University of California STEM FACULTY LEARNING COMMUNITY

UC STEM Faculty Learning Community Webinar

Biology 20A: It's alive!..Bringing the lecture to life with student-centered active learning strategies

Presented by: Susanna Honig, MCD Biology &
Gabriel Mednick, Chemistry & Biochemistry
UC Santa Cruz

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https://uc-flc.mcdb.ucsb.edu/

HHMI-UCSC Active Learning Initiative Team


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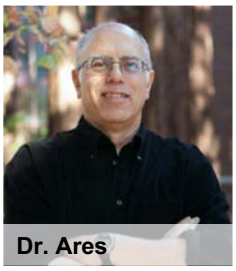
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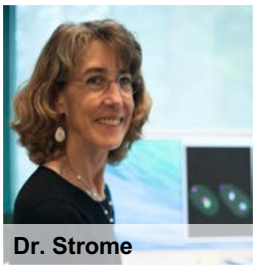
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Dr. Marcus


Dr. Mednick


Dr. Honig

Biology Faculty


Dr. Dunkin


Dr. Marinovic

NOT Pictured: Dr. Roland, Dr. Switkes, Dr. Sher, Dr. Deutsch, Director Cox-Konopelski, Director Andreasen, Dr. Palomino, Dr. McConnell, Nicole Mattacola and many (many) more!!

HHMI Active Learning Initiative at UCSC

- Transform gateway STEM courses at UC Santa Cruz from large lecture courses into smaller, 'active learning' versions
  - Chemistry Department
  - Physics Department
  - Biology Department
    - Biology 20A: Introduction to Cell & Molecular Biology
    - Biology 20B: Introduction to Development & Physiology
    - Biology 20C: Introduction to Ecology & Evolution

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HHMI Active Learning Initiative at UCSC

- **Biology 20A: Introduction to Cell & Molecular Biology**
  - covers biochemistry, cell biology, molecular biology, and genetics
  - Traditionally, ~400 student capacity, fixed stadium seating
  - W2016, S2017- Active Learning Version
    - 75 -90 person capacity, movable desks, 1 chalkboard
  - W2018- Active Learning Version
    - 75 person capacity, offered in Active Learning Classroom

Outline for today

- How to transform a course, structurally
- A few examples from biology
- Common pitfalls and how to fix them… or avoid them in the first place!

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Goals of an active learning class

- ALL students learn **content** *better*
- ALL students get the opportunity to develop and execute skills or **practices** that scientists use
- ALL students are included in a community that fosters **equity**, inclusivity and motivation through the development of science identity
- When these three goals are successfully met for all students, they are *disproportionately* beneficial for those who have been traditionally *underrepresented.*

Content Learning Outcomes

-describes what students should be able to ***do*** with a topic and concept

-Key Topic / Key Concept

Mendelian Genetics / Independent Assortment

-Learning Outcome

"Use a model to illustrate how independent assortment of homologous chromosomes increases genetic variation of gametes"

Content Learning Outcomes

STEM Practices

- Claim, Evidence, Reasoning
- Generating hypotheses
- Using evidence to build models
- Creating and interpreting graphs
- Translating jargon into plain language
- Carrying out investigations
  - Experimental design
    - Manipulating and controlling variables
- (continued in *ISEE PDP* 'Recommended' List of STEM Practices)

