Intro to POGIL: Process-Orientated Guided Inquiry Learning

Glen Ernstrom, Ph.D.

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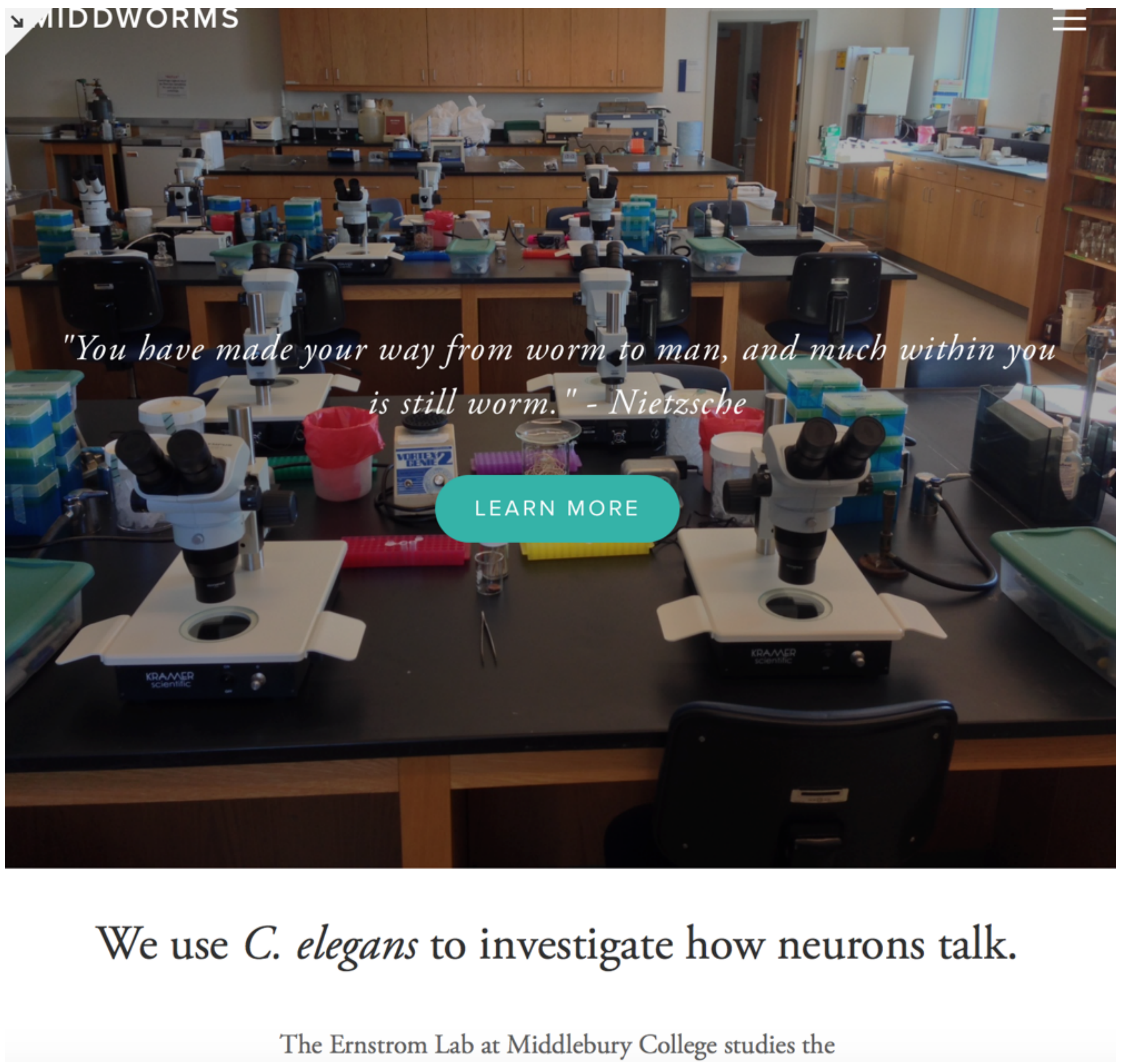
The Plan

- Brief Intro
- Run Part I of a POGIL
- Discuss how and why POGIL
- Run Part II of a POGIL
- Wrap-up

About me



- Assistant Professor Neuroscience and Biology (year 2)

- Interested in active learning (colleagues, pedagogy research)

- Attended 3-day POGIL workshop (July 2014)

Colleges Reinvent Classes to Keep More Students in Science

By RICHARD PÉREZ-PEÑA   DEC. 26, 2014

DAVIS, Calif. — Hundreds of students fill the seats, but the lecture hall stays quiet enough for everyone to hear each cough and crumpling piece of paper. The instructor speaks from a podium for nearly the entire 80 minutes. Most students take notes. Some scan the Internet. A few doze.

