Active Learning in the Classroom

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Guiding Questions for the Workshop

- *What is active learning?*
- *Why is active learning important?*
- *Are there challenges associated with an active classroom?*
- *How can I implement active learning into my classroom or lab?*

Minute Paper

Based on your current knowledge, how would you define active learning?

What benefits or drawbacks does it bring to the classroom?

What is Active Learning?

Anything students do in a classroom other than merely passively listening to an instructor's lecture

(Paulson & Faust)

Involves students in doing things and thinking about the things they are doing

(Bonwell and Eison)

When learning is active, students do most of the work. They use their brains…above all, students need to do it

(Silberman)

What is Active Learning?

Students actively *engage in thinking* during class:

Formulate Questions

Debate Alternatives

Solve Problems

Design Products

Discuss Scenarios

Create Knowledge

All learning is active

Active Learning Strategies

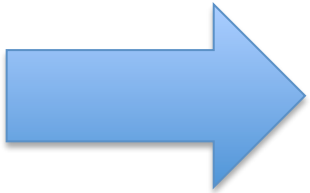
Optimal attention span

Use content “modules”

Punctuate with learning strategies

Interactive activities

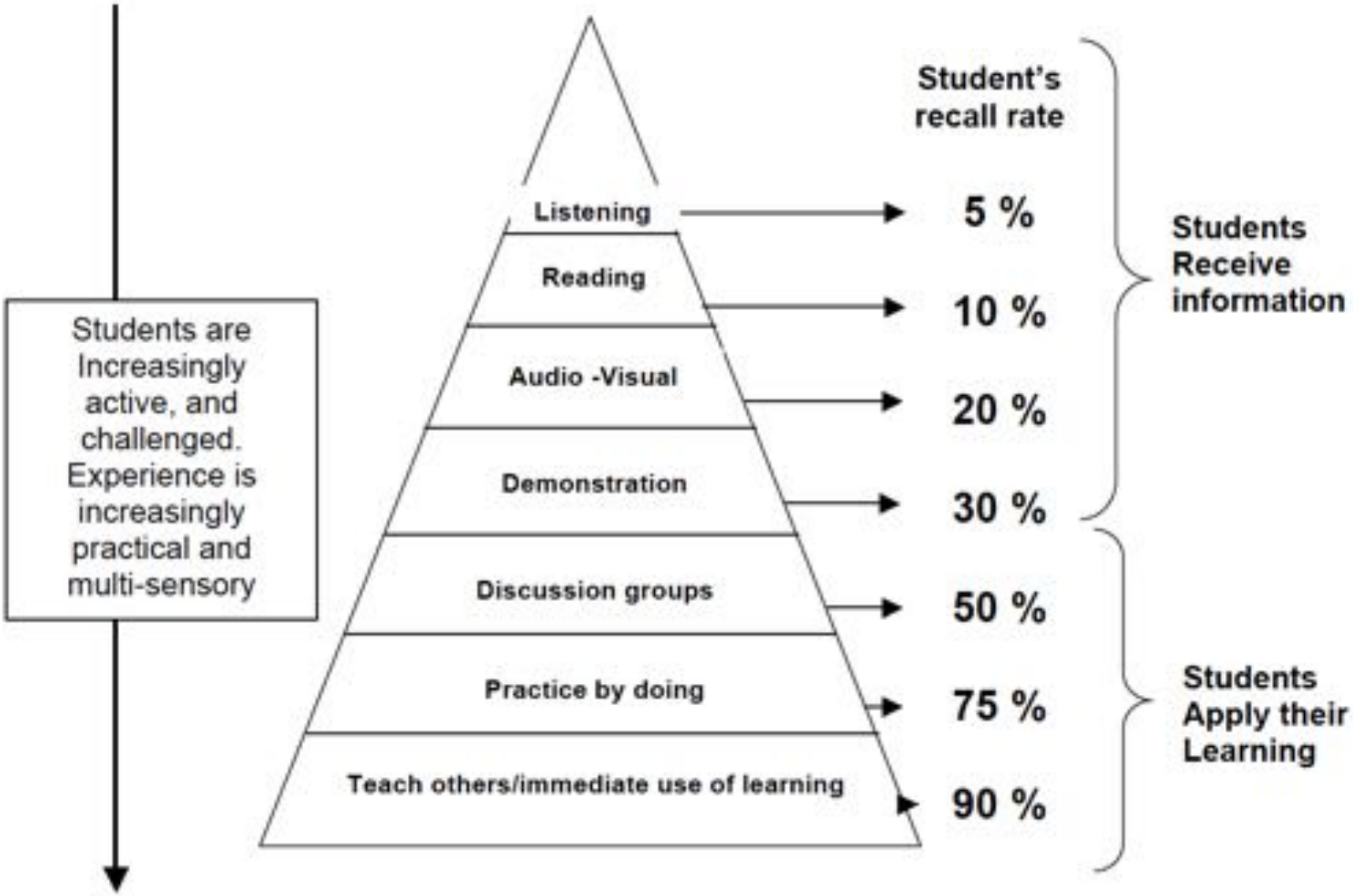
Questions, errors, assumptions, problems



Bloom's Taxonomy (1956)

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: the classification of educational goals; Handbook I: Cognitive Domain* New York, Longmans, Green, 1956

The Learning Pyramid: The recall rate of different teaching strategies. The National Training Laboratories (US)



Think-Pair-Share

Do you use active learning in the classroom?

1. Describe an activity to a partner (2 min each)
2. Join another group
3. Describe your partner's activity to the group (2 min each)

Classroom Assessment Techniques

Geared for individuals	Geared for groups
Minute papers	*Think-Pair-Share*
Muddiest point	*POGILs*
Journals	*Active Review*
Reading quizzes	*Jigsaw Projects*
Clickers	*Games*
Chain Notes	*Debates*
Fish-Bowls	*Case Studies*
Clarification Pauses	*Peer-Evaluated Exams*
Review Sets	*Presentations*

