



# Promoting Engagement in the (Sometimes Very) Large “Lecture” Classroom

Lori Kayes and Devon Quick



# Session Outcomes

- Identify and discuss challenges and opportunities associated with teaching in the large lecture and for engaging students in this context
- Provide examples of strategies for promoting engagement in the large lecture classroom and evidence of success of different strategies for promoting engagement.
- Explain implementation tips utilizing strategies across a variety of classroom sizes.
- Describe ways to prepare students for success in the large lecture classroom

# Identify Challenges

(5 min)

- Discuss with your table:
  - What is the largest lecture you have ever given or attended?
  - What was the most successful teaching strategy in that lecture?
    - What made it successful?
  - What was the biggest failure in that lecture?
    - Why?

(2 min)

# Identify Challenges of the Large Lecture

(2 min)

# Identify Opportunities of the Large Lecture

# Student Engagement in the Large Lecture





# Why student engagement matters

- **Increase student performance**

- Students in active learning classes earn higher grades compared to students in traditional lecture sections  
-enough to raise grades by half a letter.

- **Increase Retention**

- Students in lecture sections are 1.5 times more likely to fail, compared to students in active learning classes
- Note: students who leave STEM bachelor's or associate's degree programs have GPA's 0.5 and 0.4 lower than persisters.

\*Wenderoth, MP. End of the Lecture; the Future of Evidenced Based Teaching, OSU 2014.

# What is Active Learning?

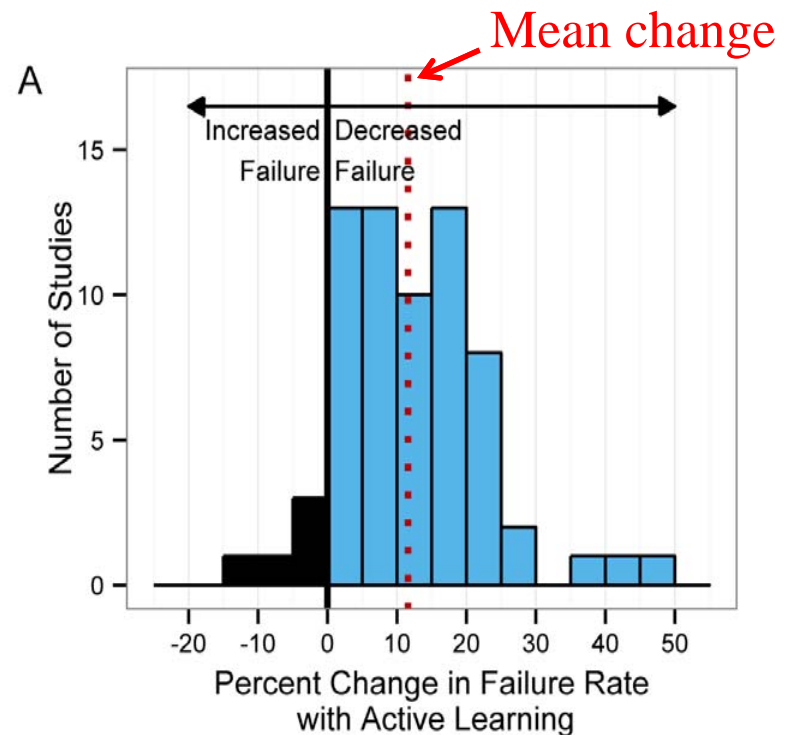
1. Students are **involved** in more than passive listening
2. Students are **engaged** in activities  
(e.g., reading, discussing, writing)
3. **Less** emphasis on **information transmission** and  
**greater** emphasis on **developing student cognitive skills**
4. Student **motivation** is increased
5. Students receive **immediate feedback** from instructor
6. Students are involved in **higher order thinking**  
(analysis, synthesis, evaluation)

Bonwell, C.; Eison, J. (1991). *Active Learning: Creating Excitement in the Classroom* AEHE ERIC Higher Education Report No. 1. Washington, D.C.: Jossey-Bass. [ISBN 1-878380-08-7](#).



