Lessons from a (Mostly) Successful Flip

Robin Dunkin, Ph. D

University of California, Santa Cruz

Active Learning Seminar

October 13, 2016

Teaching Team

Susie Honig

- Anne Warner (TA)
- Chandra Goetsch (TA)
- Hailun Wan (LA)
- Rebecca Rook (LA)
- Kyler Asato (LA)
- Raymond Tan (MSI)

AL/HHMI Team

- Lisa Hunter (ISEE)
- Manny Ares
- Ian Marcus
- Tammy Bye

TEAM EFFORT!

With your neighbor

What are your biggest worries about flipping a class/incorporating active learning?

What were our major concerns at the beginning?

- Will students do the work needed outside of class?
- How much content are we going to have to cut?
- Will students engage or will it be like a whole quarter of flopping at open mic night?
- Will our evaluations suffer?
- How much extra time/work is this going to take?
- *Will they really do better?*

1. Planning the flip
2. Flipping: What did it look like?
3. Were we successful? How do we know?
4. What would we change?
5. Taking it to the masses!

What did we consider active learning for our purposes?

Active Learning. The process of having students engage in some activity that forces them to reflect upon ideas and how they are using those ideas. Requiring students to regularly assess their own degree of understanding and skill at handling concepts or problems in a particular discipline. The attainment of knowledge by participating or contributing. The process of keeping students mentally, and often physically, active in their learning through activities that involve them in gathering information, thinking, and problem solving.

- Collins and O'Brian, 2006

What did we consider active learning for our purposes?

- Active lecture (clickers, pair shares)
- Working on problems alone or in small groups
- Class discussions
- Worksheets
- Working on questions/problems at poster stations
- Class demonstrations
- Fish bowl exercises
- Peer Teaching

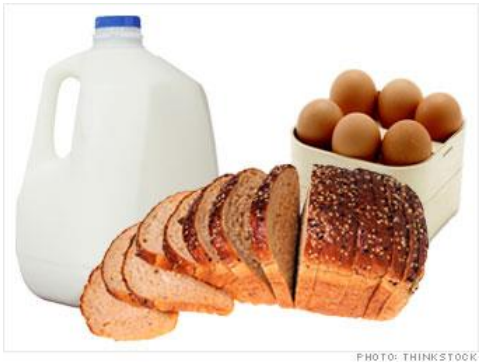
- Group Projects (quarter long)

Planning to Flip

- Started with previous syllabus + info from "campfires"
- Quasi-Backwards design
- Went class by class and designed original activities, used online activities, relied on some "staples"

AL "Staples"

- Active lecture
- Postering
- Worksheets paired with discussion



UCSC Active Learning Initiative
Bio 20b-Development & Physiology of Organisms

5 April 2016
Honig and Dunkin

Instructor Notes
Tuesday April 5 2016

Class Schedule
15 minutes: Students fill in "mouth to colon" drawing
30 minutes: Evidence and models activity
10 minutes: The 'real' models
10 minutes: Jigsaw
30 minutes: Leptin graphing and diabetes active lecture
10 minutes: Synthesis (What did we learn and assign HW)

Class schedule (usually thrown out the window)

Before-Class Assignments
- Read Chapter 51
- Online Lecture: The digestive system parts I and II: Crash Course/Khan Academy

What students should have done before class

Learning Outcomes

Digestive System
- Be able to describe the major organs of the digestive system including what type of fuels are digested and absorbed and where this occurs.
- Understand the difference between digestion and absorption
    - Students should be able to describe that the breakdown from polymers to monomers is digestion and they should predict the method of transport of different molecules based on polarity.
- Understand that digestion is extracellular
- Be able to describe mechanisms of transport of different molecules to cross epithelial cell
- Understand that mechanism of absorption is based on molecular characteristics.

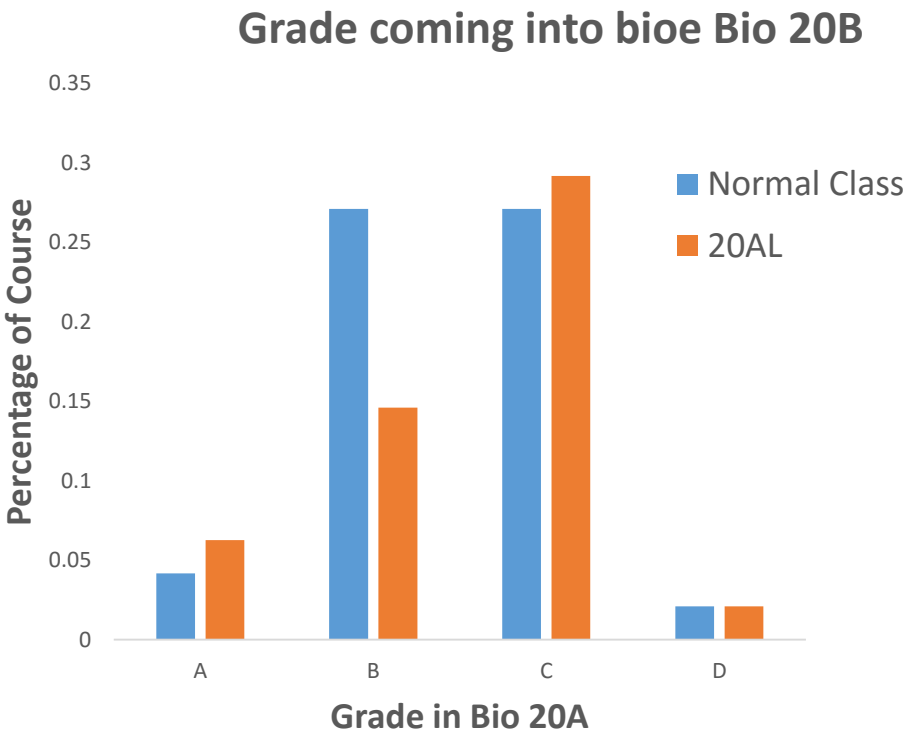
Hormonal Control
- Be able to describe hormonal regulation of digestion at the level of Figure 15.17 in Sadava.
- Draw a graph of blood sugar, insulin, and glucagon over time and before and after a meal.
- Describe the difference between Type I and Type II diabetes
- Draw a graph of leptin vs. body mass and predict the correct graph for humans or mice that lack the leptin gene

Learning outcomes based on what had been done in previous classes

Materials
- Student Guide handouts for Evidence-based models
- Poster paper
- Markers

1. Planning the flip
2. Flipping: What did it look like?
3. Were we successful? How do we know?
4. What would we change?
5. Taking it to the masses!