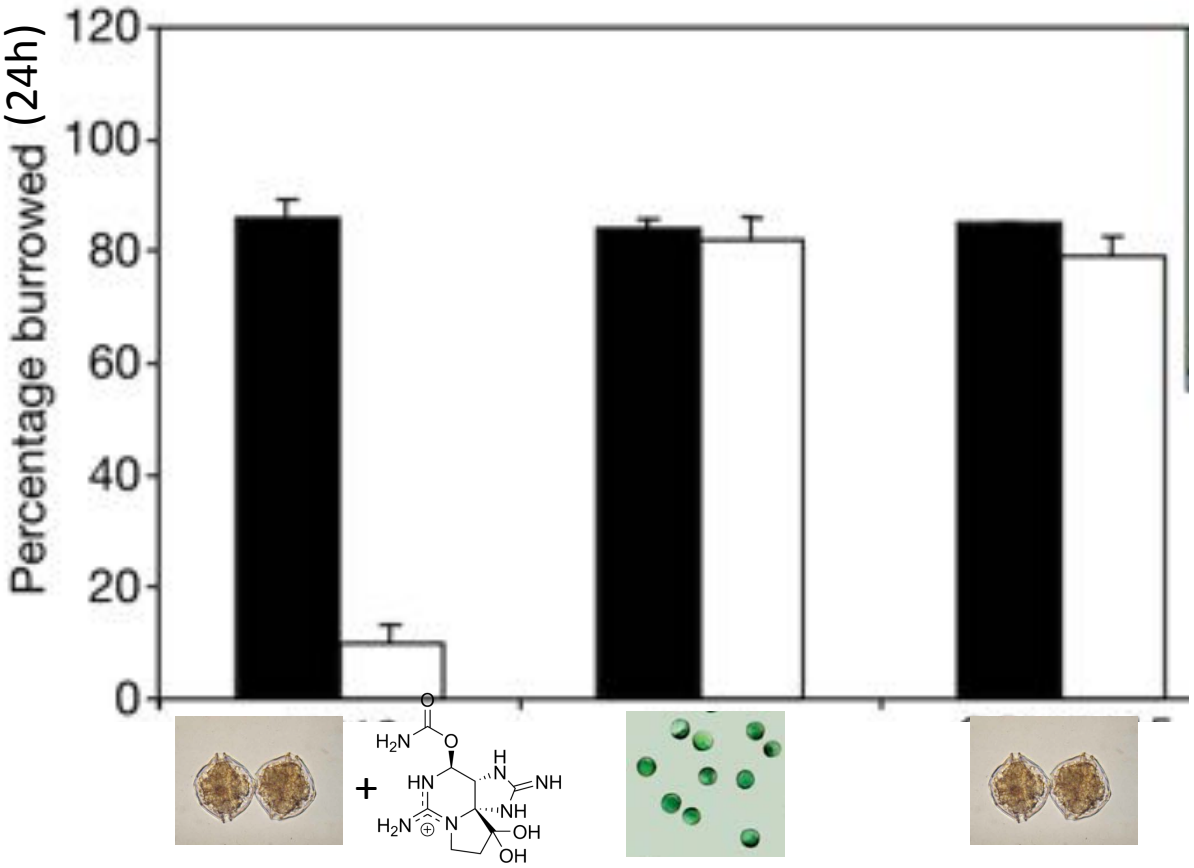
Paulson and Faust, Angel and Cross, and others

Case Study Examples

Classical Genetics through Kitties

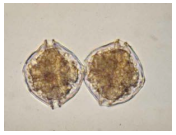
Community Ecology through Sea Otters

Interrupted Case Study

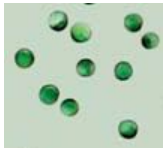


= Bay of Fundy clams

= Nova Scotia clams



= *Alexandrium tamarense*



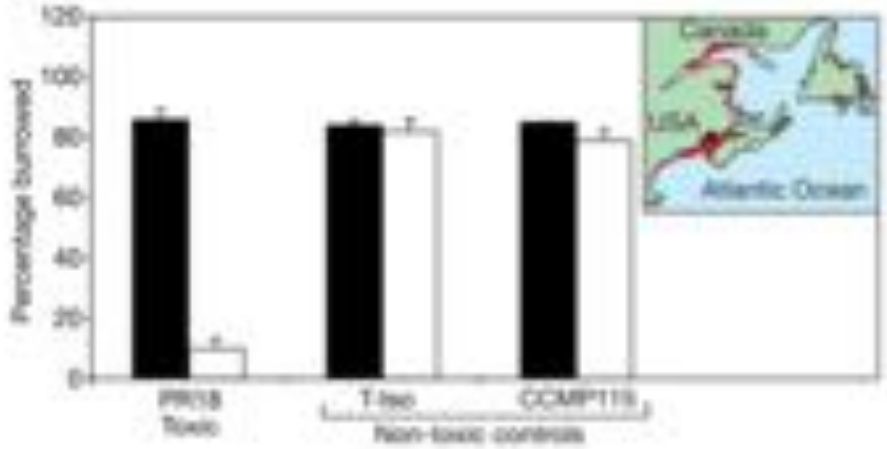
= *Isochrysis galbana*

Bricelj *et al*. 2005 *Nature*

Interrupted Case Study

Breakout Activity #1 – Clam burrowing behavior

Figure 1 Responses to PSTs in two *M. arenaria* populations. **a**, Percentage of clams that burrowed after 24 h of exposure to *A. tamarense* (strains PR1Bb or CCMP115) or *I. galbana* (T-iso) ($n = 2$ tanks). Map shows the study sites BF (filled circle) and LE (open circle); the PSP-affected coastline is in red



1. *Based on this data set, what physiological effect do you think saxitoxin has on clams? Why would burrowing behavior be a good indication of this?*

2. *Why did the researchers decide to use two controls for this experiment?*

3. *What are you left wanting to know more about at this point?*

Games - Taboo Cards

Credit to Angel Kaur (UNC-Asheville)

Angiosperm
Flower
Seeds
Enclosed

Hydrophobic
Water
Oil
Mix

Active Learning Challenges

Take 2-3 minutes, and brainstorm common challenges that could limit implementation of active learning in the classroom

Covering the content

Faculty are “good lecturers”

