Adapting a traditional lecture course for an active-learning classroom

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Evolution of "BIO381: Intro to Ecology"

2011

90 students in steep, stadium-style seating

- Lecture + short, turn-to-your neighbor activities
- Attempt few POGIL worksheets
- Recommended reading
- Minute write & muddiest point index cards

2012

50 students in better lecture classroom

+ Few longer activities
+ Few case studies
+ Grant proposal project

2013

50 students in active-learning classroom

+ Adopt e-text that facilitates <u>required reading</u> before class and <u>computer simulation labs</u> in class
+ Better group work → students doing more talking, explaining, drawing, creating
+ More and better peer-review of grant proposals
+ Slowly adapting more lecture → activity

Learning goals for course

- Understand principles of ecological relationships between organisms and their environments
- Appreciate that ecology is a quantitative science
- Be able to utilize basic mathematical models in ecology
- Describe and utilize the process of scientific inquiry:
  - ❑ Develop questions, hypotheses, and predictions based on observations, data, or results from published literature
  - ❑ Understand elements of research design and how they impact results and conclusions
  - ❑ Justify predictions, inferences, and conclusions based on quantitative data
  - ❑ Read, interpret and draw graphical representations of data
  - ❑ Understand and interpret basic statistics

Scientific/quantitative literacy

1. **CREATE method to analyze papers** **(Hoskins et al 2007)**
   - Consider, Read, Elucidate the hypotheses, Analyze and interpret the data, and Think of the next Experiment
   - Concept mapping, sketching, visualization, transformation of data, creative experimental design
   - Deep understanding of the methods and principles
2. **Quantitative literacy** **(Speth et al 2010)**
   - Experimental design, interpreting, drawing, labeling

- Hoskins, S. et al. (2007) Selective Use of Primary Literature Transforms the Classroom into a Virtual Laboratory. Genetics, 176 1381-1389.
- Speth, E. B., et al. "1, 2, 3, 4: Infusing quantitative literacy into introductory biology." *CBE-Life Sciences Education* 9.3 (2010): 323-332.

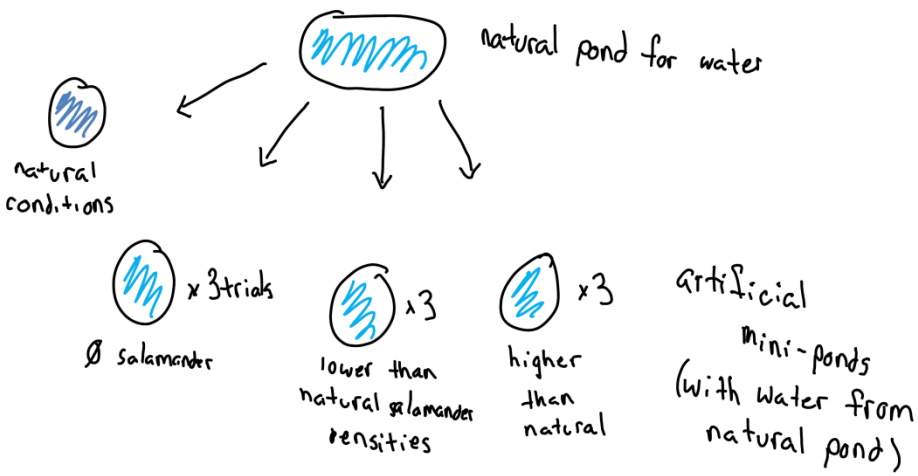
ALC allows in class…

- Better group work than a lecture classroom
- Draw experimental design and predicted results in groups
- Review HW questions (draw, explain)
- Simulation games with chips, dice, candy, etc.
- Computer labs
- Peer review grant proposals (“chalk talk” presentations & guided peer review of draft)