The Students



58 students in course
49 responded to this survey

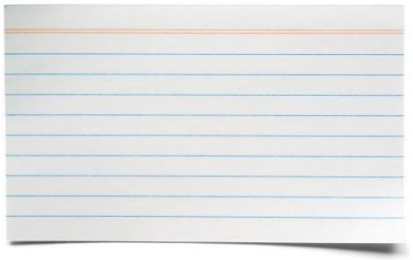
Full data from institutional research is pending

The first day

Equity & Inclusion

Feedback from students

- *What do I want my instructors to know?*
- *What I am excited to learn about?*



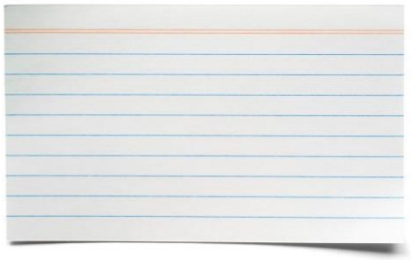
Some real responses:

- I am working 20 hours a week to pay for school
- This is the second time I am taking this class and I am going to work extra hard to pass
- I am scared of talking in class but I am still engaged
- I am scared of math
- I want to be a researcher
- I LOVE biology
- I want to learn about the nervous system
- I have to commute 2 hours to get here
- English is my second language
- You should know that this is not my only class ☺

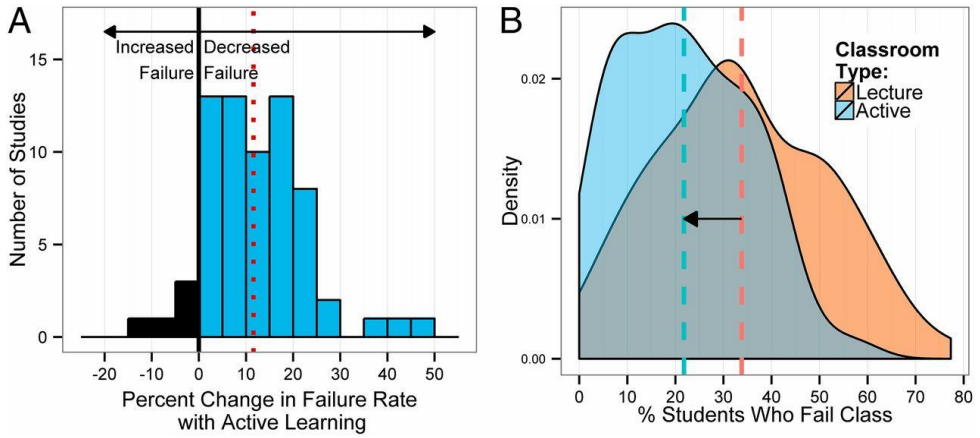
The first day

Feedback from students

- *What do I want my instructors to know?*
- *What I am excited to learn about?*



Make the evidence based case for AL



Scott Freeman et al. PNAS

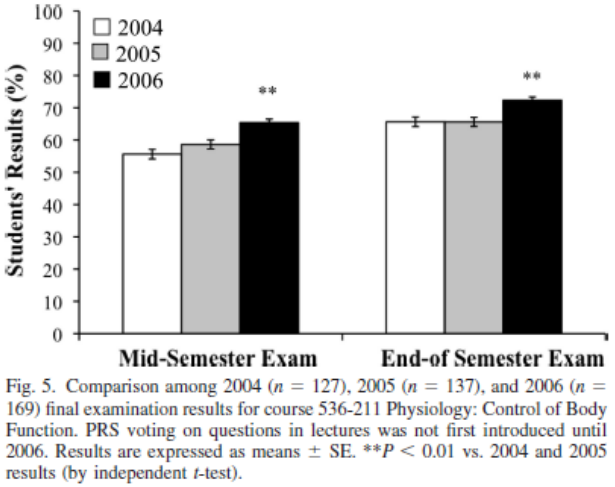


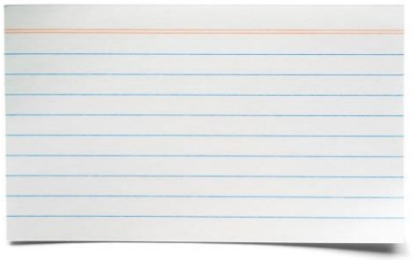
Fig. 5. Comparison among 2004 (n = 127), 2005 (n = 137), and 2006 (n = 169) final examination results for course 536-211 Physiology: Control of Body Function. PRS voting on questions in lectures was not first introduced until 2006. Results are expressed as means ± SE. $^{**}P < 0.01$ vs. 2004 and 2005 results (by independent t-test).

Gauci et al., 2009

The first day

Feedback from students

- *What do I want my instructors to know?*
- *What I am excited to learn about?*



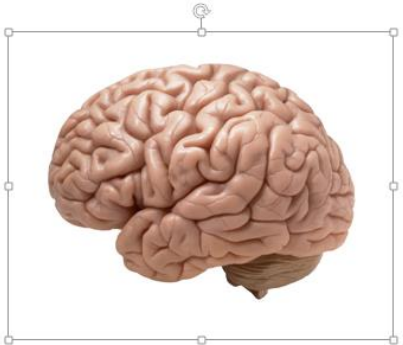
Make the evidence based case for AL

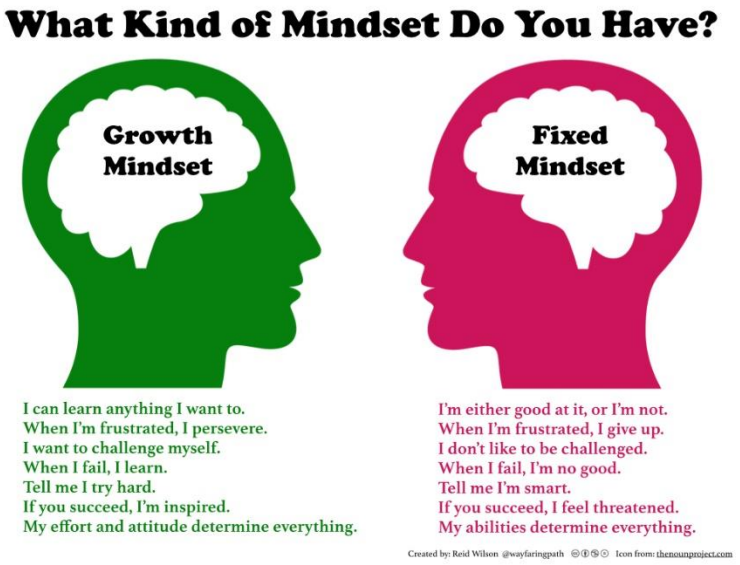
Pair Share on Growth Mindset

With your neighbor…

Is intelligence fixed or flexible?

Deep down…what do you REALLY think?

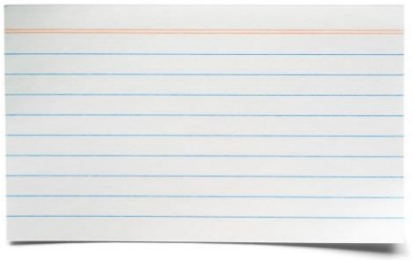




The first day

Feedback from students

- *What do I want my instructors to know?*
- *What I am excited to learn about?*



Make the evidence based case for AL

Pair Share on Growth Mindset

Conveyed confidence in their ability to get an A but more importantly deeply learn

Equity & Inclusion

Course organization, stipulated that things may change, welcomed feedback, told them how we would let them know what they are responsible for knowing.