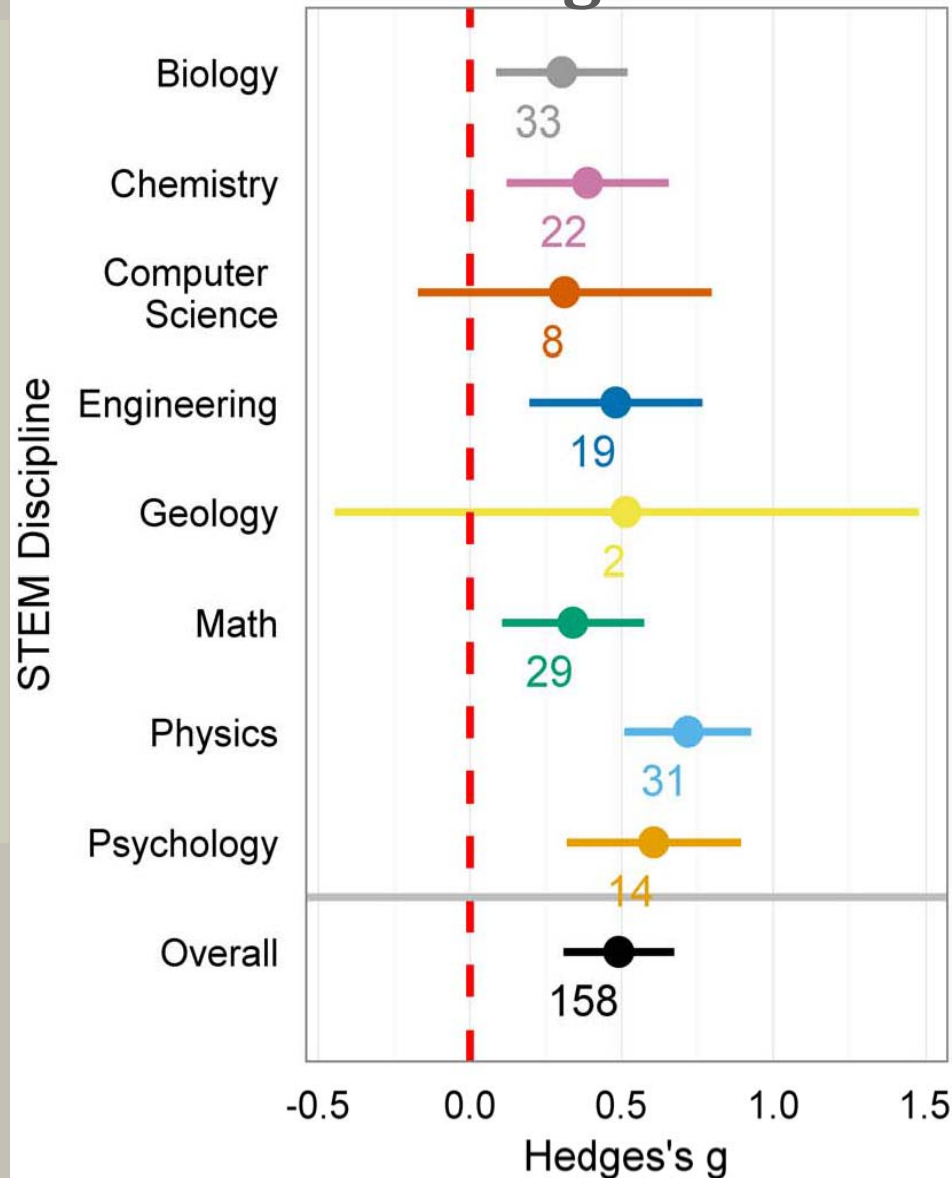
# Active Learning Decreases Failure Rate

- Risk ratio = 1.5;  
**students in lecture are 1.5x more likely to fail**
- Average failure rate:  
active learning 21.8% vs.  
33.8% for traditional  
lecture
- **55% increase in fail rate  
with traditional lecture**



\*Scott Freeman, Sarah L. Eddy, Miles McDonoug, Michelle K. Smith, Nnadozie Okoroafor, Hannah Jordt, & Mary Pat Wenderoth. 2014 PNAS 111(23): 8410-8415  
[www.pnas.org/cgi/doi/10.1073/pnas.1319030111](http://www.pnas.org/cgi/doi/10.1073/pnas.1319030111)

# Active Learning Increases Exam Scores

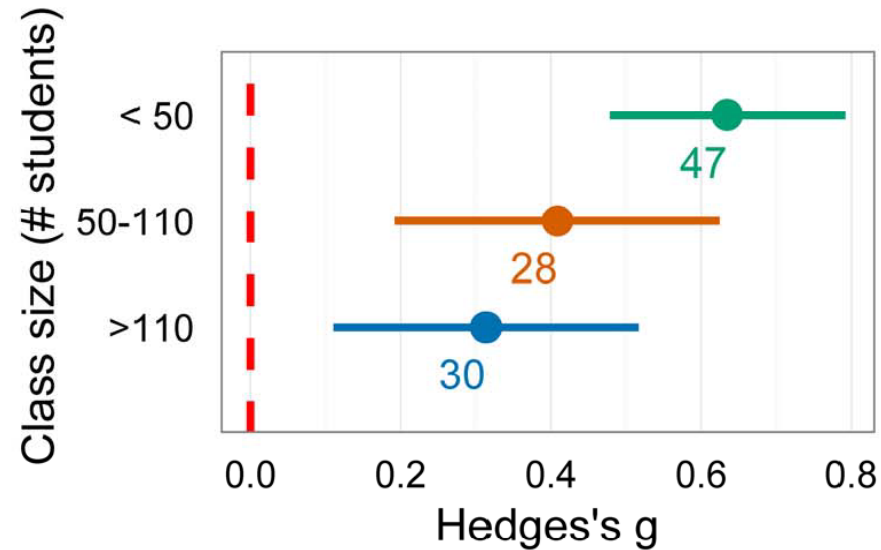


- Overall effect size = 0.47  
(In K-12, 0.2 is large effect size)

- Student performance with active learning **increased** by just under half a standard deviation

\*Freeman et al. 2014.

# Exam Data by Class Size



Which of the following can you conclude from this graph?