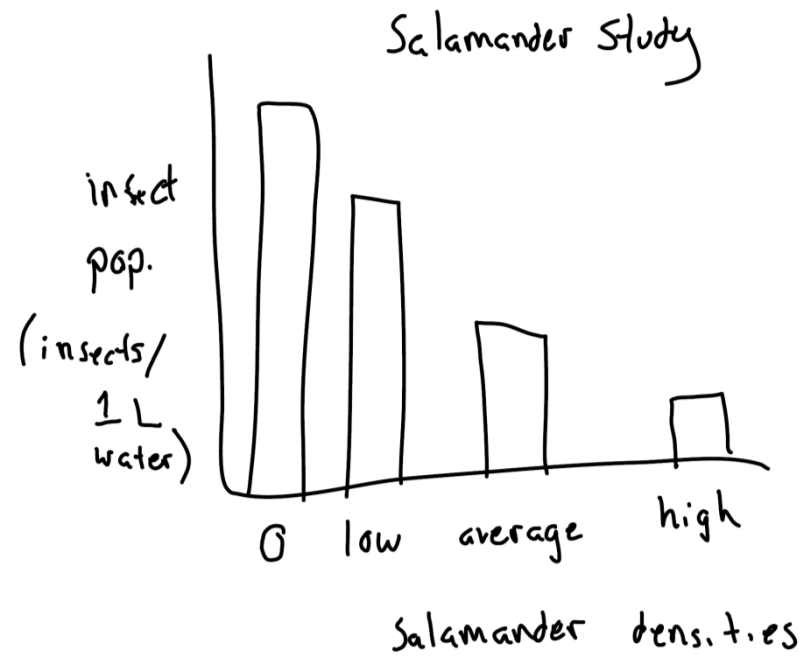
Experimental design: Draw, label, explain

- **Observation:** Ponds have few insects. Salamander larvae eat insects.
- **Question:** Do salamanders influence abundance of insects in ponds?

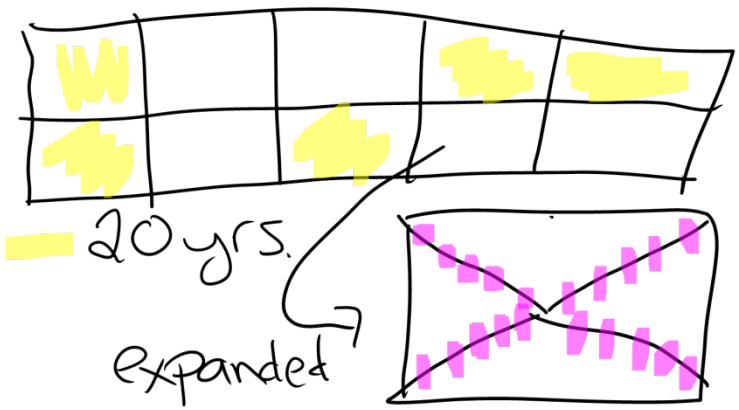
Draw and label your experimental design.

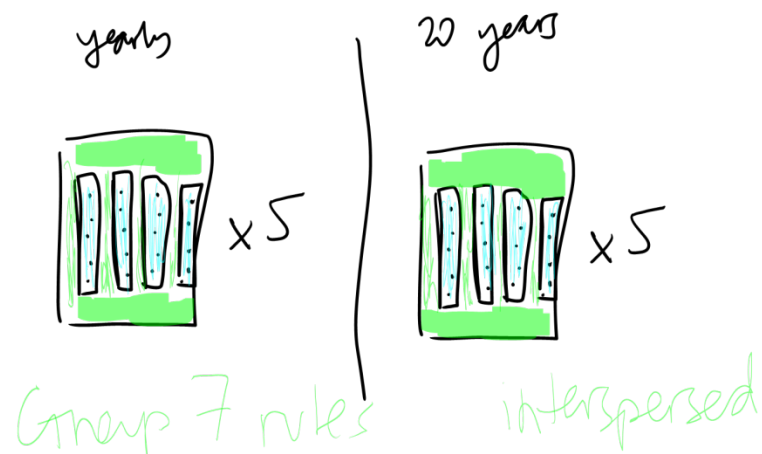


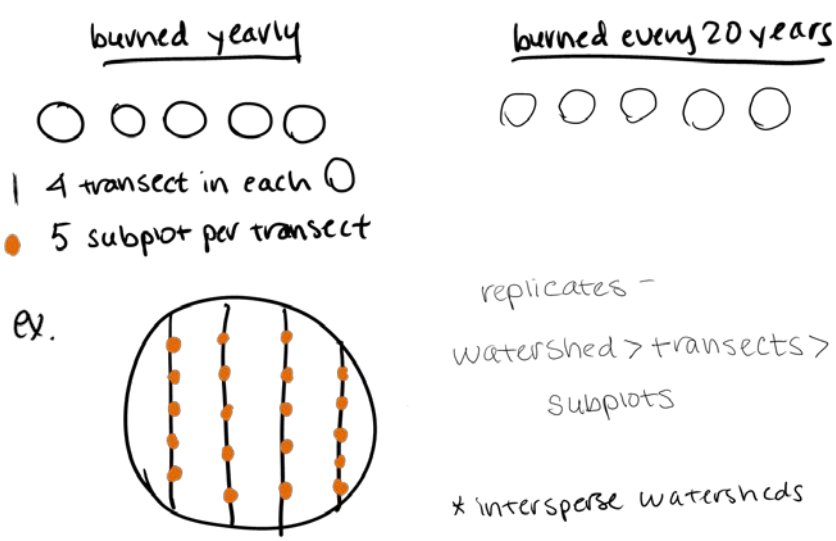
Draw your expected results in the form of a labelled figure.