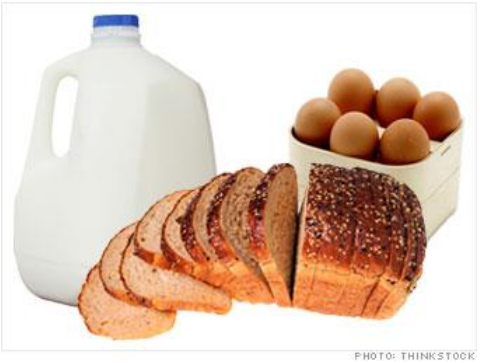
Examples of Activities

Staples

1) *Active Lecture* with clicker questions & "*with your neighbor*"

Generally have two types:

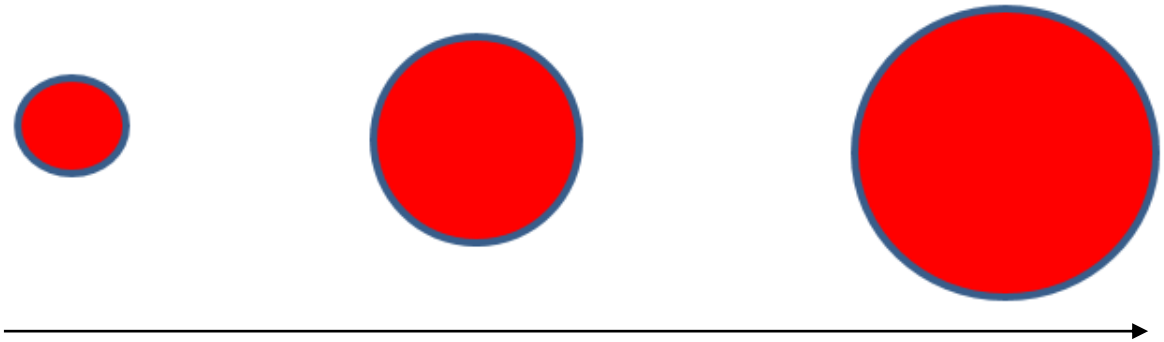
- Checking understanding
- Challenge questions



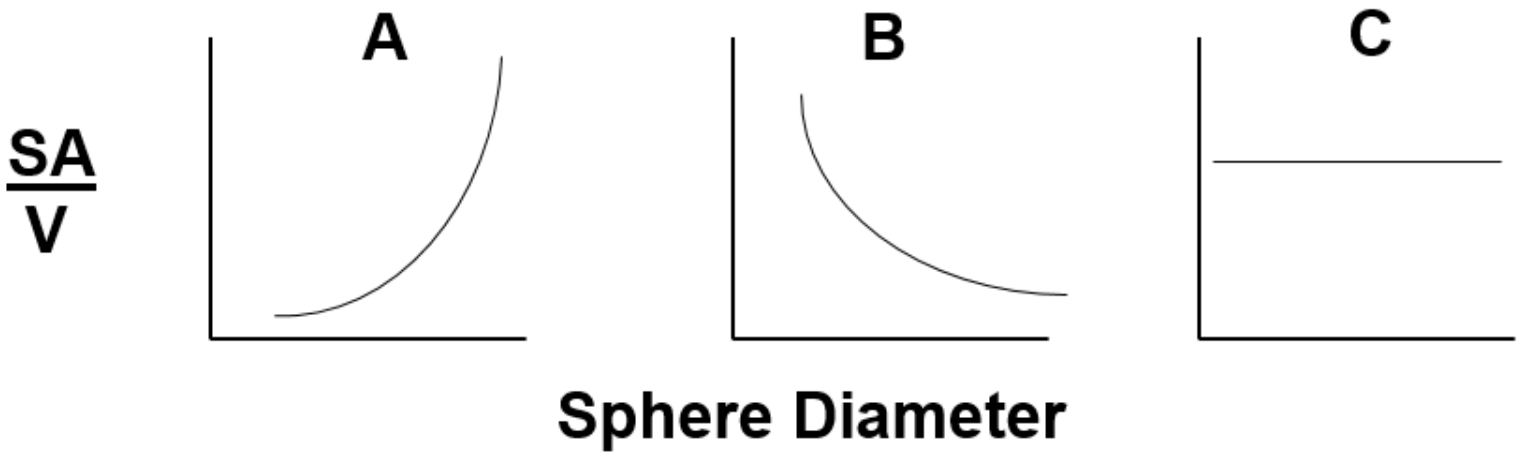
Skill focused

- Draw a graph/interpret graph
- Critical thinking
- How would you test X or Y?

Examples of Activities



The graph that most accurately describes the surface area to volume ratio of the spheres above is:



Examples of Activities

Staples

1) Active Lecture with clicker questions & "*with your neighbor*"

2) ***Postering***

- Facilitates peer teaching
- Encourages metacognition
- Encourages revision
- Helps instructor see student's thinking
- Helpful for:

  Processes

  Learning a system

  Working out critical thinking questions

Examples of Activities

Staples

1) Active Lecture with clicker questions & "*with your neighbor*"

2) Postering

3) *Worksheets*

- Targeted typically difficult topics
- Aimed at giving them practice
- Basic to challenge questions
- Always went over in class

Examples of Activities

Additional activities

- Evidence and Modeling x 3
- Graph Speed Data-ing
- Act out an action potential
- Human demonstration of tree growth
- Human demonstration of water transport

- Rap Genius
  - *Quarter long project focused on reading and interpreting scientific literature using rap genius annotation website*
  - *Culminated in a mock "conference"*

Equity & Inclusion

Given evidence statements

Asked to build a model that fits the data

- *Guard cell function*
- *Transport of nutrients across intestine*
- *Effects of neurotoxins*

Evidence & Modeling of how guard cells open & close

amyloidogenic processing pathways [5]. This pathway is initiated when APP undergoes proteolytic cleavage by β-secretase, encoded by the *BACE* gene. This cleavage produces a soluble extracellular/lumenal fragment of APP (sAPPβ) and a membrane spanning C-terminal fragment (βCTF/C99). The γ-secretase complex then cleaves βCTF to produce Aβ peptides and the APP intracellular domain (AICD) [5]. Aβ peptides of a variety of lengths are produced but $A\beta_{40}$ and $A\beta_{42}$ are the major isoforms produced in the central nervous system (CNS). Compared to $A\beta_{40}$, $A\beta_{42}$ is more prone to oligomerization and has been shown to be more neurotoxic [6].