In a nearby hall, an instructor, Catherine Uvarov, peppers students with questions and presses them to explain and expand on their answers. Every few minutes, she has them solve

Catherine Uvarov, a chemistry instructor at the University of California, Davis, has adopted an experimental approach to teaching an introductory course. Max Whittaker for The New York Times

Active learning increases student performance in science, engineering, and mathematics

Scott Freeman[a,1], Sarah L. Eddy[a], Miles McDonough[a], Michelle K. Smith[b], Nnadozie Okoroafor[a], Hannah Jordt[a], and Mary Pat Wenderoth[a]

[a]Department of Biology, University of Washington, Seattle, WA 98195; and [b]School of Biology and Ecology, University of Maine, Orono, ME 04469

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To test the hypothesis that lecturing maximizes learning and course performance, we metaanalyzed 225 studies that reported data on examination scores or failure rates when comparing student performance in undergraduate science, technology, engineering, and mathematics (STEM) courses under traditional lecturing versus active learning. The effect sizes indicate that on average, student performance on examinations and concept inventories increased by 0.47 SDs under active learning (n = 158 studies), and that the odds ratio for failing was 1.95 under traditional lecturing (n = 67 studies). These results indicate that average examination scores improved by about 6% in active learning sections, and that students in classes with traditional lecturing were 1.5 times more likely to fail than were students in classes with active learning. Heterogeneity analyses indicated that both results hold across the STEM disciplines, that active learning increases scores on concept inventories more than on course examinations, and that active learning appears effective across all class sizes—although the greatest effects are in small ($n \leq 50$) classes. Trim and fill analyses

225 studies in the published and unpublished literature. The active learning interventions varied widely in intensity and implementation, and included approaches as diverse as occasional group problem-solving, worksheets or tutorials completed during class, use of personal response systems with or without peer instruction, and studio or workshop course designs. We followed guidelines for best practice in quantitative reviews (*SI Materials and Methods*), and evaluated student performance using two outcome variables: (*i*) scores on identical or formally equivalent examinations, concept inventories, or other assessments; or (*ii*) failure rates, usually measured as the percentage of students receiving a D or F grade or withdrawing from the course in question (DFW rate).

The analysis, then, focused on two related questions. Does active learning boost examination scores? Does it lower failure rates?

Results

The overall mean effect size for performance on identical or equivalent examinations, concept inventories, and other assess-

PSYCHOLOGICAL AND COGNITIVE SCIENCES

Active (Guided) Learning

Student-centered
most of class time is spent by student solving problems

Professor facilitates
assigns readings, writes questions, activities, delivers “mini lectures”, gives quizzes, exams, introduces and sequences topics, wraps up/ties together classes

Active Learning

Examples:

student-driven research projects in various formats: instructional videos, websites, grant proposals, manuscripts

class response systems: “clicker” questions

in-class problem solving (ask a neighbor)

“1 minute papers” (summarize key points in class in 1 minute)

online discussion boards

flipped classes: video recorded lectures followed by in class discussion

POGIL

POGIL is defined by

- In-class problem solving done by students working in **small groups**

- activities to follow a **3 step learning cycle:** exploration, concept invention, application

- activities that simultaneously **develop “process” skills**: time management, information retrieval, managing resources, oral and written communication

POGIL provides institutional support

- NSF funded non-profit organization
- Runs training workshops
- Provides standardized feedback on instructor-designed activities

pogil.org

Activity 1

Assign roles

- Manager: keeps an eye on the clock, makes sure group is progressing on-time
- Scribe: records answer; provides notes for the whole group
- Spokesperson: orally presents the group's answer
- Process Analyst: takes notes on how well the group is working together - strengths and areas for improvement