Active learning is too time-consuming

Student / faculty resistance

Disconnect between lecture and activities

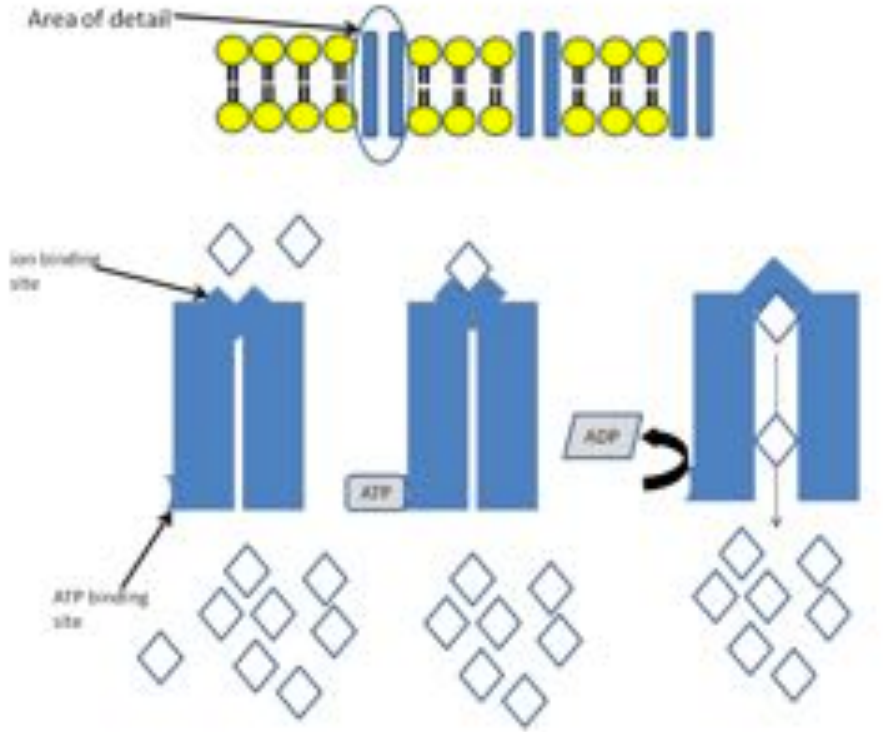
Space / technology concerns

POGIL

POGIL

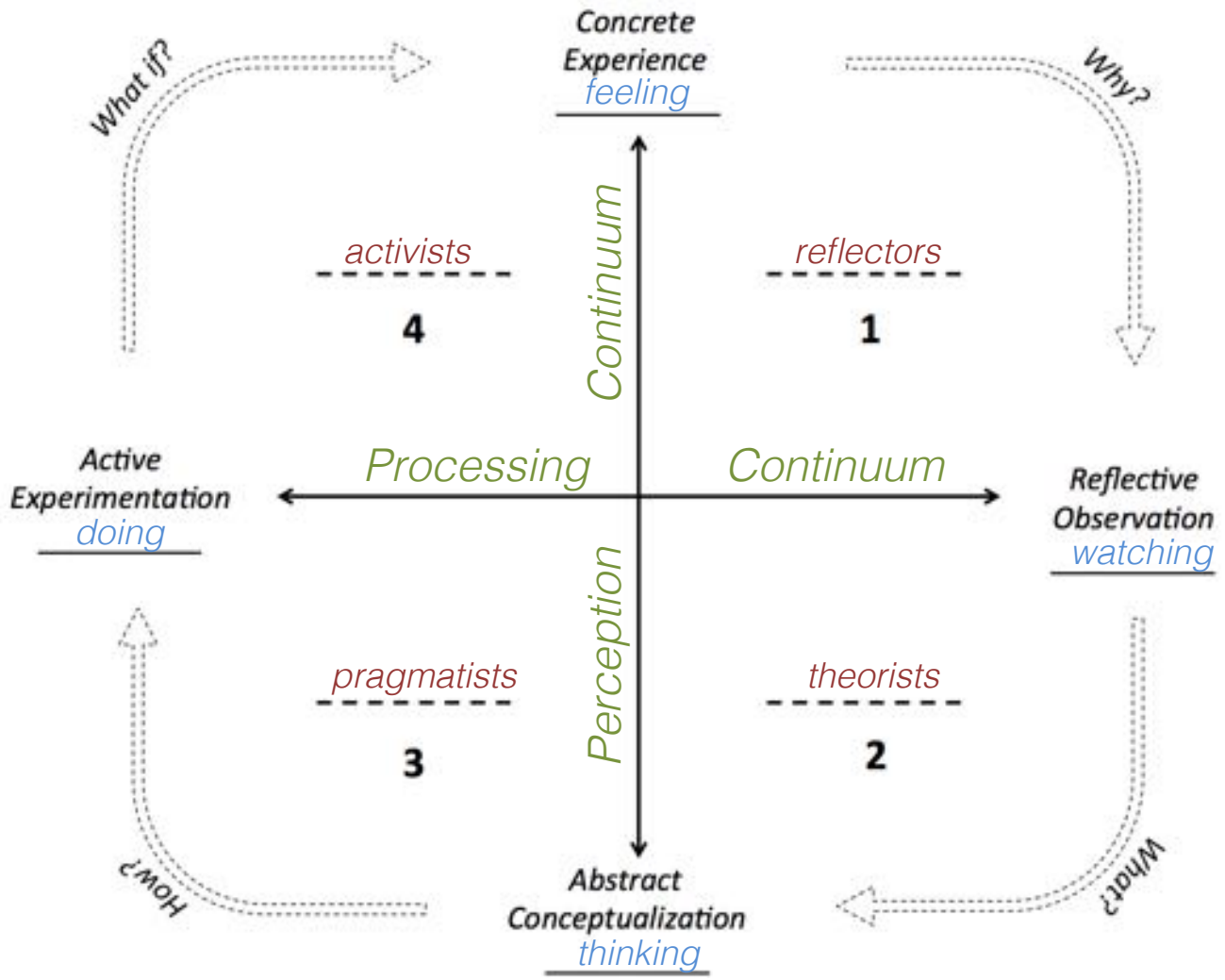
Process Oriented Guided Inquiry Learning