1. Active learning only works in small classes
- ★ 2. Active learning only works in large classes
3. Active works across a variety of class sizes

\*Scott Freeman, Sarah L. Eddy, Miles McDonoug, Michelle K. Smith, Nnadozie Okoroafor, Hannah Jordt, & Mary Pat Wenderoth. 2014

PNAS 1111(23): 8410-8415 [www.pnas.org/cgi/doi/10.1073/pnas.1319030111](http://www.pnas.org/cgi/doi/10.1073/pnas.1319030111)

# Examples from our Classroom

- Clickers
- POGIL
- Biological Data Interpretation

# Human Anatomy & Physiology

- A content heavy, 3-term, upper division sequence course that is required for those interested in most health care related fields.
- Is a large lecture (500-700 students each term) in auditorium classroom with balcony.
- Class meets 3x 50-minute lectures per week at 8 am all year long (10 week terms).
- Student population is consistent throughout year, but diverse:
- No prerequisites.

## Features of a POGIL activity

- Cooperative, self-managed teams of 3-4
  - Manager, recorder, reporter, reflector (consensus builder)
- A POGIL activity guide (explorative worksheet)
- Embedded activity includes development of process skills that are not dependent upon the facilitator

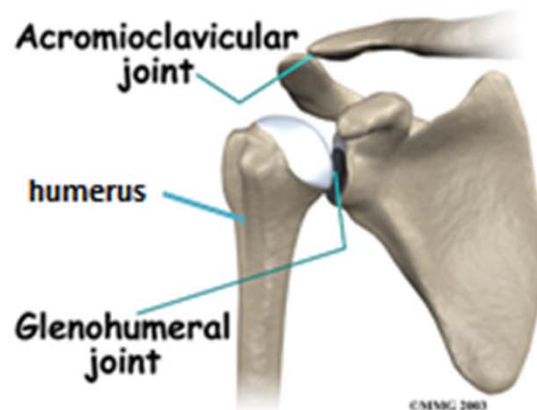


# Anatomy and Physiology Active Learning Joint Activity

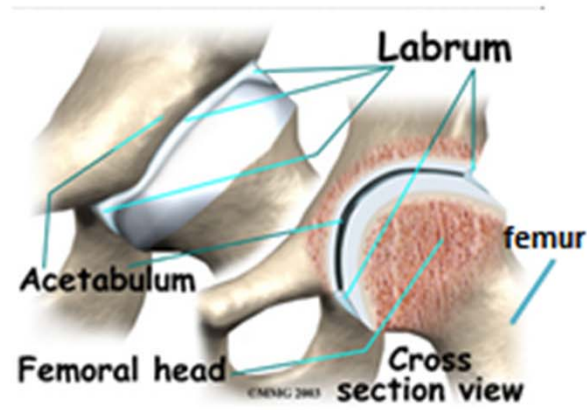
(5 min)

- Arrange yourself into groups of 3
  - Tallest person is the recorder; shortest is the manager; middle is the consensus builder
- Everyone gets a worksheet
- Talk through the questions with each other

Shoulder  
(glenohumeral)



Hip  
(femoracetabular)





# In Spring 2014, 24 LAs facilitated group work among 500 students in Milam Aud on Fridays

## Heart Valves and the Cardiac Cycle

2333 - Friday, April 12, Worksheet #1

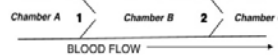
### LEARNING OBJECTIVES

- Anatomy of the heart and pathway of blood flow through the heart and great vessels, especially for the left side of the heart.
- Students should know blood flow relationship to pressure gradients.
- Definitions of cardiac cycle, systole and diastole.
- General knowledge of the relationship between electrical activity and mechanical activity in the heart.
- Phases of the ECG.

### Model 1: Opening and Closing of Heart Valves

Heart valves act to keep blood flowing in one direction and prevent the back flow of blood. Heart valves open and close, somewhat like a door, because of the pressure on the two sides of the valve (across the valve). When pressure on the "upstream side" is greater, the valve is open. When pressure on the "downstream side" is greater, the valve is closed.

In Model 1, Chamber A is on the "upstream side" and Chamber B is on the "downstream side" of valve 1.



### QUESTIONS:

- When the pressure in Chamber A is greater than the pressure in Chamber B ( $P_A > P_B$ ), is valve 1 open or closed? Explain.
- When the pressure in Chamber C is less than the pressure in Chamber B ( $P_C < P_B$ ), is valve 2 open or closed? Explain.
- What would the pressures need to be in Chambers A, B, and C that would cause both valves 1 and 2 to be closed at the same time?

## Mechanisms of Pulmonary Ventilation

2333 - Friday, May 2, Worksheet #4

### LEARNING OBJECTIVES

- Anatomy of the respiratory system.
- Boyle's Law of pressure and volume relationships.

Fill out this table before you get started

| Name of Group | Name of member (designate recorder or researcher) | E-mail or phone number of group member |
|---------------|---|--|
| Members       |   |  |

### Model 1: The Thoracic Cavity Before and During Inspiration

Pulmonary ventilation is what moves air from the atmosphere in and out of the lung. There are two phases of pulmonary ventilation: inspiration (also called inhalation, when air enters the lung) and expiration (also called exhalation, when air exits the lung). At the transition between inspiration and expiration (and the transition between expiration and inspiration, there is a brief period of no air movement called "static conditions."

Model 1 shows the rib cage of a person during (1) the static condition at the end of expiration and (2) during an inspiration.



### Model 1 Questions:

- According to the model, what is atmospheric pressure outside the body?
- What is the pressure inside the lung when the diaphragm is relaxed? [This is the static condition at the end of the expiration (the left hand picture).]
  - What should be the direction of air flow (into the lungs or out of the lungs or no movement) at this time?