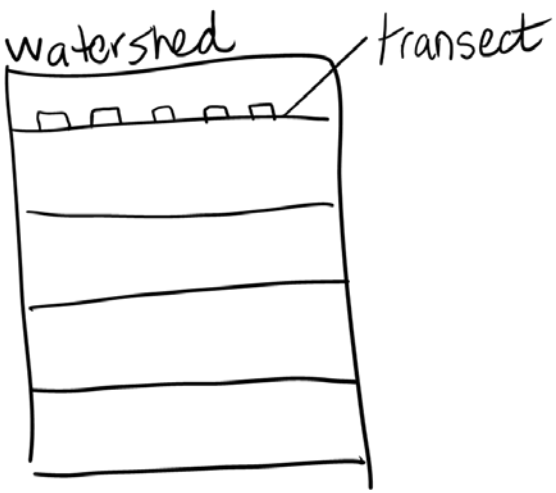


Konza Prairie (KPBS) is divided into 60 watersheds used to study three factors critical for maintaining the tallgrass prairie ecosystem: periodic fire, bison grazing, and variation in climate. Between 1989 and 2010, at the end of each growing season, the accumulation of new plant **biomass** (dry weight) was measured along four permanent **transects** within each watershed of KPBS. Within each transect, five 0.1 m^2 **subplots** were sampled. The problem set uses data to investigate differences in plant biomass between **five watersheds that are burned yearly** versus **five watersheds that are burned every 20 years**. **Draw and label a sketch of the experimental design including replication**.

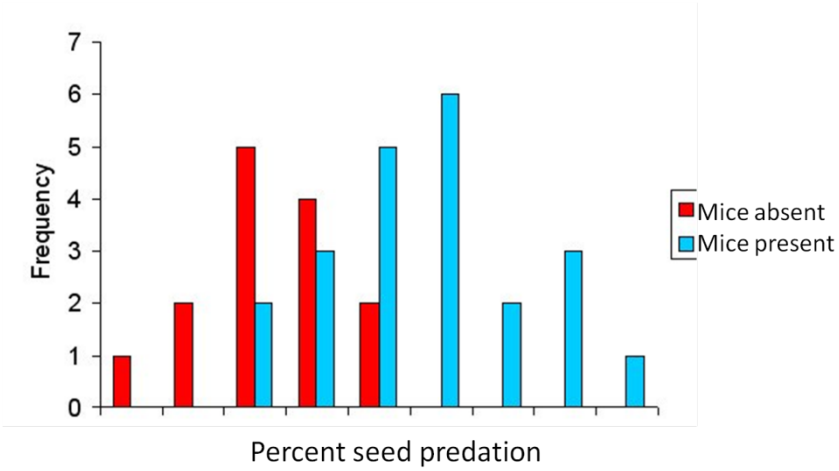








Interpret figures: identify, label, explain



- What is the dependent variable? Is it categorical or continuous?
- What is the independent variable? Is it categorical or continuous? If it is categorical, how many levels are there?
- What was the probable hypothesis for this experiment?