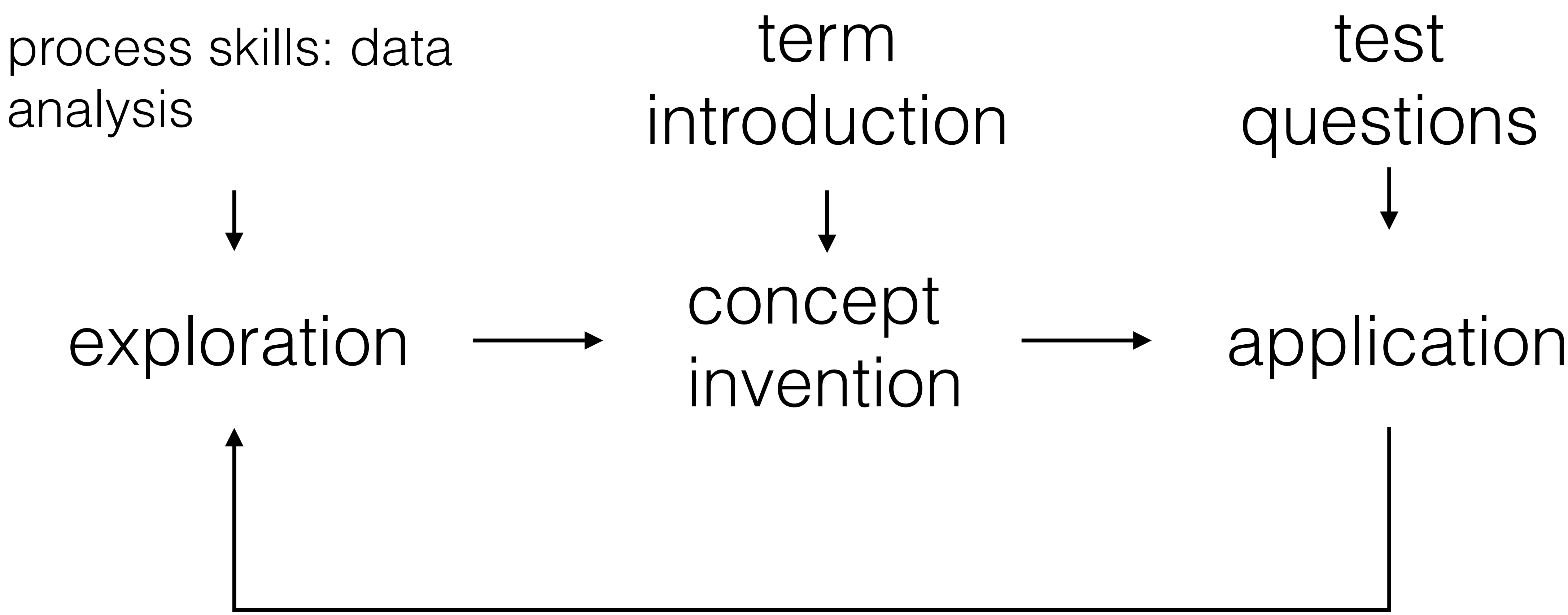
In 10 minutes

- Answer questions about Model 1 in the Membrane Potential activity.

- Please have the Spokesperson ready to answer the question to 7.

Analysis and Significance

The Learning Cycle



Schools and employers want good process skills

Guidelines

1. Provide an accurate assessment of the applicant's suitability for medical school rather than advocate for the applicant.

2. Briefly explain your relationship with the applicant:
   - how long you have known the applicant;
   - in what capacity you have interacted (e.g., faculty, pre-medical advisor, supervisor, etc.); and
   - whether you are writing based on direct or indirect observations.

3. Quality is more important than letter length. Focus on the applicant rather than details about the lab, course, assignment, job or institution.

4. ***Only*** include information on grades, GPA or MCAT scores ***if*** you are providing context to help interpret them. Grades, GPA, and MCAT scores are available within the application.

5. Focus on behaviors that you have observed directly when describing applicants' suitability for medical school. Consider describing:
   - The situation or context of the behavior
   - The actual behavior(s) you observed
   - Any consequences of that behavior

6. Admissions committees find comparison information helpful. If you make comparisons, be sure to provide context. Include information about:
   - the comparison group (e.g., students in a class you taught, students in your department, co-workers, etc.)
   - your rationale for the final comparison

Key Areas of Interest

A.) Unique Contributions to the Incoming Class

- Describe obstacles that the applicant had to overcome, and if applicable, how those obstacles led to new learning and growth
- Explain how the applicant may contribute to a medical school's diversity, broadly defined (e.g., background, attributes, experiences, etc.)