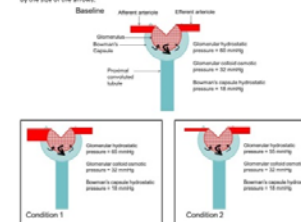
## Control of Urine, Blood Composition and Volume

2333 - Friday, May 16, Worksheet #6

Principles of nephron function: Filtrate formation via filtration, reabsorption and secretion.

### Model 1: Glomerular Filtration Rate

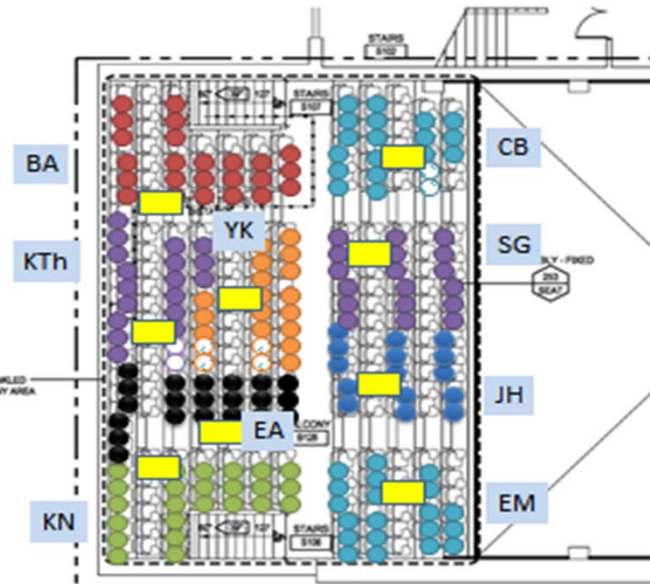
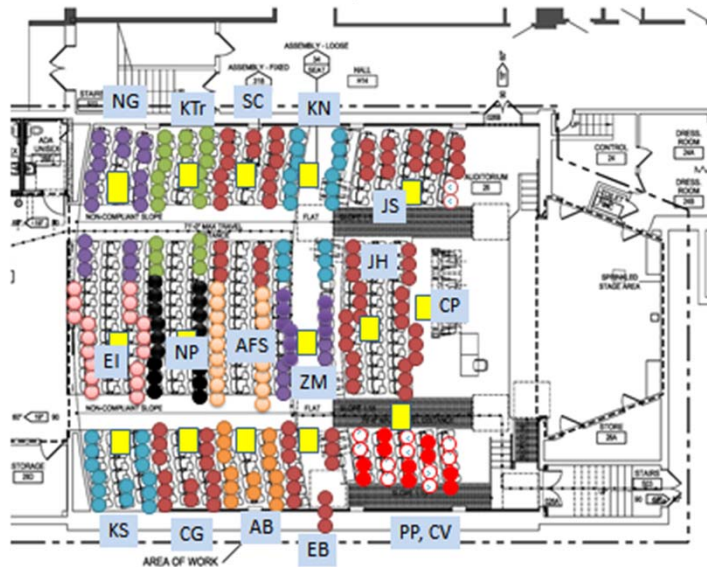
Model 1 shows the size of filtration in the nephron. Filtrate is formed as blood flows through the glomerulus and filtrate is forced out into the Bowman's capsule. The same principles that created interstitial fluid at capillaries apply here, with one exception: the Bowman's capsule has some fluid in it (filtrate) that tries to force fluid back into the glomerulus. These conditions are represented in Model 1 (baseline, Condition 1 and Condition 2). For each condition, all forces acting on the capillary are listed and are proportionally represented by the size of the arrows.



### Model 1 Questions:

- In Model 1, what vessel fills the glomerulus?
  - Is the glomerulus upstream or downstream of the afferent arteriole?
- Draw arrows to show how blood flows through the nephron.

Nicole G.  
Kaitlyn T.  
Sam C.  
Klare N.  
Jana S.  
Jacob H.  
Caroline P.  
Paige P.  
Christina V.  
Eric B.  
Ambor B.  
Crystal G.  
Kathryn S.  
Emily I.  
Nik P.  
Ariel F-S  
Zach M.



Charles B.  
Shelby G.  
Brittany A.  
Kayla Th.  
Emily M.  
Josh H.  
Younghee K.  
Eric A.  
Karleen N.

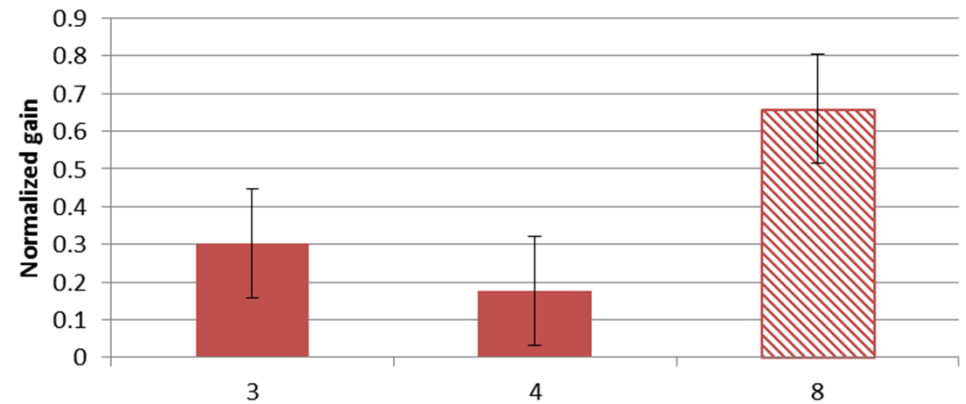
### Typical Friday Session (50 minutes)

| 2 min             | 15-25  | 5-10 min                             | 10-15 min  | 2-5 min  |
|-------------------|--|--------------------------------------|--|--|
| Intro-<br>duction | Students work through first models on worksheet (timer shown on projector) as LAs facilitate & give feedback | Clicker questions & group discussion | Continue to work through worksheet as LAs facilitate & give feedback | Clicker questions, “sticky issues,” final thoughts |