Work with models: solve, draw, explain

Write expressions using e and c to describe conditions when… (Refer to SUT Section 4, page 11 for help)

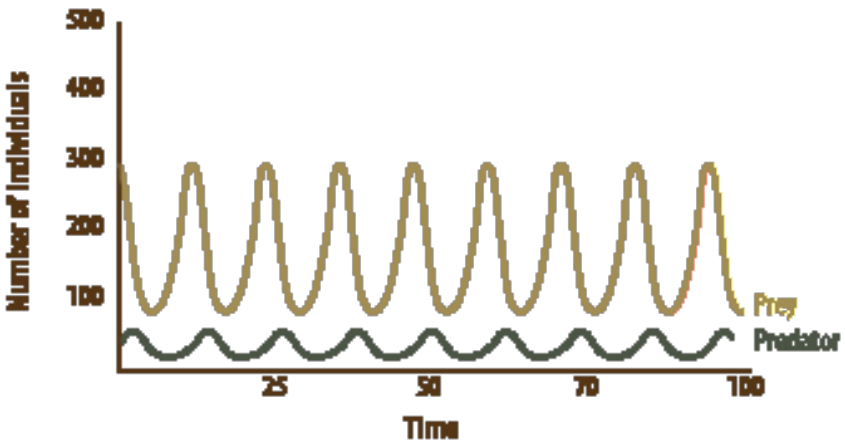
a. All patches are occupied

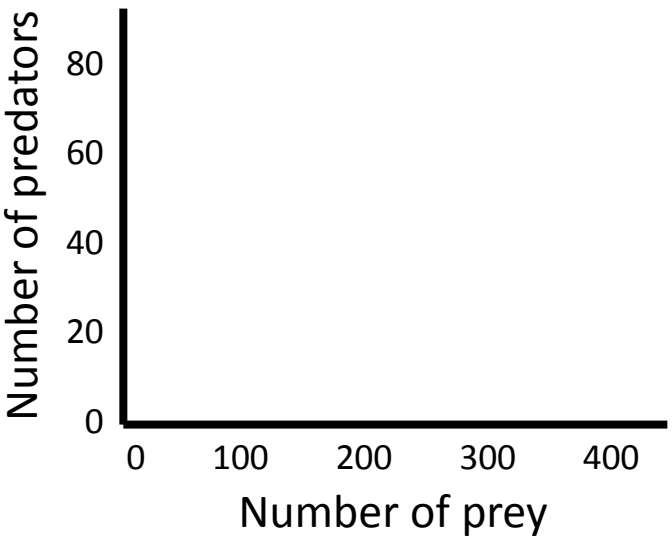
b. The metapopulation will head toward extinction

c. There will be metapopulation persistence, with a shifting mosaic of occupied and unoccupied patches

Review HW: Draw, explain

- For the time plot shown, what would the equivalent phase plane plot look like?





Review HW: Draw, explain

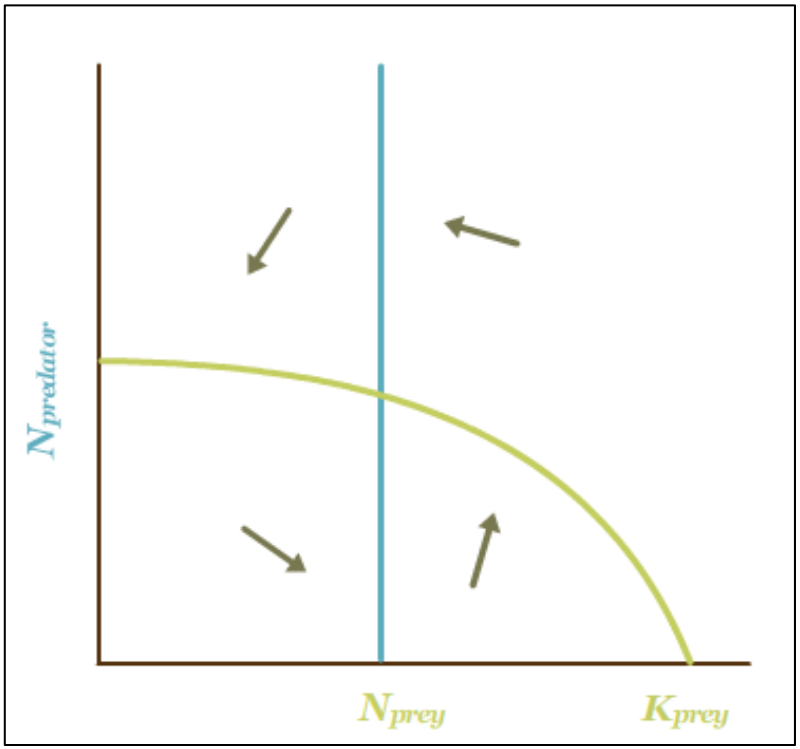
If prey are density dependent and the prey population has increased beyond its carrying capacity (e.g., due to immigration), which of the following will happen, as predicted by the isoclines?