Model 4: Active Transport

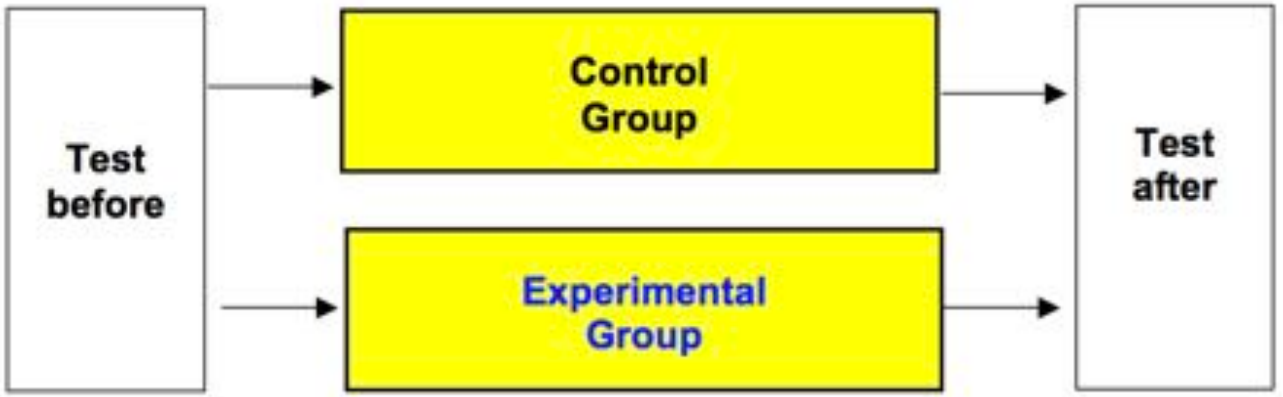


Active Learning in Action

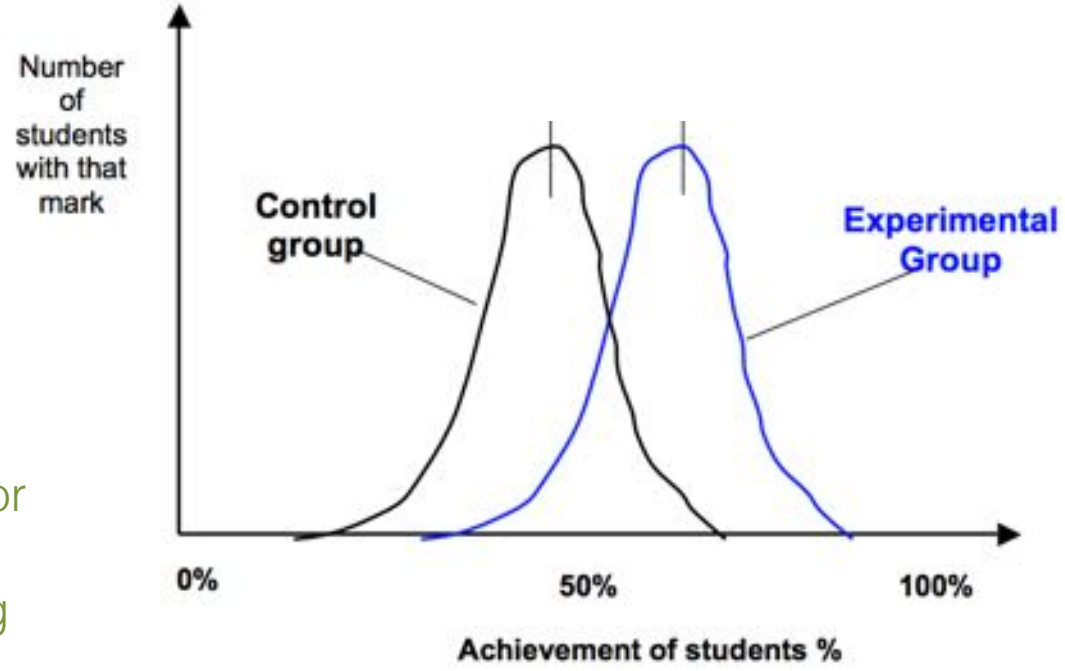
POGIL – Process Oriented Guided Inquiry Learning



Does Active Learning Pay Off?



Cumulative outcome for meta-analysis of 253 active learning studies (Hattie, 2004)

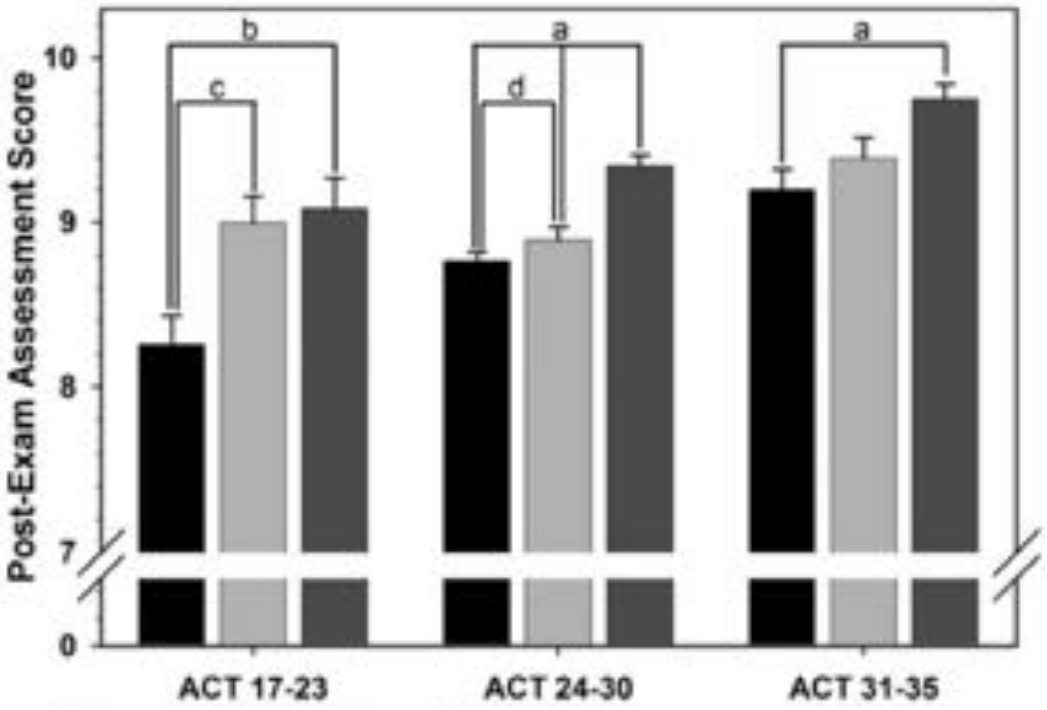


~15% improvement for students with active learning

Adapted from G. Petty

Does Active Learning Pay Off?

Exam-correcting activities enhance long-term retention of introductory biology content



No corrections (control)

Group discussion to correct incorrect questions

Individual written reflection on incorrect questions (w/ answer key)

Active

Note effectiveness at different ACT levels

Adapted from (Mynlieff et al. 2014 *CBE-Life Sci*)

Does Active Learning Pay Off?