Note. If you write about any information that could be considered potentially sensitive, confirm with the applicant that s/he is comfortable with the inclusion of that information.

B.) Core, Entry-level Competencies

Describe how the applicant has, or has not, demonstrated ***any*** of the following competencies that are necessary for success in medical school.

Thinking & Reasoning Competencies

Critical Thinking: Uses logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, or approaches to problems

Quantitative Reasoning: Applies quantitative reasoning and appropriate mathematics to describe or explain phenomena in the natural world

Scientific Inquiry: Applies knowledge of the scientific process to integrate and synthesize information, solve problems and formulate research questions and hypotheses; is facile in the language of the sciences and uses it to participate in the discourse of science and explain how scientific knowledge is discovered and validated

Written Communication: Effectively conveying information to others using written words and sentences

Science Competencies

Living Systems: Applies knowledge and skill in the natural sciences to solve problems related to molecular and macro systems

Human Behavior: Applies knowledge of the self, others, and social systems to solve problems related to the psychological, social, and biological factors that influence

Interpersonal Competencies

Service Orientation: Demonstrates a desire to help others and sensitivity to others' needs and feelings; demonstrates a desire to alleviate others' distress; recognizes and acts on his/her responsibilities to society, locally, nationally, and globally

Social Skills: Demonstrates awareness of others' needs, goals, feelings, and the ways social and behavioral cues affect peoples' interactions and behaviors; adjusts behaviors appropriately in response to these cues; and treats others with respect

Cultural Competence: Demonstrates knowledge of social and cultural factors that affect interactions and behaviors; shows an appreciation and respect for multiple dimensions of diversity; recognizes and acts on the obligation to inform one's own judgment; engages diverse and competing perspectives as a resource for learning, citizenship, and work; recognizes and appropriately addresses bias in themselves and others; interacts effectively with people from diverse backgrounds

Teamwork: Works collaboratively with others to achieve shared goals; shares information & knowledge with others and provides feedback; puts team goals ahead of individual goals

Oral Communication: Effectively conveys information to others using spoken words and sentences; listens effectively; recognizes potential communication barriers and adjusts approach or clarifies information as needed

Intrapersonal Competencies

Ethical Responsibility to Self and Others: Behaves in an honest and ethical manner; cultivates personal and academic integrity; adheres to ethical principles and follows rules and procedures; resists peer pressure to engage in unethical behavior and encourages others to behave in honest and ethical ways; and develops and demonstrates ethical and moral reasoning

Reliability and Dependability: Consistently fulfills obligations in a timely and satisfactory manner; takes responsibility for personal actions and performance

Resilience and Adaptability: Demonstrates tolerance of stressful or changing environments or situations and adapts effectively to them; is persistent, even under difficult situations; recovers from setbacks

Capacity for Improvement: Sets goals for continuous improvement and for learning new concepts and skills; engages in reflective practice for improvement; solicits and responds appropriately to feedback