A. The predator population will grow and the prey population will shrink.

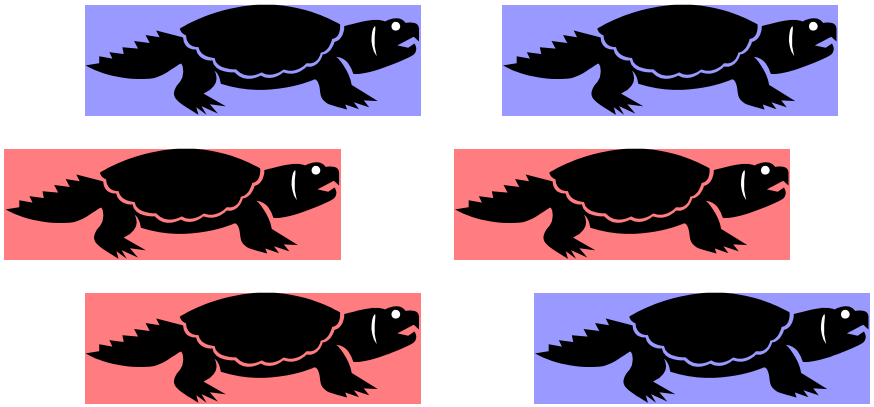
B. The predator population will shrink and the prey population will shrink.

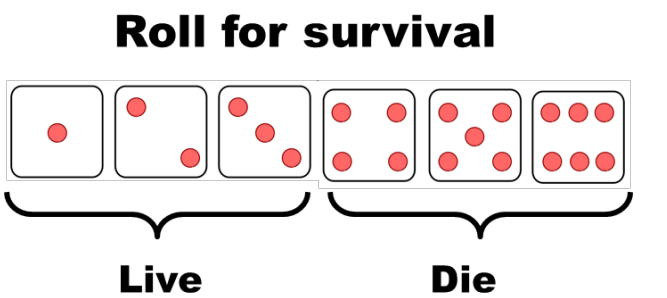
C. The predator population will grow and the prey population will grow.

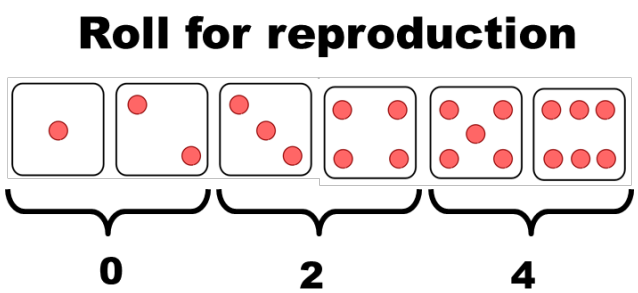
D. The predator population will shrink and the prey population will grow.