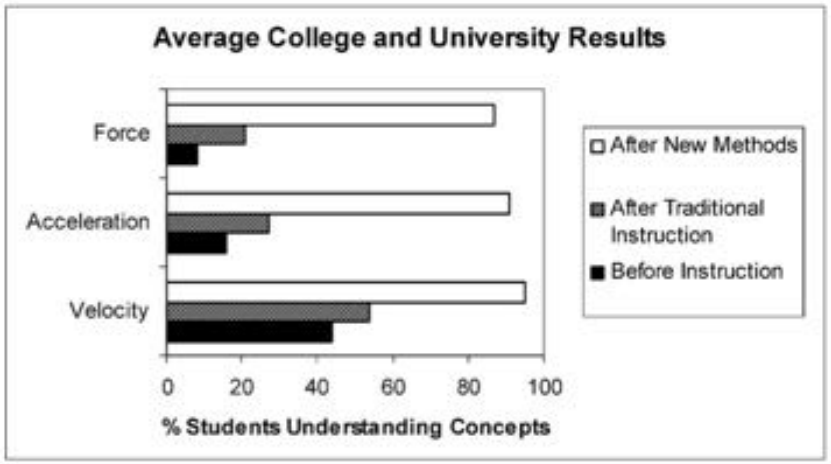
CATs improve organic chemistry performance

Course	Sections (No.)	Av Enrollment	% Pass
Standard Lecture Format: 1984-1994			
Chem 301A	8	48	71 ± 5
Chem 301B	8	50	63 ± 4
Chem 301C	8	40	85 ± 3
Cooperative Learning and Active Learning: 1994-1998			
Chem 301A	3	43	92 ± 2
Chem 301B	3	50	86 ± 4
Chem 301C	4	44	94 ± 2

Organic Lecture Pedagogy	Lab	Students (No.)	Lab Retention (%)	GPA
Intense active learning	302A	109	97	2.73
Predominantly lecture	302A	129	72	2.26
Intense active learning	302B	84	96	2.67
Predominantly lecture	302B	91	86	2.62

(Paulson 1999 – *J. Chem Ed.*)

Active learning increases concept retention in physics



(Prince 2004 – Adapted from Laws *et al.* 1999)

What about active learning in the lab?

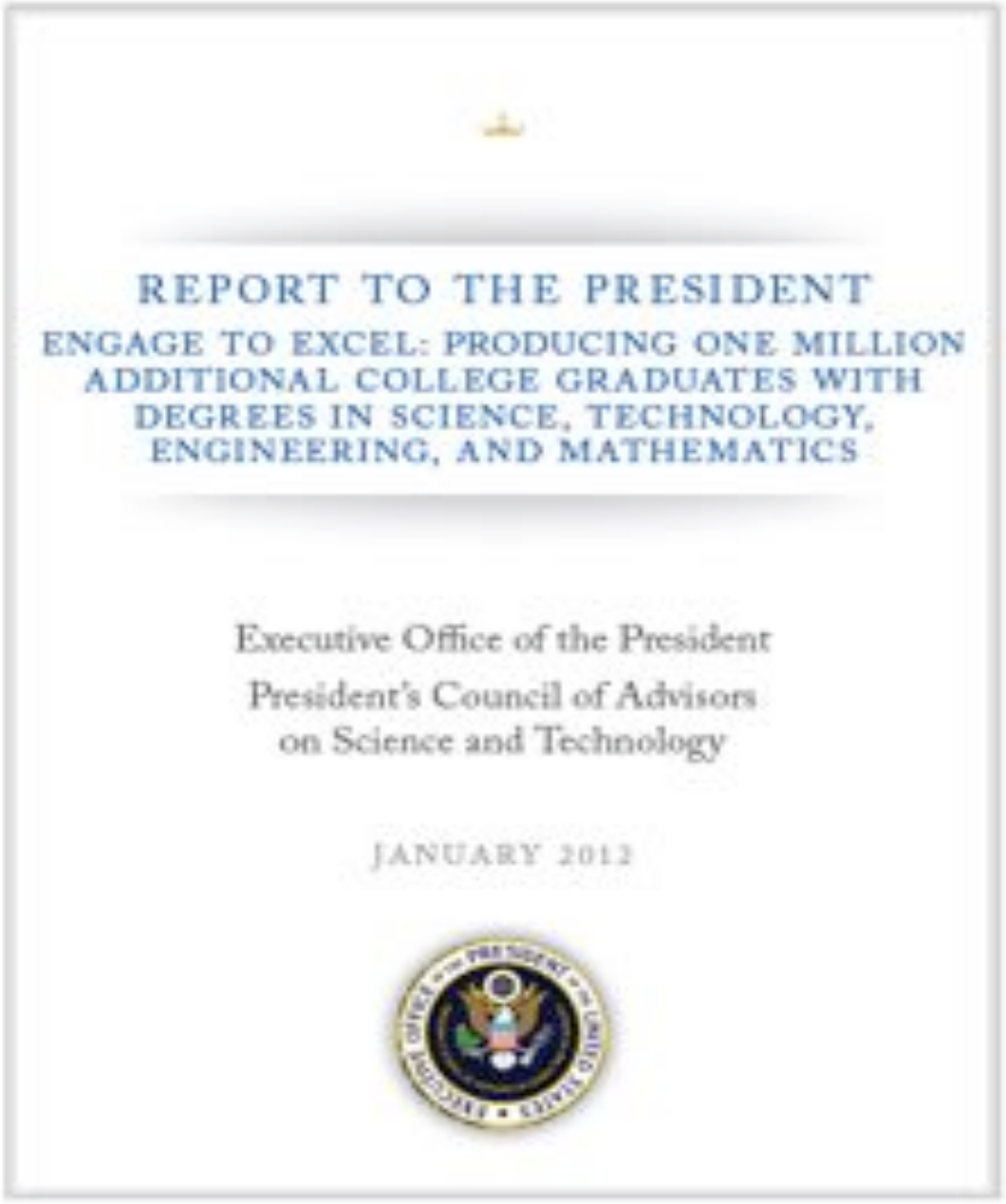
The Issue

< 40% of college students intending to major in STEM complete a STEM degree

Uninspiring introductory labs
"Cookie cutters"

Insufficient math or lab prep

The Call to Action: Engage to Excel



REPORT TO THE PRESIDENT

ENGAGE TO EXCEL: PRODUCING ONE MILLION ADDITIONAL COLLEGE GRADUATES WITH DEGREES IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS