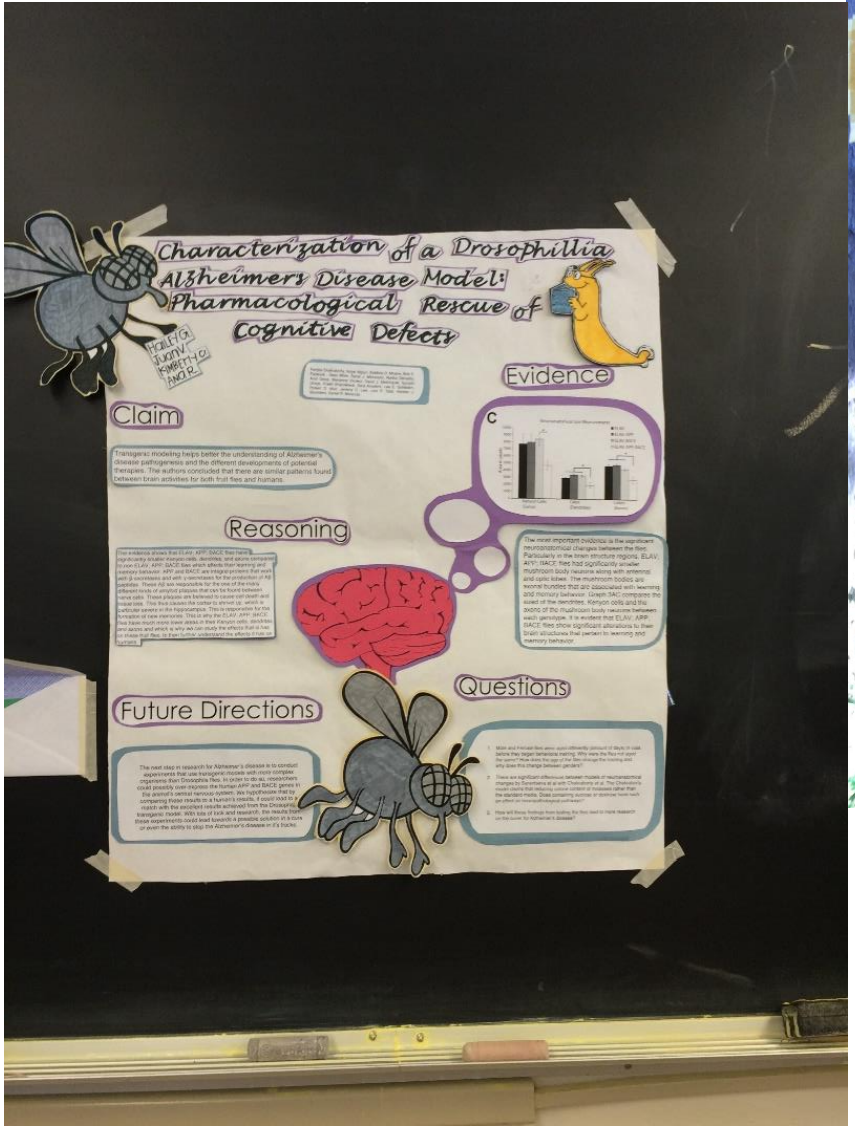
APP also undergoes an alternative proteolytic processing pathway termed the non-amyloidogenic pathway. In this pathway, α-secretase initially cleaves APP, rather than β-secretase, to produce a soluble extracellular/lumenal fragment of APP (sAPPα) and a membrane spanning C-terminal fragment (αCTF/C83). Again, the γ-secretase complex then cleaves αCTF to produce the P3 peptide and AICD [5].

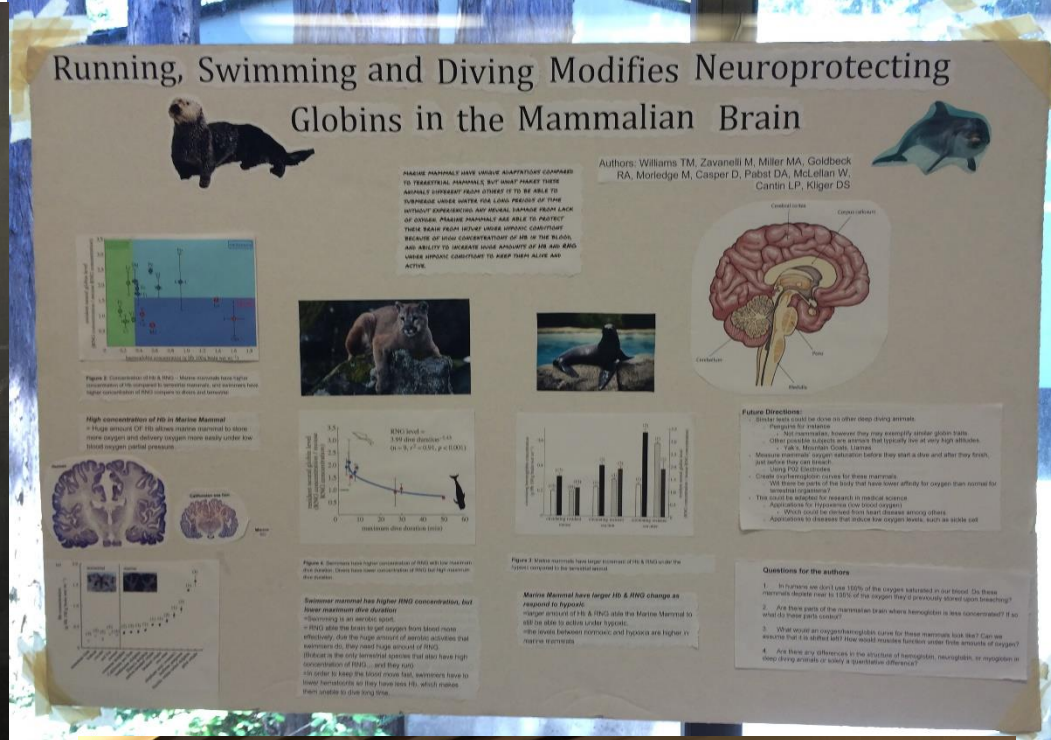
APP proteolysis is an important step towards development of AD. Therefore, it is important to identify genes and pharmaceuticals that modulate APP metabolism and Aβ production and clearance. Developing *in vivo* disease models has proven crucial to illuminating disease mechanisms, since *in vitro* studies do not always represent the natural physiological complexity of the tissue and/or organism. In particular, the fruit fly, *Drosophila melanogaster*, has been tremendously important and influential in furthering our understanding of the mechanisms of many forms of neurodegenerative diseases, including AD [7], [8], [9], [10], [11].

