Teaching a science lab

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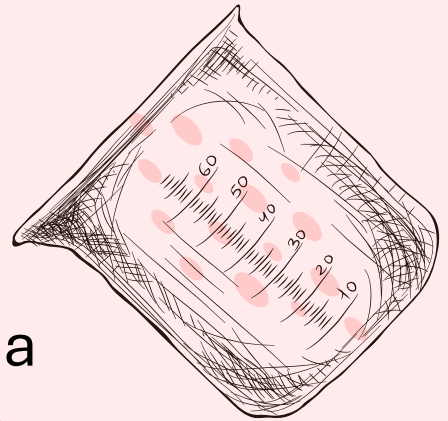
CTE – Fall 2024 TA Training

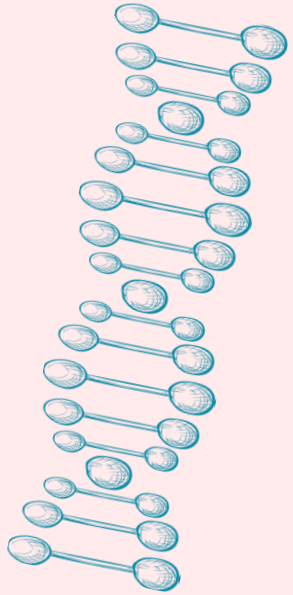


Before we start

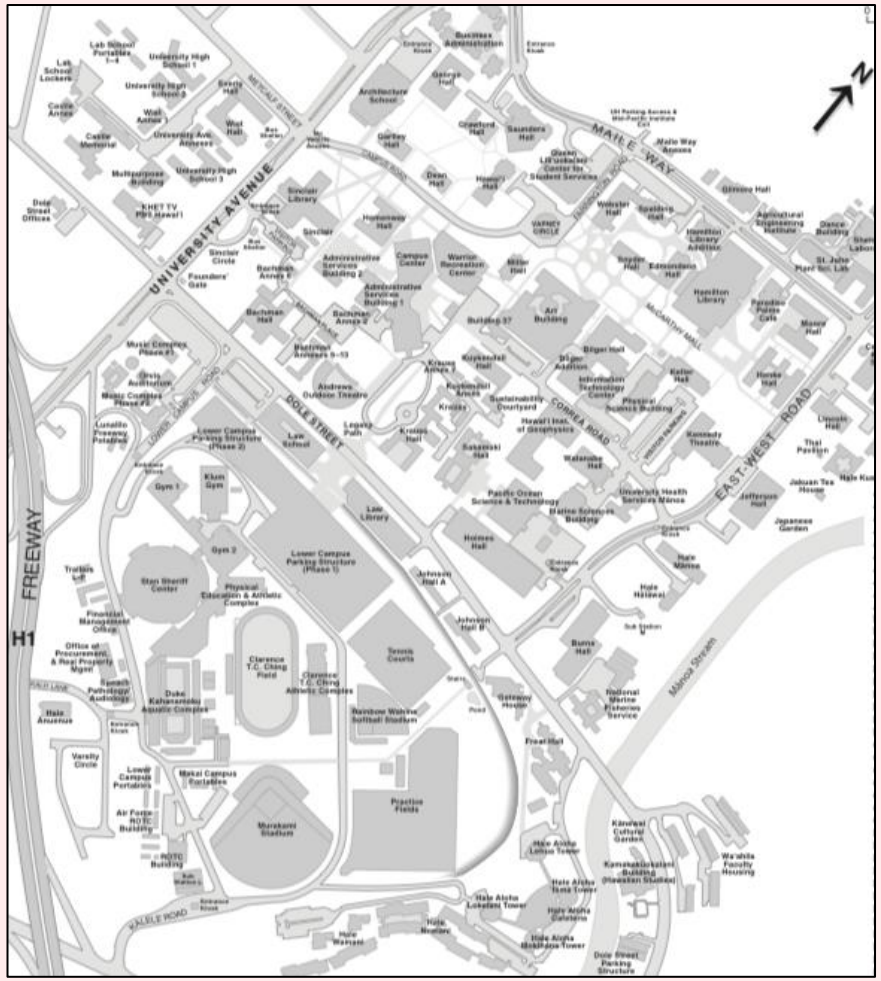
Think of one question you have about teaching a science lab