Executive Office of the President
President's Council of Advisors
on Science and Technology

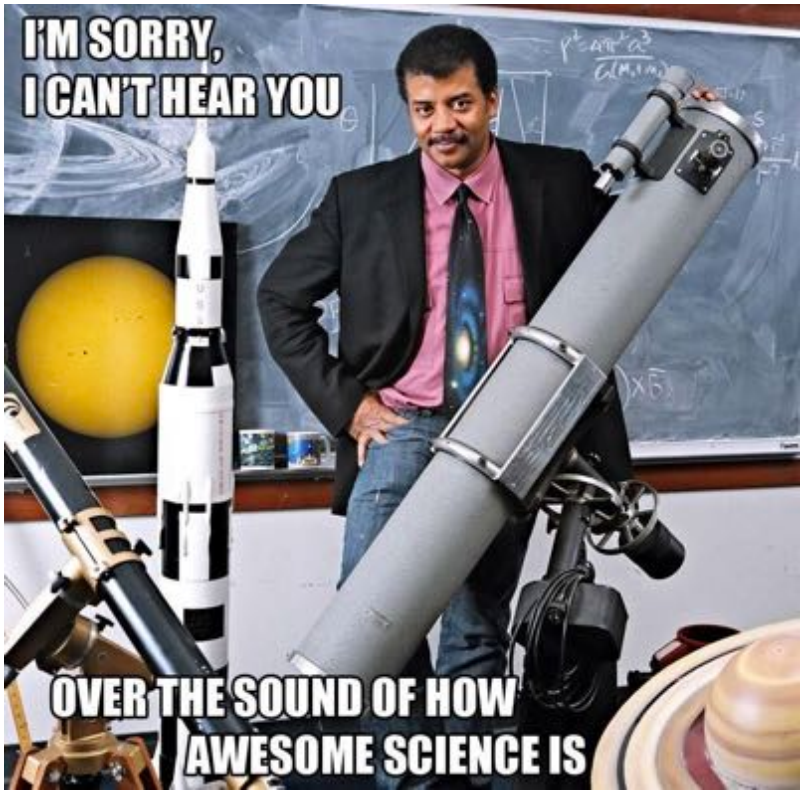
JANUARY 2012

1. Increase graduates in STEM fields by 33%
2. Focus on first two years of college
3. Uniform call across university landscape
4. Aim for retention

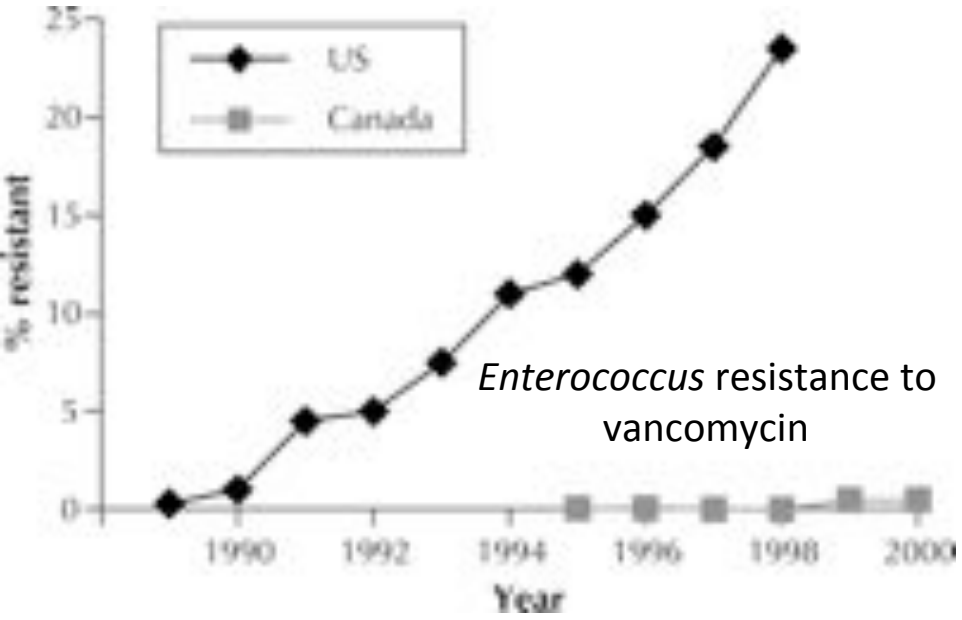
Engage to Excel

Recommendation #2

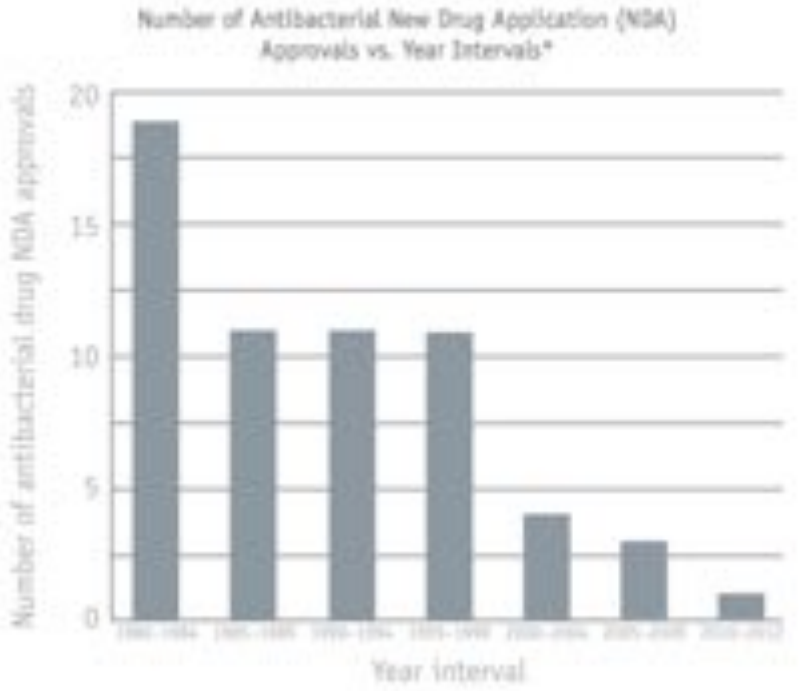
"Advocate and provide support for replacing standard laboratory courses with discovery-based research courses."