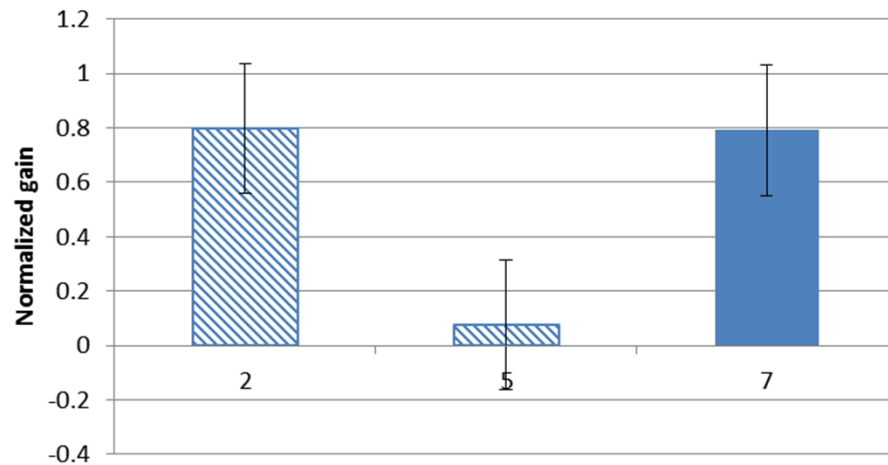
# Content Data From POGIL

- Concept questions

Knowledge/Comprehension  
Concept Questions



Analysis Concept Questions



# Engagement Data from POGIL

- There was no change in engagement as measured by lecture attendance for the entire year cohort.
- There was no change in engagement as measured by on-line quiz participation.

# Provide Examples

- Clickers
- POGIL
- **Biological Data Interpretation**

# Principles of Biology

- Introductory biology course for life science majors at Oregon State University.
- Is a large lecture (1200 students split into 2 lectures) and lab (40-48 students/lab) course.
- Is team taught by 2 tenure-track faculty (1 each from the Botany and the Zoology Depts.) in five week segments.
- Perceived as a difficult, “weeding out” course by students.

# Active Learning

- Activity from Pearson “Practicing Biology”
- Students work on data interpretation using graphs
- Students must apply complex concepts of evolution to real data
- Short lecture in consequences of two similar species interacting in a hybrid zone – followed by data analysis activity



# Lecture 16: Speciation and hybridization

## Themes

What are the causes of speciation?

**What happens when species come in contact?**

How do rates of speciation and extinction vary?

## Readings

Chapter 24, sections  
3-4 (pg. 498-504)

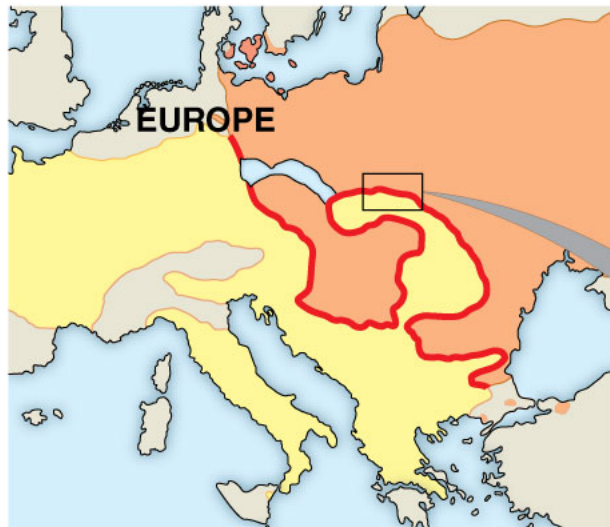
You should be able to:

Describe pre- and postzygotic reproductive isolating barriers and give an example.

**Describe the three outcomes if hybrids survive over evolutionary time.**

Compare and contrast gradualism with punctuated equilibrium.