American Association of Medical Colleges

POGIL improves performance for more students

lecture only

lecture+POGIL

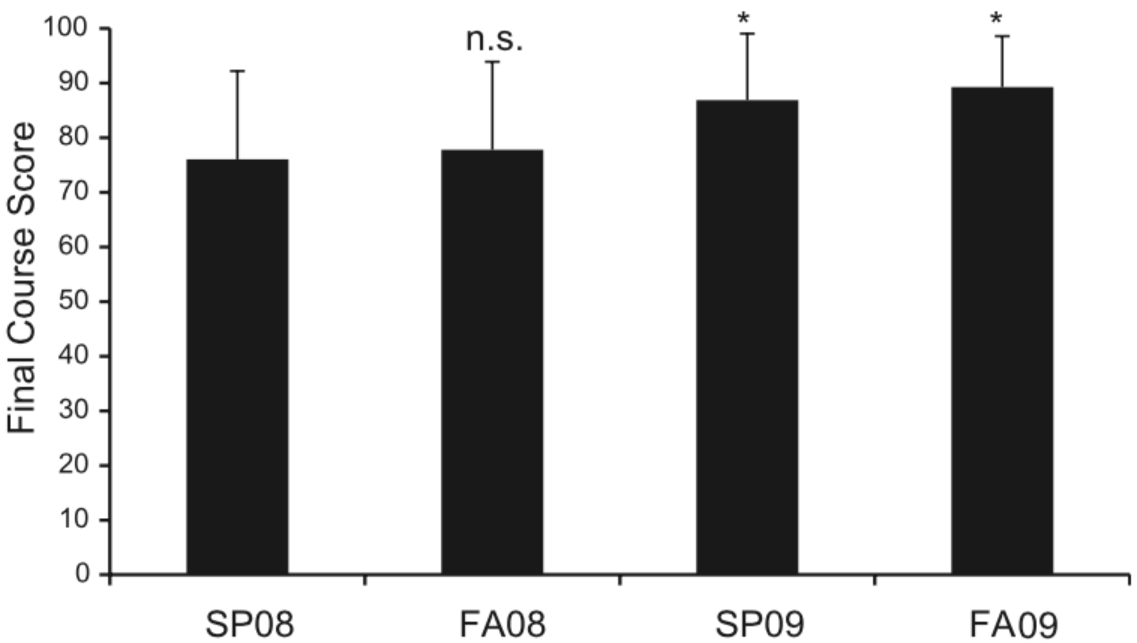


Fig. 1. Mean final scores in the Anatomy and Physiology 2 (A&P 2) course from spring 2008 (SP08), fall 2008 (FA08), spring 2009 (SP09), and fall 2009 (FA09). Values are means ± SD. NS, not significant ($P \geq 0.05$). $^{*}P < 0.01$ as measured using a two-tailed Student's t-test.

L-only

L+P

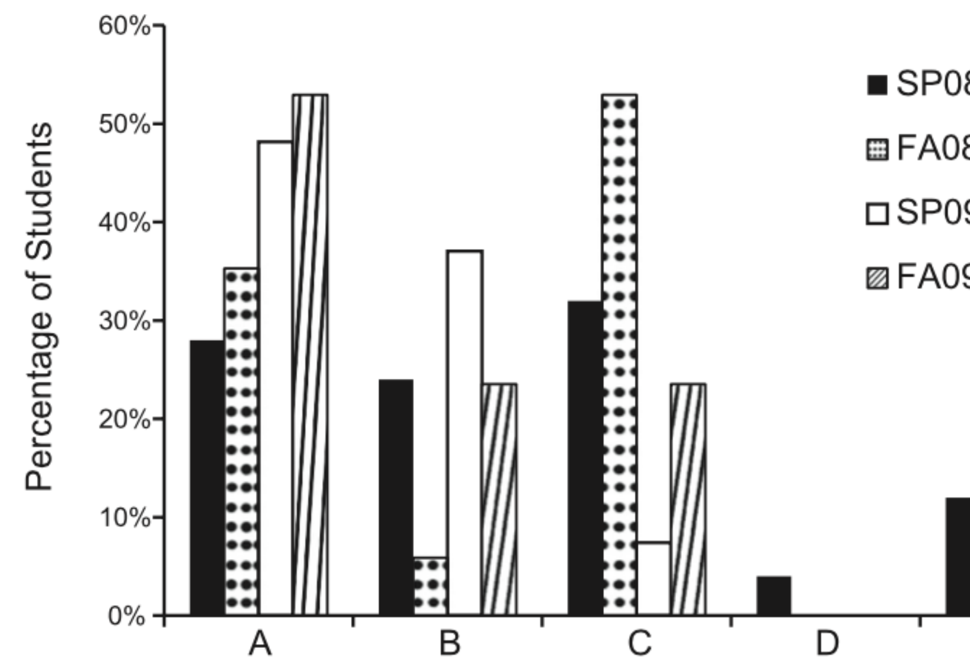


Fig. 3. Final course grade distributions in A&P 2 from SP08, FA08, SP09, and FA09.

Brown, 2010

Implementing POGIL

- POGIL suggests a regular schedule (weekly, biweekly)
- Others use POGIL to complement lectures that cover particularly difficult material
- Some go all-in and run their entire class lecture-free
- Colleagues share POGILs, published POGIL texts
- Writing your own takes 3-5 hours and can be adapted from pre-existing lecture preps, problem sets, quizzes, exam questions.
- Recommend workshop to learn more about effective POGIL design and facilitation

Activity 2

Meta analysis activity

In 10 minutes Label each question in Model 2:

Exploratory (E): directed questions designed to engage the model: list, describe, define

Concept Invention (CI): questions that require comparison/contrast, analysis

Application (A): questions that require synthesis, evaluation