Daily Schedule

+ Introductory lecture
& Synthesis

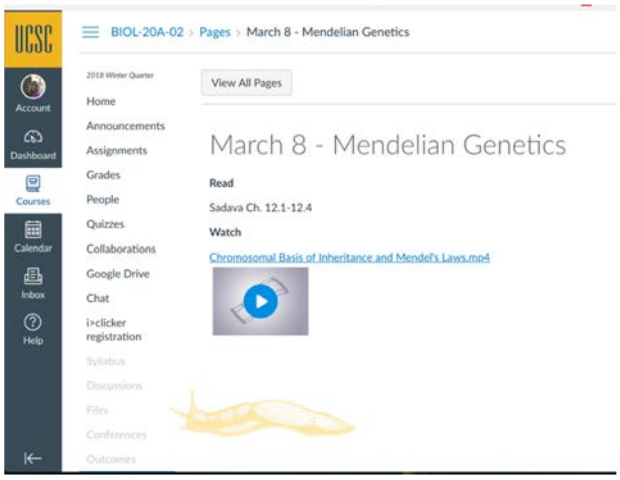
Types of AL Activities or Strategies

- Lecture-based… "Active Lecture"
  - Pair-shares
  - Clicker questions
  - 'Fill-in' slides
- Postering (short activities OR culminating session)
- Speed Data-Ing
- Worksheets
- Case study investigations
- Fishbowls or whole-class 'role-playing'
- Debates
- Games
- Peer-teaching
- Concept Map creation
- Physical Modeling

Institute for Scientist & Engineer Educators Professional Development Program

Doing the Pre-Work

- Emphasis on reading and videos
- Double or triple exposure to text
- Before-class online quizzes on pre-work through Canvas



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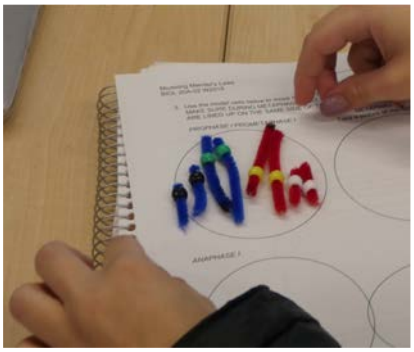
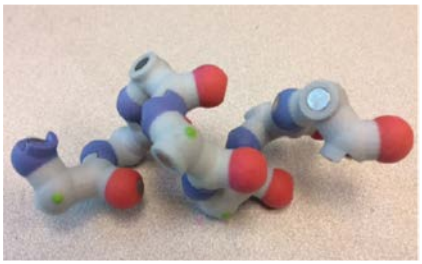
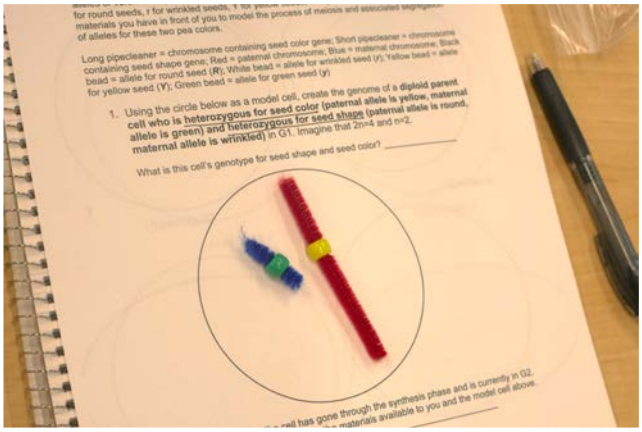
Physical Modeling

- Students use physical objects to represent a scientific process
- Can be scaffolded with a worksheet or photos





Physical Modeling



- Stepwise modeling process can elucidate misconceptions in a way that lecture never would
- Particularly good for reinforcing 3-dimensional processes (e.g. chromosomes & genes; protein structure)

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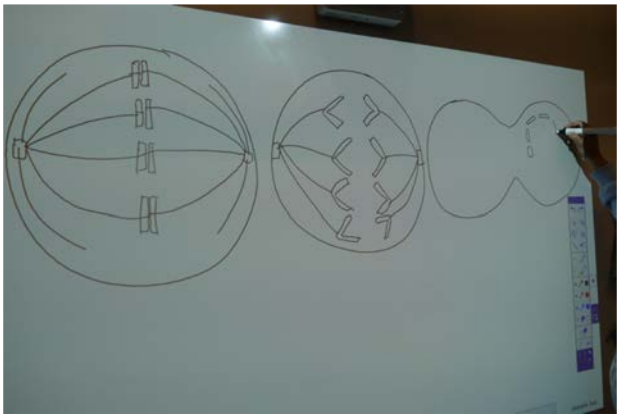
Peer Teaching