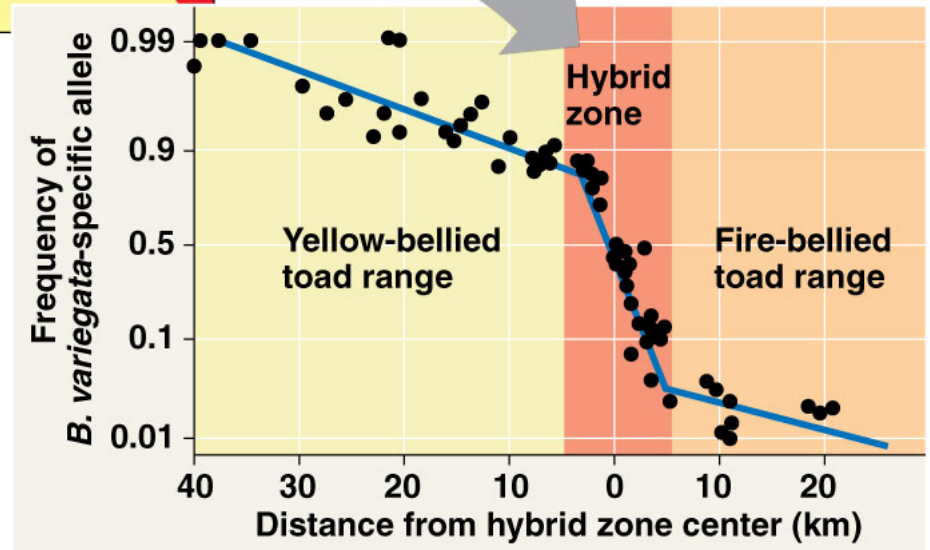
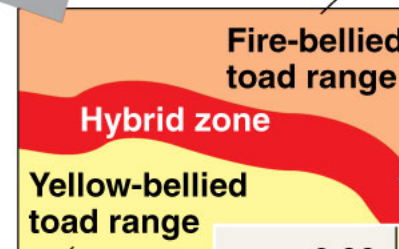
Describe the rate of speciation and some factors that affect this rate.



Fire-bellied toad, *Bombina bombina*

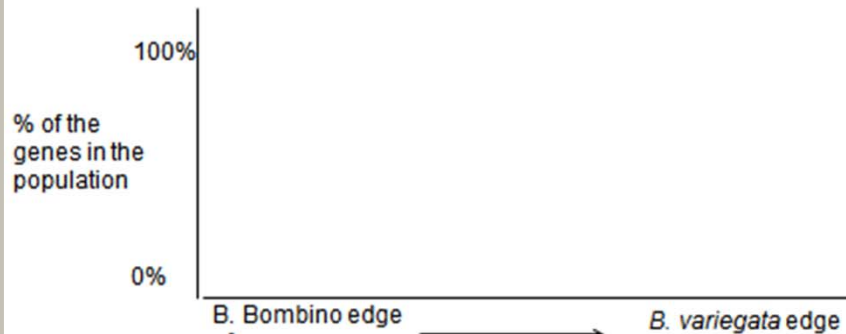


Yellow-bellied toad, *Bombina variegata*



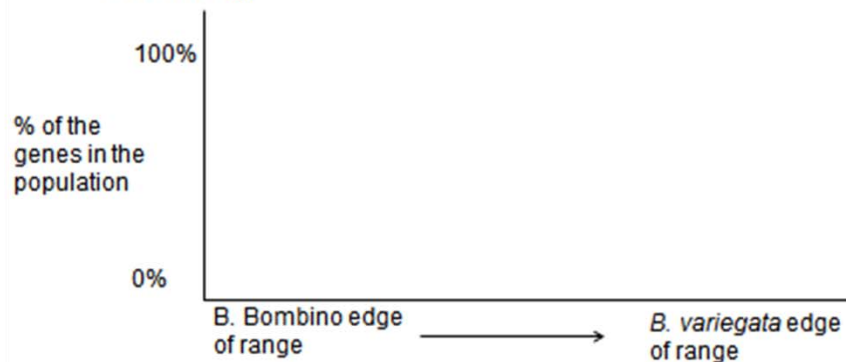
## In Class Activity

- Graph the percentage of each type of species specific genes present across the hybrid zone. Use an X to indicate *B. bombino* and O to indicate *B. variegata*.



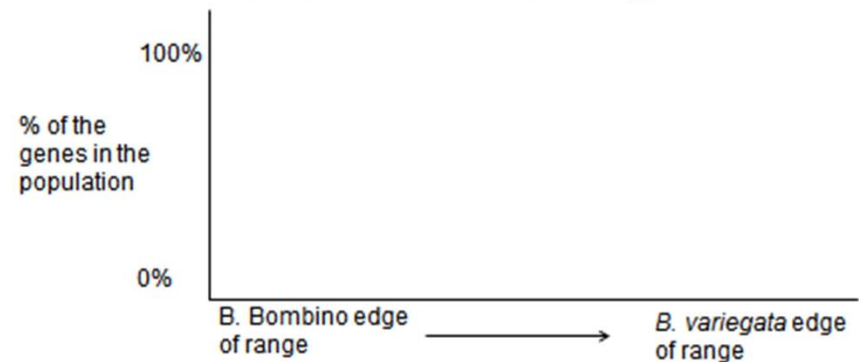
## In Class Activity

- What would the graph from Bombino frog alleles look like over time if fusion were occurring?



## In Class Activity

- What would the graph of alleles in the population of *Bombino* frogs look like if reinforcement were occurring?



## **In Class Activity - Discussion**

Is reinforcement or fusion more likely to occur if environmental conditions vary gradually across the species ranges such that one end of the range is, for example, much colder than the other. Explain.