Drosophila endogenously express orthologues to the human *APP* [12], α-secretase [13], [14], and γ-secretase [15], [16], [17], [18]. Recently, a functional *Drosophila* homolog of the BACE (β-secretase) family of proteins has also been identified [19]. Though the *Drosophila* homolog to human *APP*, *Appl*, does not contain significant sequence similarity within the Aβ region of human APP [12], there is recent evidence suggesting

“Mock Conference” at end of Course

- *Students presented posters*
- *Authors of papers discussed careers & role of failure in science*


Characterization of a Drosophillia Alzheimer's Disease Model: Pharmacological Rescue of Cognitive Defects
Claim
Evidence
Reasoning
Questions
Future Directions


Running, Swimming and Diving Modifies Neuroprotecting Globins in the Mammalian Brain
Authors: Williams TM, Zavanelli M, Miller MA, Goldbeck RA, Morledge M, Casper D, Pabst DA, McLellan W, Cantin LP, Kliger DS
Future Directions:
Questions for the authors

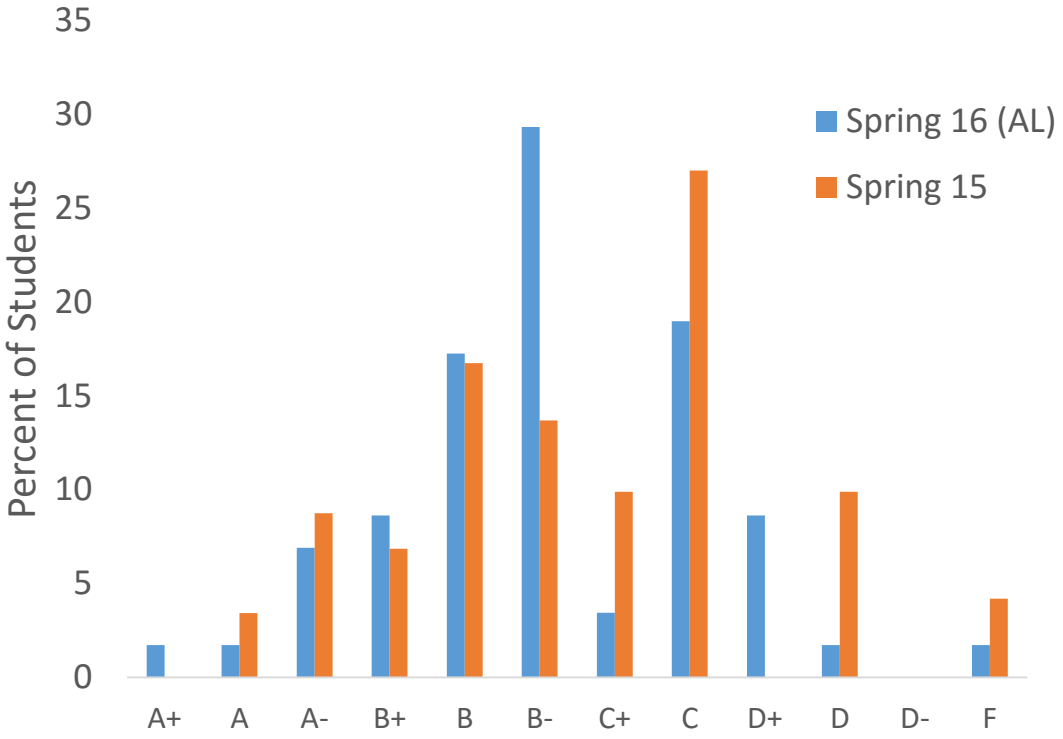
1. Planning the flip
2. Flipping: What did it look like?
3. Were we successful? How do we know?
4. What would we change?
5. Taking it to the masses!

Were we successful?

Grades

Data sources:

1) grades
2) end of quarter survey



- Failure rate – nearly identical
- Moved C students up to B- ??

Caveat: Very different sample sizes….

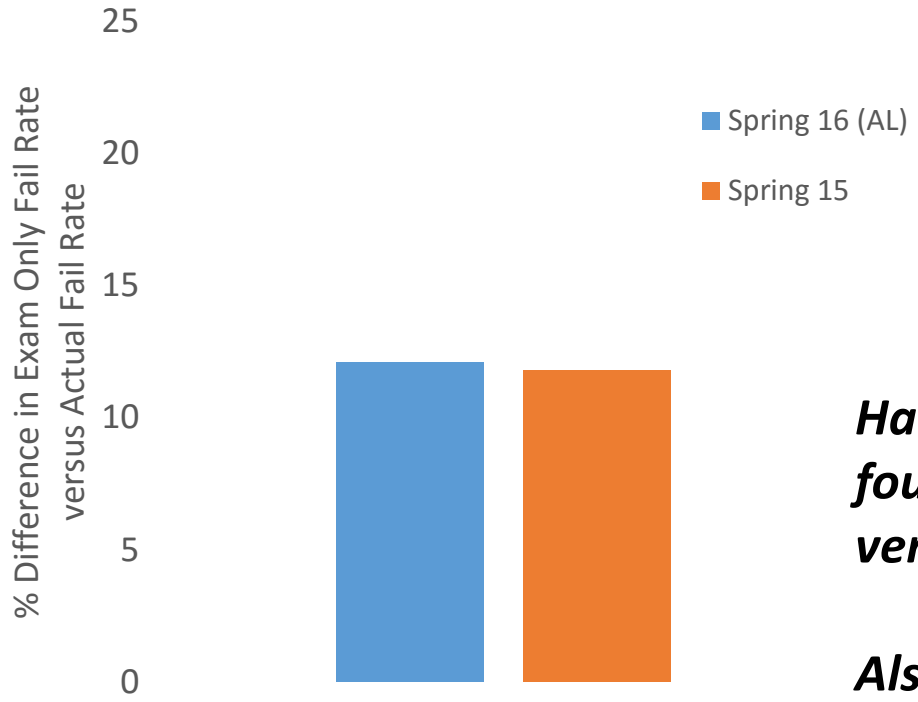
Do active learning exercise just result in grade inflation because of more non-exam points?

Were we successful?

Grades

Data sources:

1) grades
2) end of quarter survey



- Virtually identical rate of students would have failed based on exam scores only

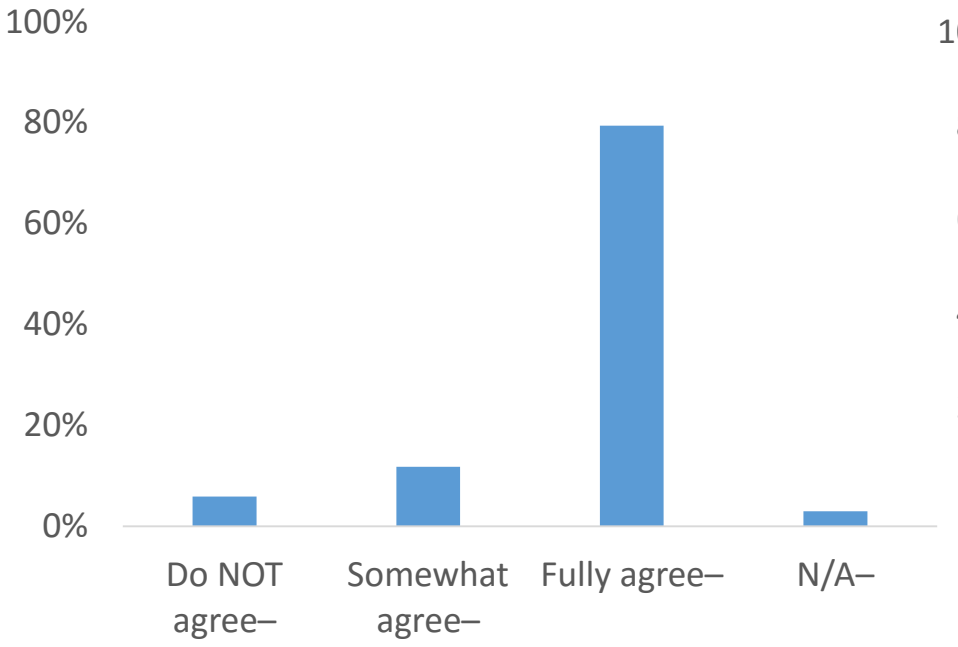
Haak and Freeman, 2011 (Science) found the same for controlled study with very large sample size.