- Students prepare an explanation of a key concept and present it to one another
- This can be scaffolded with a handout, image, video, or questionnaire
- Particularly good for reinforcing challenging or dynamic processes (e.g. motor proteins, urine concentration)

Peer Teaching

- Students have time to put the concept or process into their own words
- High memory retention
- Less intimidating than teaching an instructor



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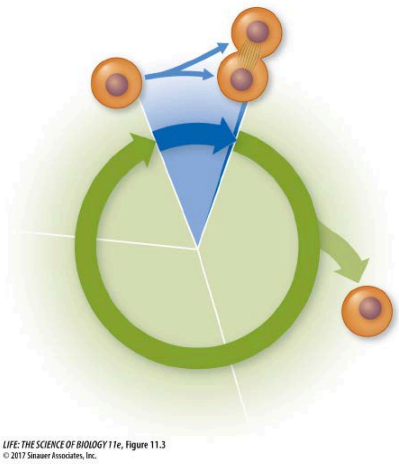
Postering

- Labeling Slides
- Re-drawing figures
- Drawing chemical structures or processes



LIFE: THE SCIENCE OF BIOLOGY 11e, Figure 11.3
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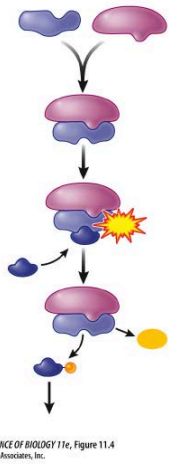

LIFE: THE SCIENCE OF BIOLOGY 11e, Figure 11.4
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Culminating Postering Session

- "Pet Protein Poster Project"
  - Quarter long project
  - Protein structure, function
  - Bioinformatics software
  - Culminating mock-conference with expert guests

Culminating Postering Session

- "Pet Protein Poster Project"
  - Opportunity for STEM practices AND *recognition* for STEM practices
  - Students become empowered when they step into the role of being the expert

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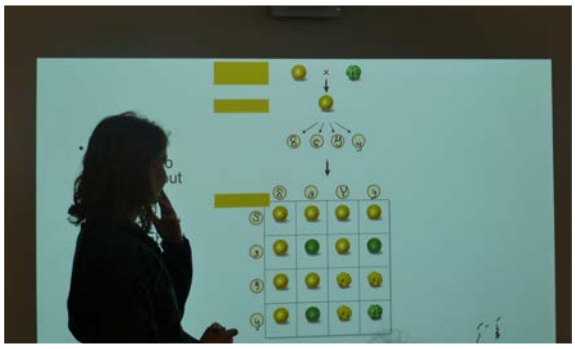
When an active learning class does not feel successful

- **CHAOS** (usually from a lack of structure or miscommunication about structure and planning)
  - No introduction or synthesis
    - Add them in!
  - Students are ill-prepared
    - Increase opportunities for accountability, context the 'struggle'
  - Instructor (or part of teaching team) is ill-prepared and a united front crumbles
    - Be prepared but don't overpromise! Flexibility and communication are paramount
    - Week to week is key, but "night before" prep is too last minute

The important role of the classroom

- Students need to be able to move into groups and also stand up and walk around
- Ideally, students should have surfaces to draw on
- In a perfect world, smartboards offer a unique way to integrate postering or labeling activities seamlessly into the active lecture format



Conclusions

- Imagine you are a student in one of these courses.
  - If you have high expectations, be transparent about what they are
  - Give students the tools they need to be able to complete their work
  - Start with small changes and go from there
  - Be kind with yourself. The growth mindset isn't just for students. When we model 'struggling' with grace to our students, they learn that it is ok for them practice risks as well.

Highlights from students

"I'm so thankful I can finally feel comfortable and truly UNDERSTAND this information instead of just memorizing it for the 8th time."

"The active learning was insanely helpful and it really helped me understand material [more] than I did last quarter"

"I really enjoy this course so much better than traditional lectures. I walk out actually learning the material and feel good about it. Thank you so much!"