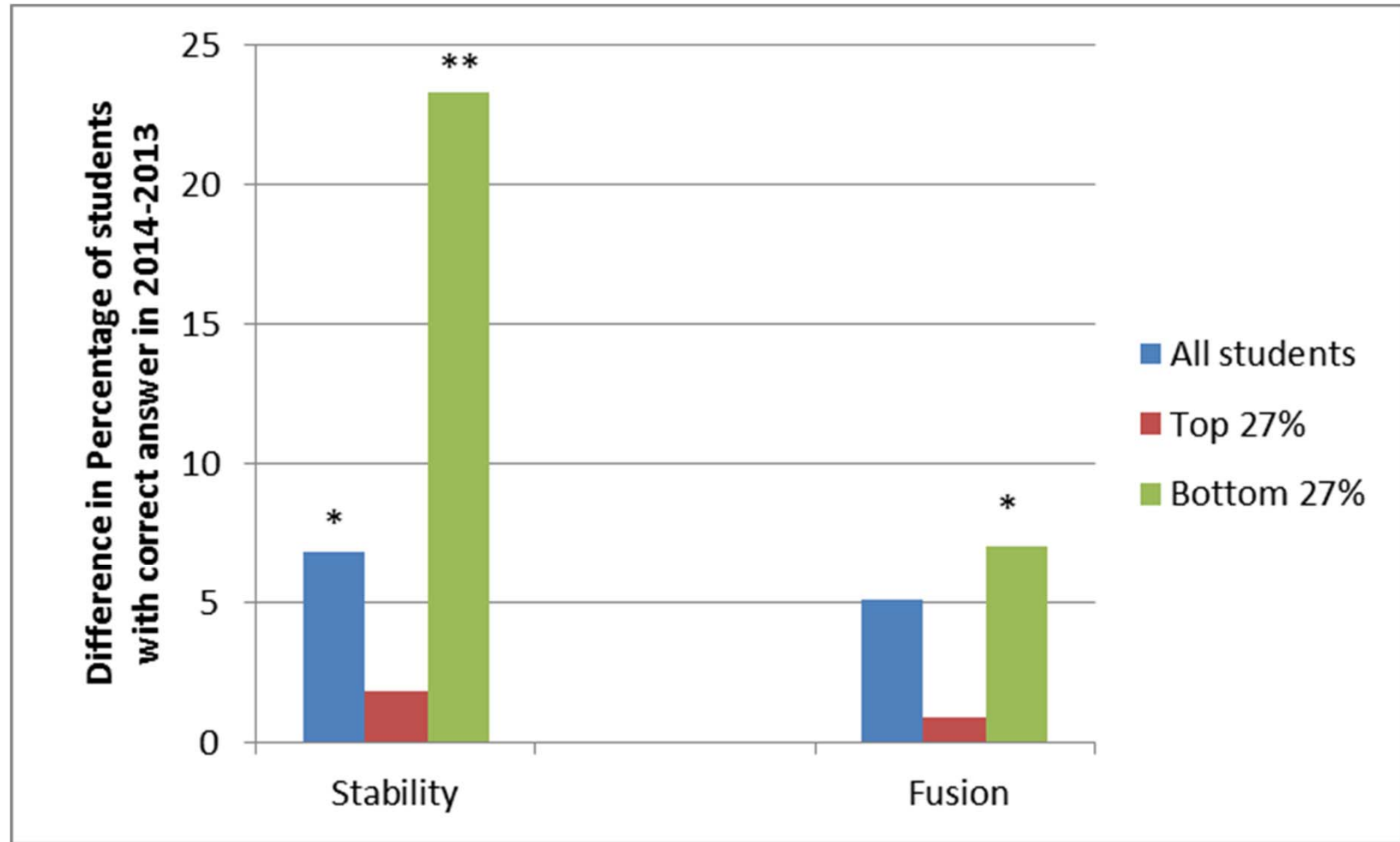
Is reinforcement or fusion more likely to occur if all environmental conditions are very similar across the species ranges. Explain.

### **Clicker Question Follow-up**

Is reinforcement or fusion more likely to occur if environmental conditions vary gradually across the species ranges.

A. Reinforcement

## Exam Improvement from 2013 to 2014





# Wrap-up Discussion

(5 min)

- If you do active learning in your class, what do you do?
- What does it look like when your students are engaged?
- How would you implement/facilitate this type of activity?

# Implementation Tips

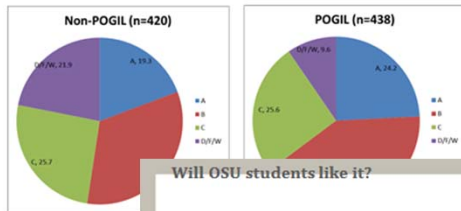


# Our Implementation Tips

- Show students the data to get their buy-in
- Ask for their feedback
- Be flexible

### Are these worksheets effective?

Over 8 years, in very small classrooms (~25 students)

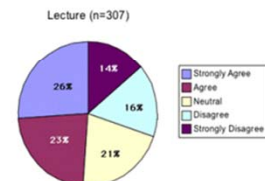


### Will OSU students like it?

Data from classrooms of Moog, Farrell  
Chi-squared = 40.9 alpha < 0.005  
Farrell, J.J.; Moog, R.S.; Spencer, J.N. /

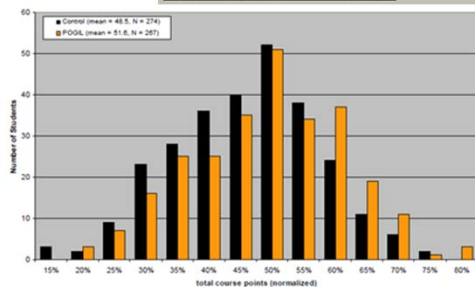
The data shown in the figure below represent students' responses to the following statement:

"I would recommend the method of teaching used in this course to a student taking this course next year."