Find an Inspiring Issue



Enterococcus resistance to vancomycin



Antibiotic Resistance Warnings Remain Unheeded, Experts Say

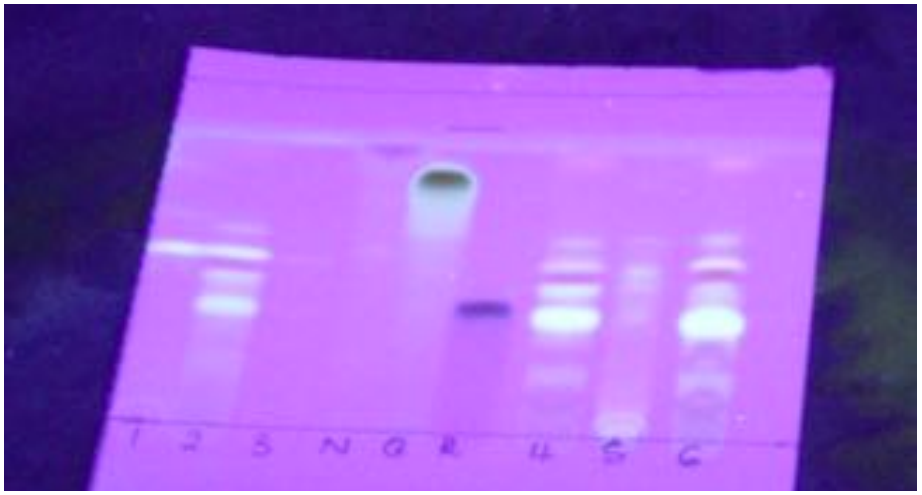
Posted: 10/09/2014 10:54 am EDT | Updated: 10/09/2014 10:59 am EDT

Antibiotic resistance 'could be far worse than ebola'

Conly (2002) CMAJ

Opportunities through the Small World Initiative

Gene sequencing
Potential new species



Compound purification
Potential new antibiotics

Screen for antibiotic resistance
Environmental impact

Active Learning in the SWI Course

Group design of projects and methods

Lab report peer-review

Reflective journals on project

Virtual poster sessions

Outreach via social media / databases

Social Media Outreach

SWI culture database

Morton Arboretum	Mar 24 2015 - 8:30am	Suraya Abruzzi	Dominican University
Morton Arboretum	Mar 24 2015 - 8:30am	Sweta Patel	Dominican University
Morton Arboretum (Oak Savanna)	Mar 19 2015 - 9:30am	Karen Lopez	Dominican University
45 Dover Street Worcester, MA	Mar 19 2015 - 8:00am	Kayli Kacoyannakis	Worcester Polytechnic Institute
The Westborough Reservoir	Mar 18 2015 - 6:59pm	Maureen Hester	Worcester Polytechnic Institute
Worcester, MA	Mar 18 2015 - 2:00pm	Gaetano Scuderi	Worcester Polytechnic Institute

LOCATION

Latitude:	35.858061 N
Longitude:	86.297406 W
Date and Time Collected:	Sep 7 2014 - 11:00am

SOIL SAMPLE

Air Tempurature (°C):	21
Depth (in.):	1.5
Type of Soil:	clay loam

CULTURE MEDIA AND CONDITIONS

Media	CFU/g	Total Number of Isolates	Frequency of Antibiotic Producers (%)	Temperature (°C)	Length of Incubation (hr)	Oxygen	Antibiotic Resistance Frequency (%)
Nutrient Broth (NB)	varied (multiple plates)		~10%	34	48	Atmospheric oxygen	

ACTIVITY PROFILE

Isolate	Medium	Genus	B	E	B	E	B	E	B	E	B
Bacillus toyonensis (99% match)	Nutrient Broth (NB)	Bacillus	+	nd	-	nd	nd	nd	nd	nd	nd
Bacillus sp. (98% match)	Nutrient Broth (NB)	Bacillus	-		-						
Ralstonia picketti (99% match)	Nutrient Broth (NB)	Other (describe below)	-		+						
Paenibacillus polymyxa (99% match)	Nutrient Broth (NB)	Other (describe below)	+		-						

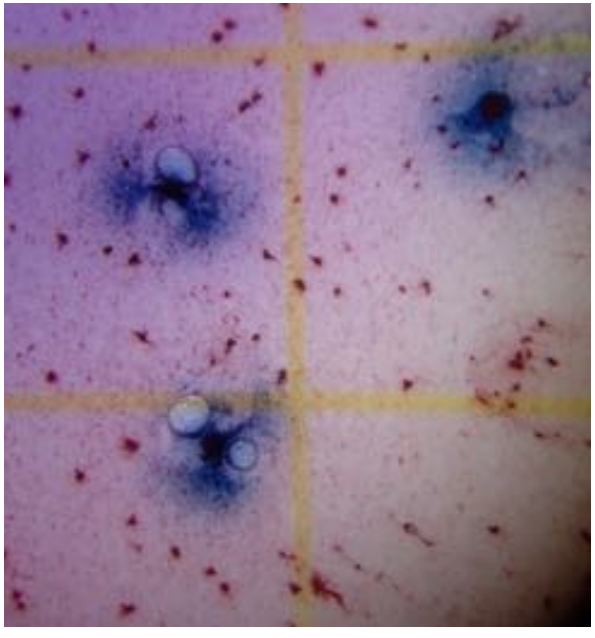
Activating Upper Division Labs - Ecology

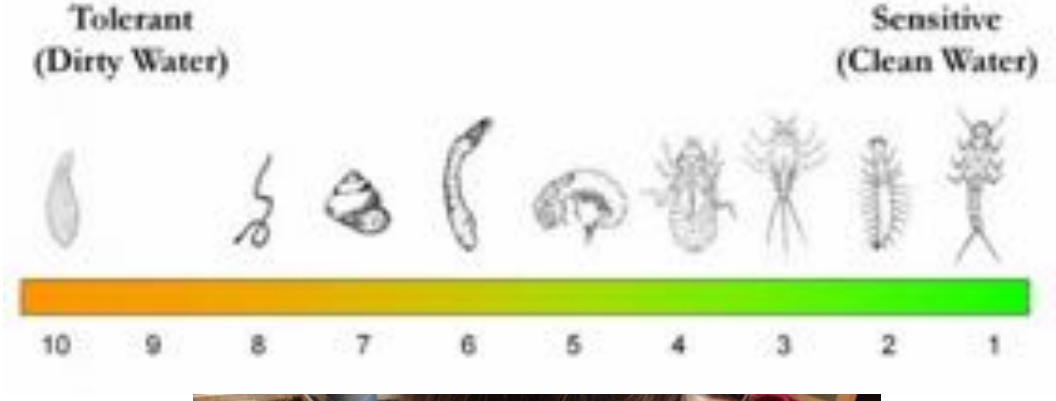
1. Given a system, allow students to design a project concerning ecosystem health
   - *Open ended research proposal, literature reviews*

