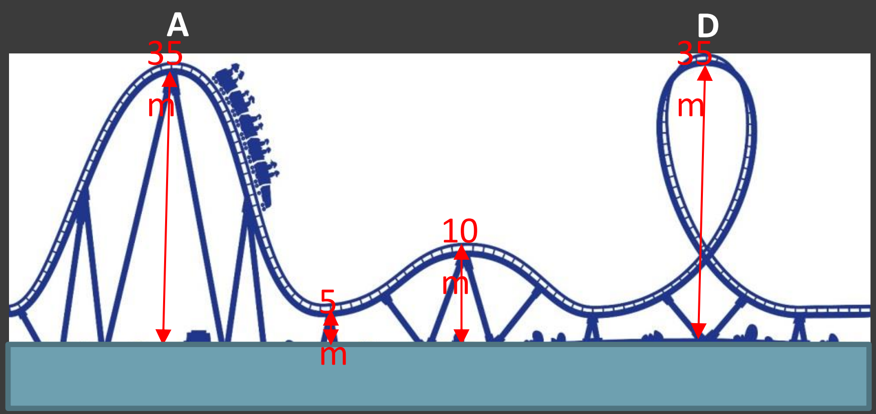
Non-majors doing Very well





New professor brings new course components

Guided quizzes



Thayaparan Paramanathan

A roller coaster car with mass 2000 kg is pulled up with an engine to point A and released from rest. Assume that the ground level has zero potential energy, the friction on the tracks does not cause any energy loss and $g=10\ ms^{-2}$.

- What is the potential energy of the car just before the release?
- How much work did the engine do to bring the cart to point A?
- What is the total Potential energy of the car at point B?
- What is the kinetic energy of the car at point B?
- What is velocity of the car at point B?
- What will be the velocity when it reaches point C?
- Guess the velocity at point D without calculation. Explain in words why?
- If you had friction on tracks. Can the cart reach point D? Explain why or why not?

Ah buoyancy – I wish teaching was as easy as floating in the Dead Sea