Also found exams tended to get harder in AL courses.

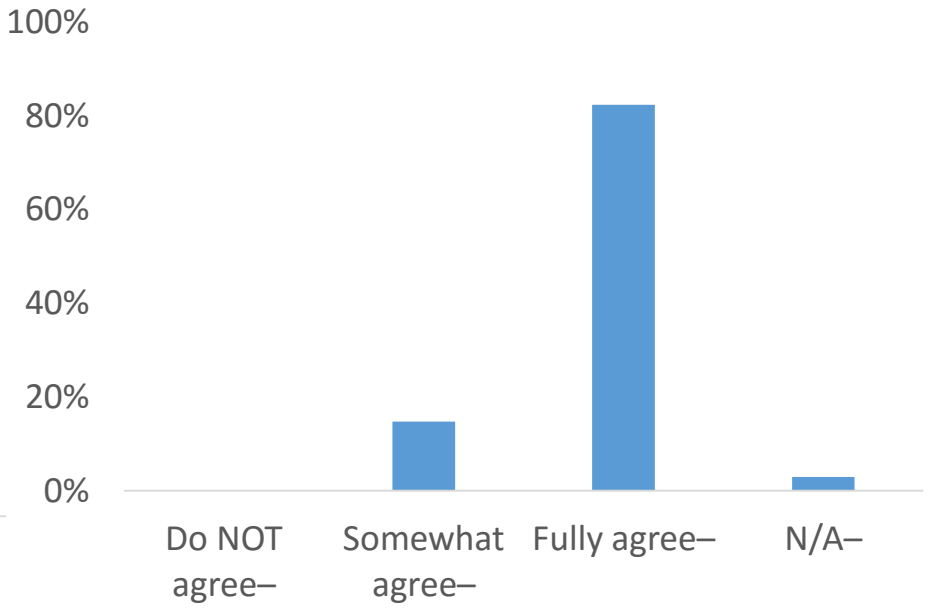
Were we successful?

End of quarter survey

STEM Identity & Equity and Inclusion



I felt that the course helped me feel more like a scientist compared to when I started the course.

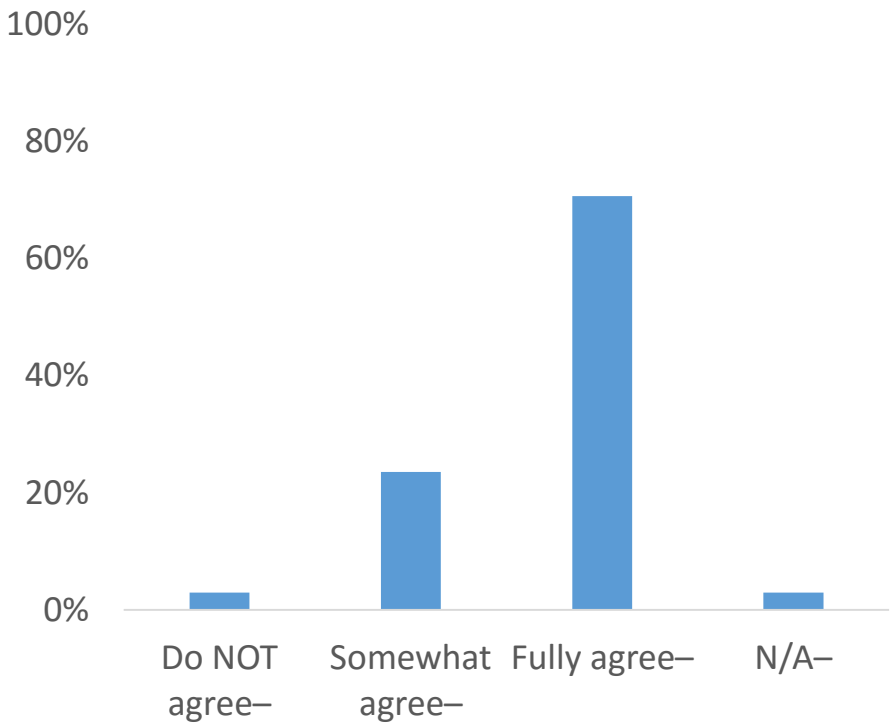


I felt the course was equitable & Inclusive

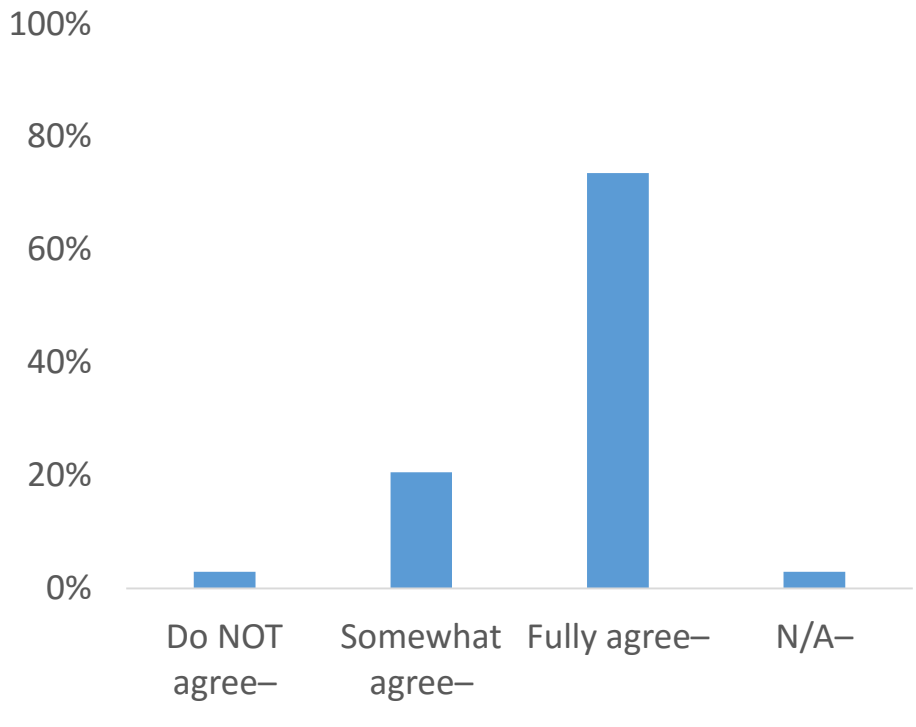
Were we successful?