Are these worksheets  
In larger lecture

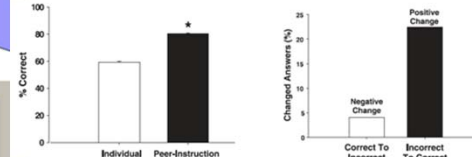
Organic 2 Sco Lecture v. POGIL  
<http://www.pogil.org/about/effectiveness>



*Classroom Implementation of Process Oriented Guided Inquiry Learning: A practical guide for instructors*, Andrei Straumane

POGIL (n=381)

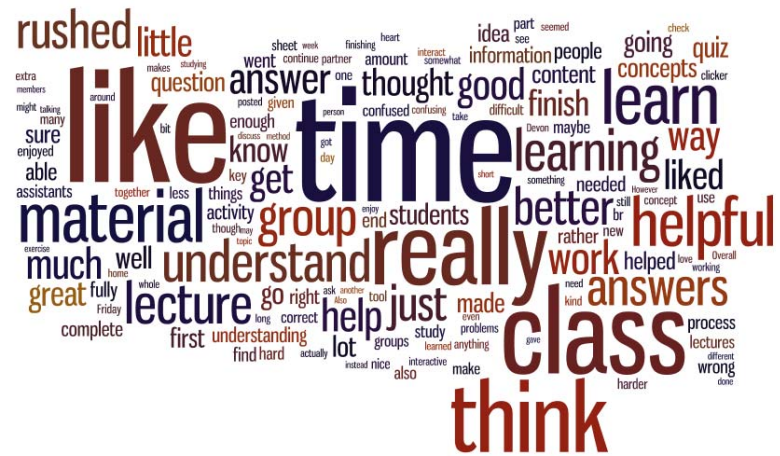
In a physiology classroom, peer cooperation improved student understanding on such questions as...



Predict (increase/decrease/no change) what would happen to the volume of blood returning to the heart through the veins if right atrial pressure (central venous pressure) increased:

- A. Increase  
B. Decrease (correct)  
C. No change

Giuliodori, et. al, Adv. Phys. Ed. 2



# Our Implementation Tips

- Start small
- Start with resources as available
- Hold students accountable
- Watch other people
- Reflect on what worked
- Peer evaluations
- Find like minded colleagues
- Discuss with administration to get buy-in and support

## How to prepare students

- Show them the data
- Give them support
- Connect session (What is the large lecture experience)

# How to be Successful in a Large Lecture

Thursday, September 25, 2014

# Goals of the session

- Introduce unique characteristics of large lectures
- Discuss strategies for success



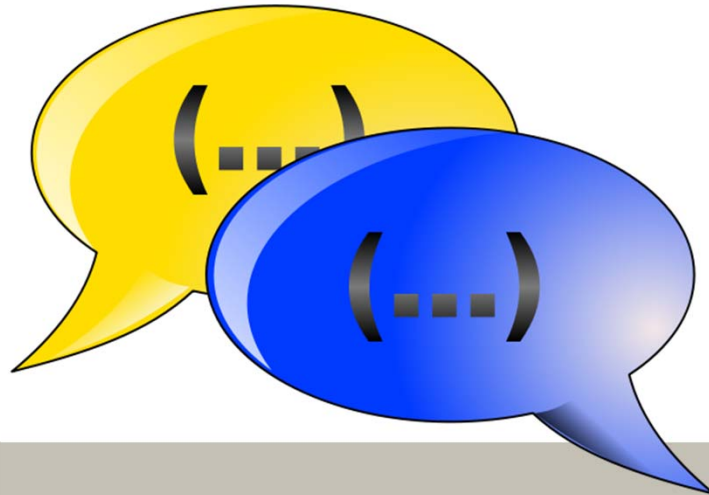
I am used to my teacher knowing me, or at least knowing my name

**MORE  
OR LESS**

**NOT  
REALLY**

I am used to my teacher knowing me, or at least knowing my name

1. Compare your response with someone nearby
2. Identify ways you think you can be “known” by your instructors





## Strategy #2 - Interact with instructors and GTAs



# Conclusion

- Identify and discuss challenges and opportunities associated with teaching in the large lecture and for engaging students in this context
- Provide examples of strategies for promoting engagement in the large lecture classroom and evidence of success of different strategies for promoting engagement.
- Explain implementation tips utilizing strategies across a variety of classroom sizes.
- Describe ways to prepare students for success in the large lecture classroom

# Resources for Active Learning Activities

## General Resources

- Merlot (<http://www.merlot.org/merlot/index.htm>)
- National Center for Case Study Teaching in Science (<http://sciencecases.lib.buffalo.edu/cs/>)
- POGIL (<https://pogil.org/>)
- Learning Assistant Resource Site (<https://sites.google.com/a/colorado.edu/la-resources/>)

## Biology specific

- Pulse Community (<http://www.pulsecommunity.org/page/active-learning>)
- TIEE (Teaching Issues and Experiments in Ecology; [www.esa.org/tiee/](http://www.esa.org/tiee/))
- EcoEd Digital Library (<http://ecoed.esa.org/index.php?P=Home>)
- <http://iclimate.org/ccc/index.asp>
- Summer Institute Teachable Tidbits (<http://cst.yale.edu/teachable-tidbit-general-categories>)
- Thinking like a biologist (<http://www.biodqc.org/dqcs>)

**Thank you!!**

**Questions?**