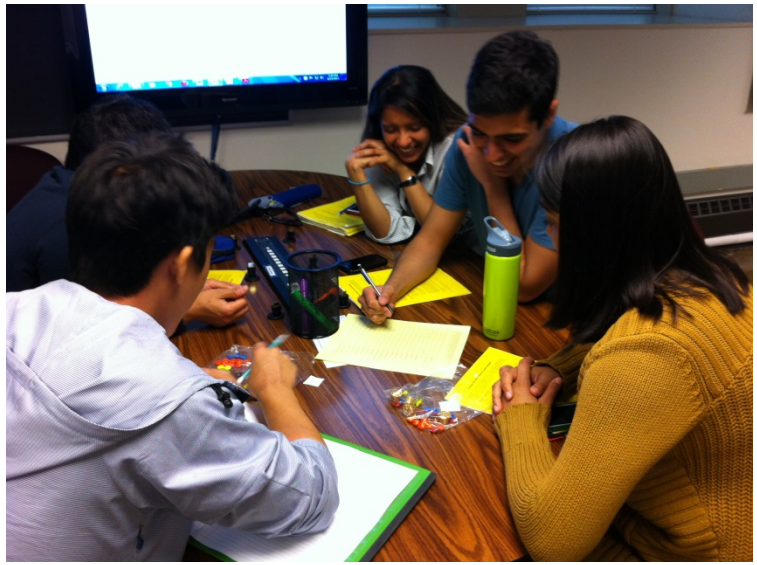


Simulation games

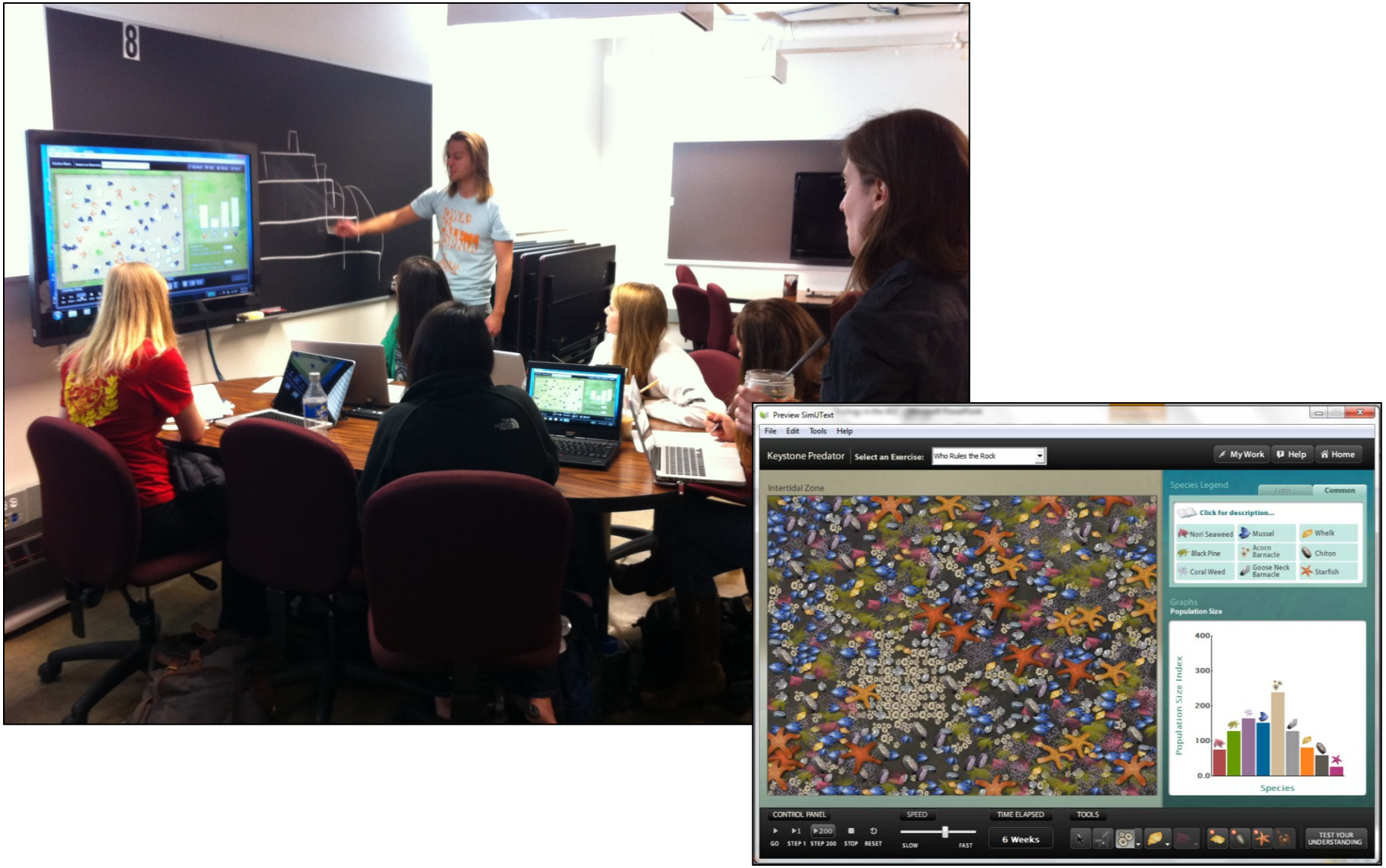








Computer simulation labs



Peer review grant proposals

Successes and challenges

What worked well

- Small group work
- e-Textbook
- Computer labs
- Practicing HW/working with equations/graphs in groups
- Students were active
- Peer review for grant proposals
- Post-it paper – they LOVE it

Challenges

- Straight lecture (somewhat forced to abandon it; pro/con?)
- Large class discussions
  - Students want/need to be able to take notes (need to stay at tables)
  - Lose the “whole class” feel if students stay at tables
- Technology kinks (take time) at beginning
- Tension around activities: some love the practice; some feel like “middle school”