End of quarter survey

Skills or STEM Practices



I feel more comfortable interpreting graphs compared to when I started the course.



I feel more comfortable translating jargon into plain language compared to when I started the course.

Were we successful?

End of quarter survey

Typical Positive Statements

"The poster activities were extremely helpful. Especially when we had to explain our diagrams/answers to another group."

"Physically modeling biological phenomena makes you remember things better. There is not a single activity or worksheet we did that I do not feel was useful."

"I would study for two weeks for exams in my other bio classes and would not retain as much information and would not do nearly as well. I walk away from this class with a strong memory of everything we learned throughout this entire course."

Typical Areas of Improvement

"This class was very demanding. I liked the style of learning a lot but I didn't like the worksheets we had to do. Often I felt that they were unfairly graded (too many points taken off) and that we didn't go over the answers enough for a full understanding of the concept. Often lecture seemed rushed."

"Better time management so we have time to talk about an activity after we do it"

1. Planning the flip
2. Flipping: What did it look like?
3. Were we successful? How do we know?
4. What would we change?
5. Taking it to the masses!

What will we change?

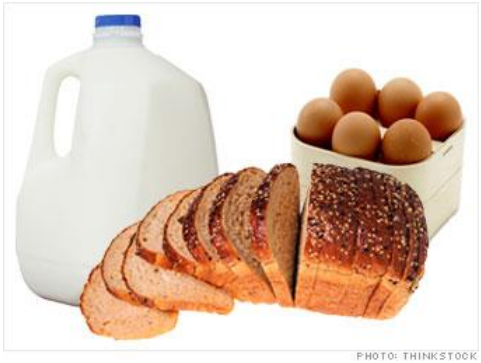
- *Pare down the number of activities*
- *Reduce active lecture more by using more original videos*
- *Use section to finish worksheets if needed*
- *Learning outcomes posted at the beginning of the course*
- *Potentially use sections to do synthesis questions*
- *Have learning assistants & teaching assistants always sit among the class rather than clustered together*
- *Incorporate more exam questions that try to get at skills*

1. Planning the flip
2. Flipping: What did it look like?
3. Were we successful? How do we know?
4. What would we change?
5. Taking it to the masses!

How do we translate to large courses?

- Group work challenging
- Space/physical challenges
- Grading more assignments takes a lot of time
- Motivation is different (choosing vs. forcing)
- Small class size benefits are absent

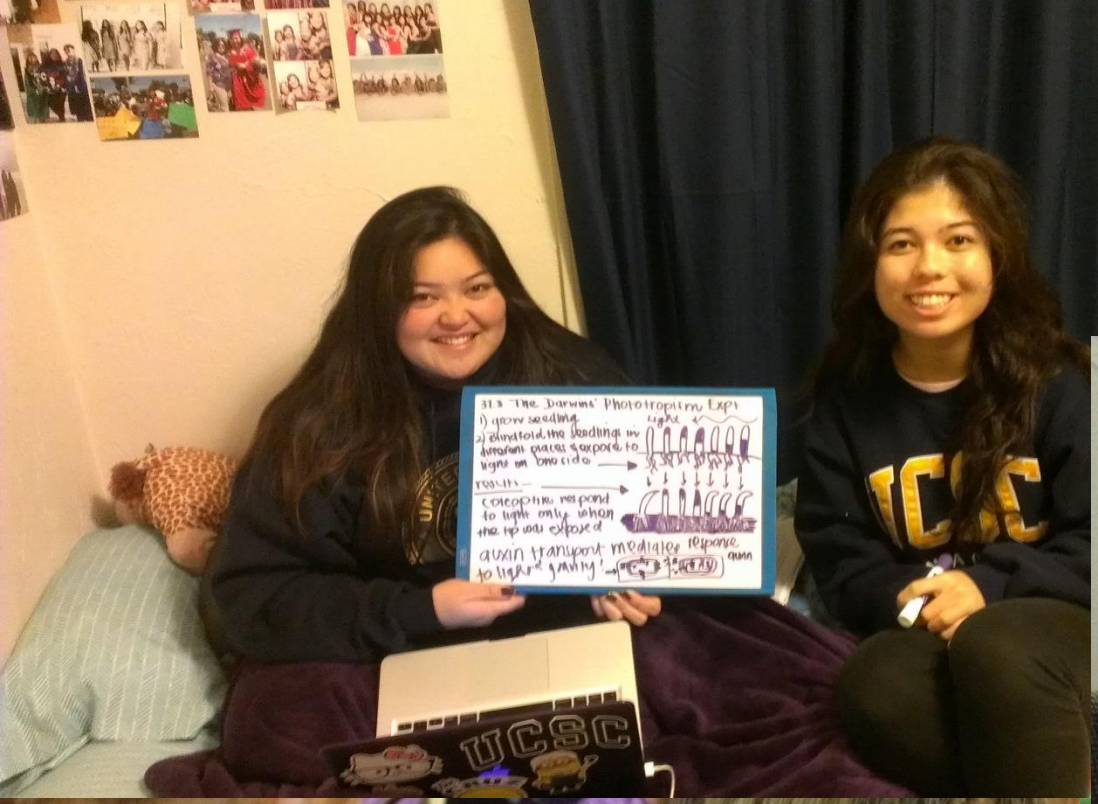
Taking it to the masses!