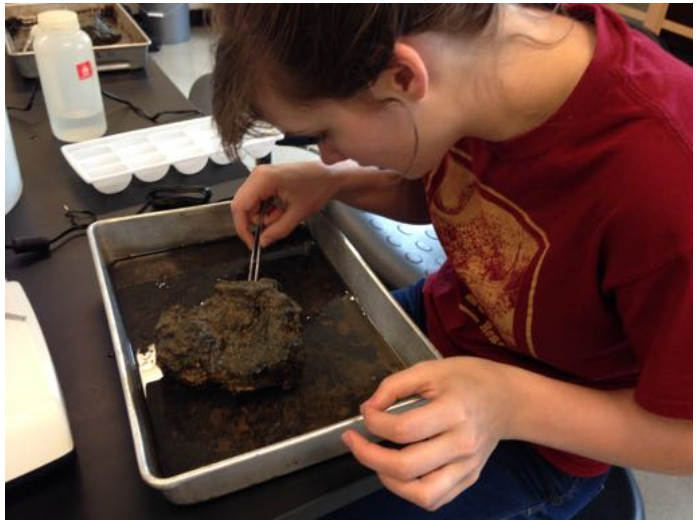
2. Allow students to implement their proposal, collect data, and present results to locals
   - *Research talk, group lab report, educational display*

The Proposal Stage

Is pollution from the Bark Park affecting the water quality of Stones River?



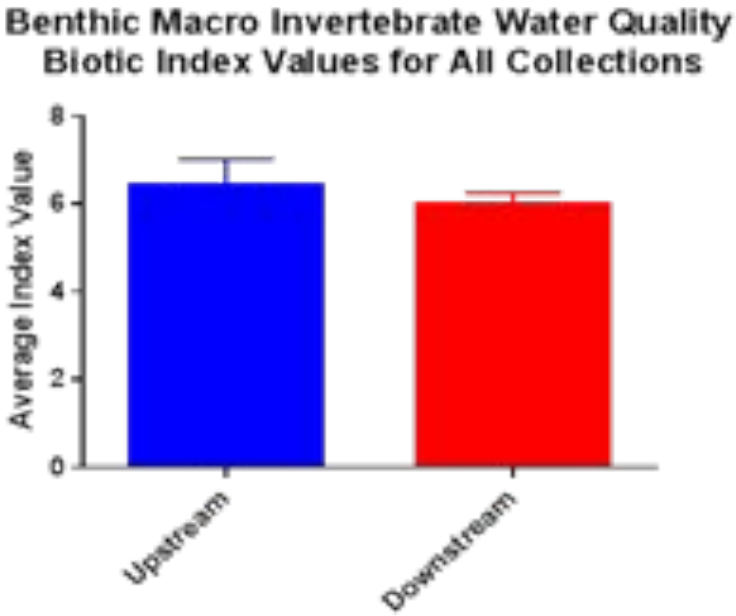




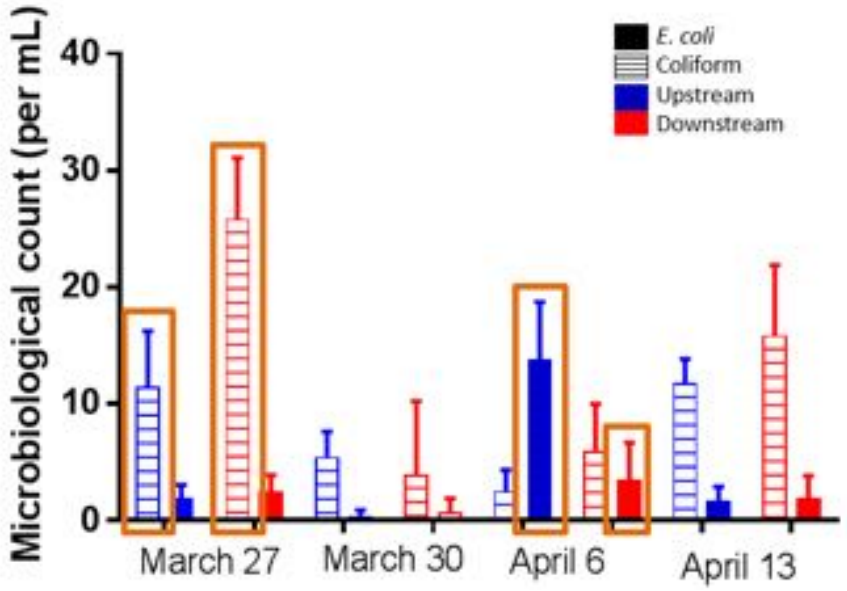
Students Designed Experiments to Answer Q

Nutrient levels

	pH	Nitrite	Nitrate	Ammonia
Week 1 - Upstream	7.6	0 ppm	0 ppm	0.25 ppm
Week 1 - Downstream	7.6	0 ppm	0 ppm	0.25 ppm
Week 2 - Upstream	7.6	0 ppm	0 ppm	0.25 ppm
Week 2 - Downstream	7.6	0 ppm	0 ppm	0.25 ppm



Invertebrate Diversity



Bacterial loads

Students Relayed Findings to the Community

Student feedback on the project

"Learning how to collaborate diverse methods for one common goal was very insightful and applicable to my studies"

"I had never been a part of any large research project like this. I learned a lot about how to work in a group, be cooperative, and tons about microbes, nutrients, and macroinvertebrates"

"I gained field work experience that I had never done before, and it made me realize that there are more research opportunities available than solely sitting at a desk with a microscope"

Wrap – Up (Fish Bowl)

Reflect on your response to the minute paper question at the beginning of the workshop

- *Has your definition of active learning changed?*
- *Discuss with your table*

On your way out, write down:

- *One concept that you were unclear on*
- *One concept you found particularly interesting*

We will post responses online, or can contact you via email if you provide it!