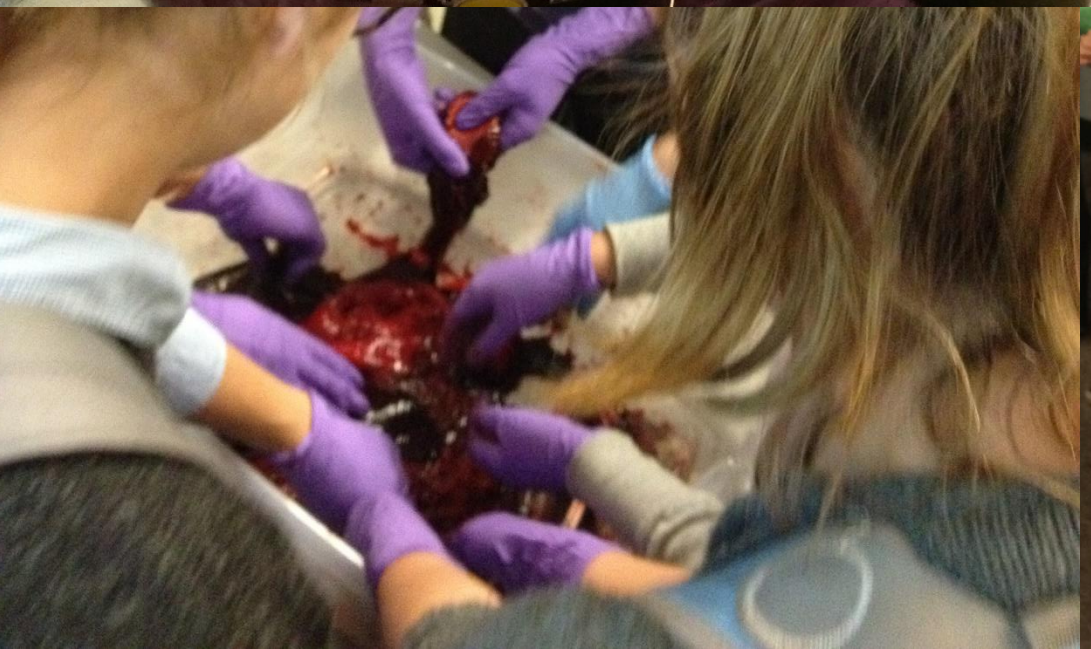


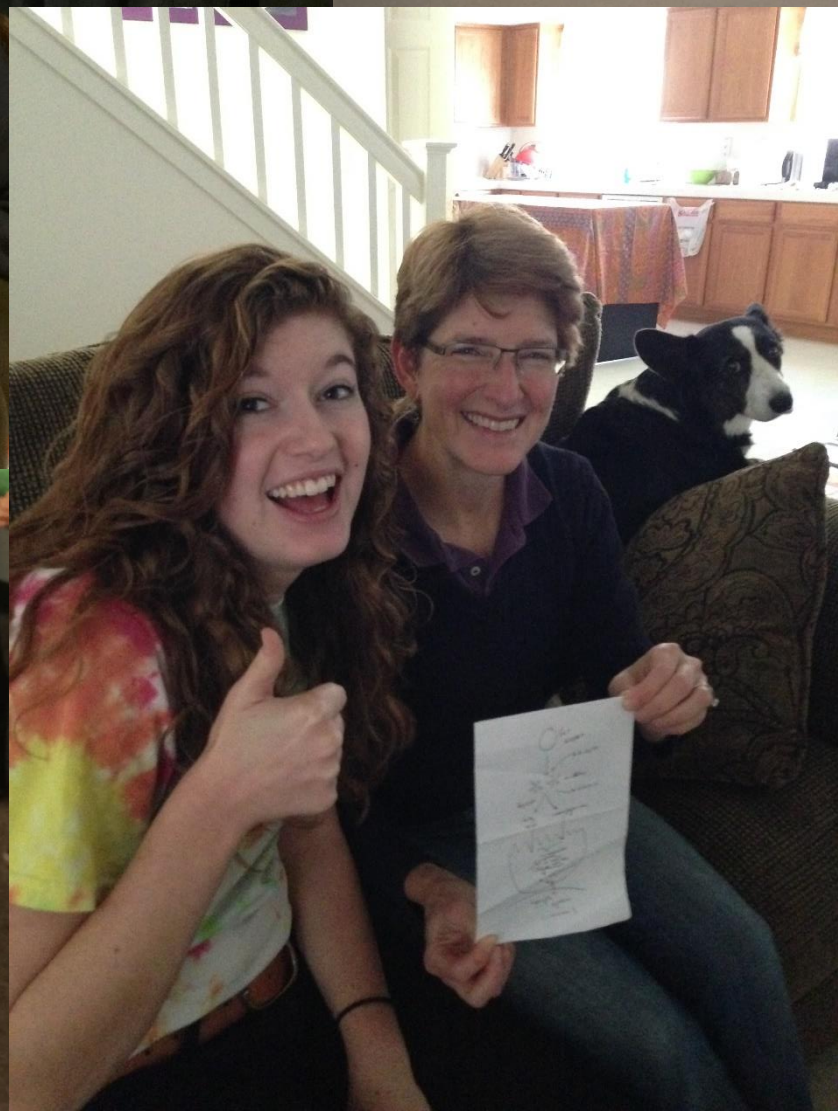
The staples….tried, true…and cheap!
(potentially considered a phase 1)

Reintegrating activities into large lecture with modifications

- *Evidence and modeling/Rap Genius with modification*
- *Giving graphs/critical thinking questions in lecture and giving time to struggle*
- *Worksheets as homework, go over in class after giving students a chance to work with neighbors*
- *Humans-as-props! Fish bowl demos*
- *A note about TAs & LAs*


3.3 The Darwins' Phototropism Expt
1) grew seedling
2) blindfold the seedlings in different places exposed to light on one side
light
results
coleoptile respond to light only when the tip was exposed
auxin transport mediates response to light & gravity!
UCSC





What I have Learned?

- Forced me to focus even more on what very specific ideas/concepts I want students to master
- Refocus on skills – with each concept that we cover, how can I work in time to practice a skill
- Less is more
- Organization is really important
- Transparency with students is really important
- Some things are going to flop – contexting at the beginning is important

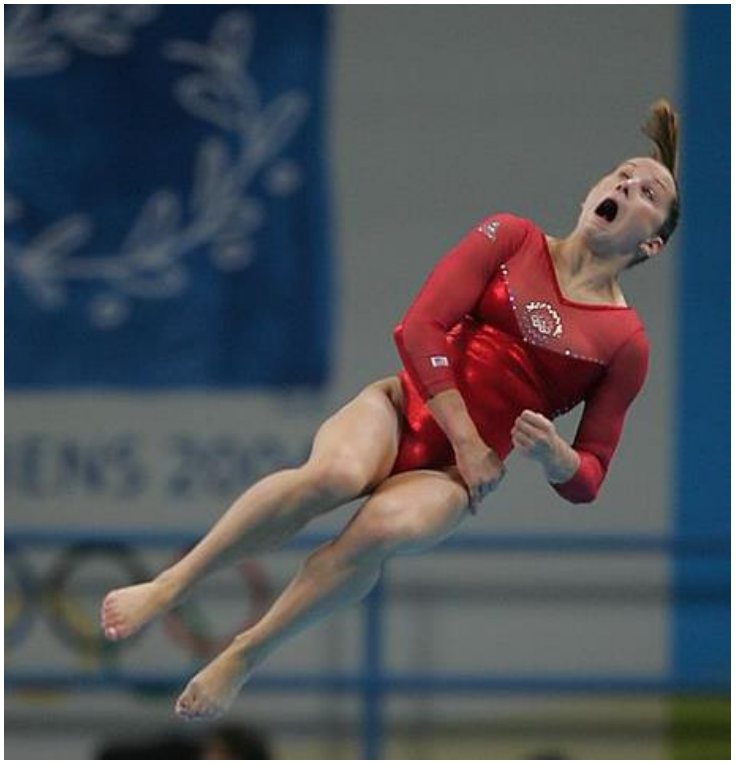
Did the concerns we started with come to pass?

- Will students do the work needed outside of class?
- How much content are we going to have to cut?
- Will students engage or will it be like a whole quarter of flopping at open mic night?
- Will our evaluations suffer?
- How much extra time/work is this going to take?
- *Will they really do better?*

Susie and I….

Questions?

Mid quarter!



End of Quarter!