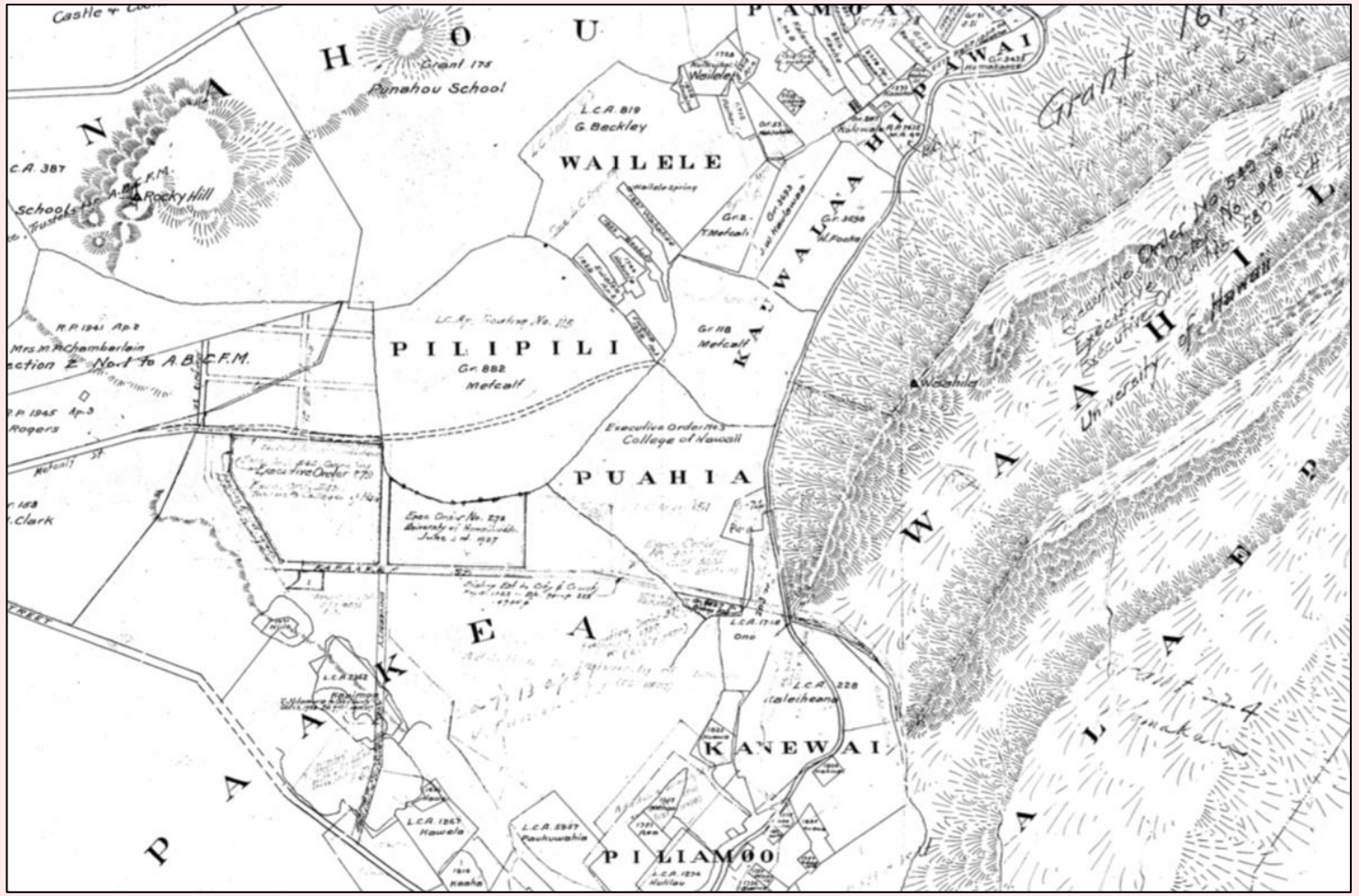
Write it down

We'll come back to it



Acknowledging occupation of Indigenous land





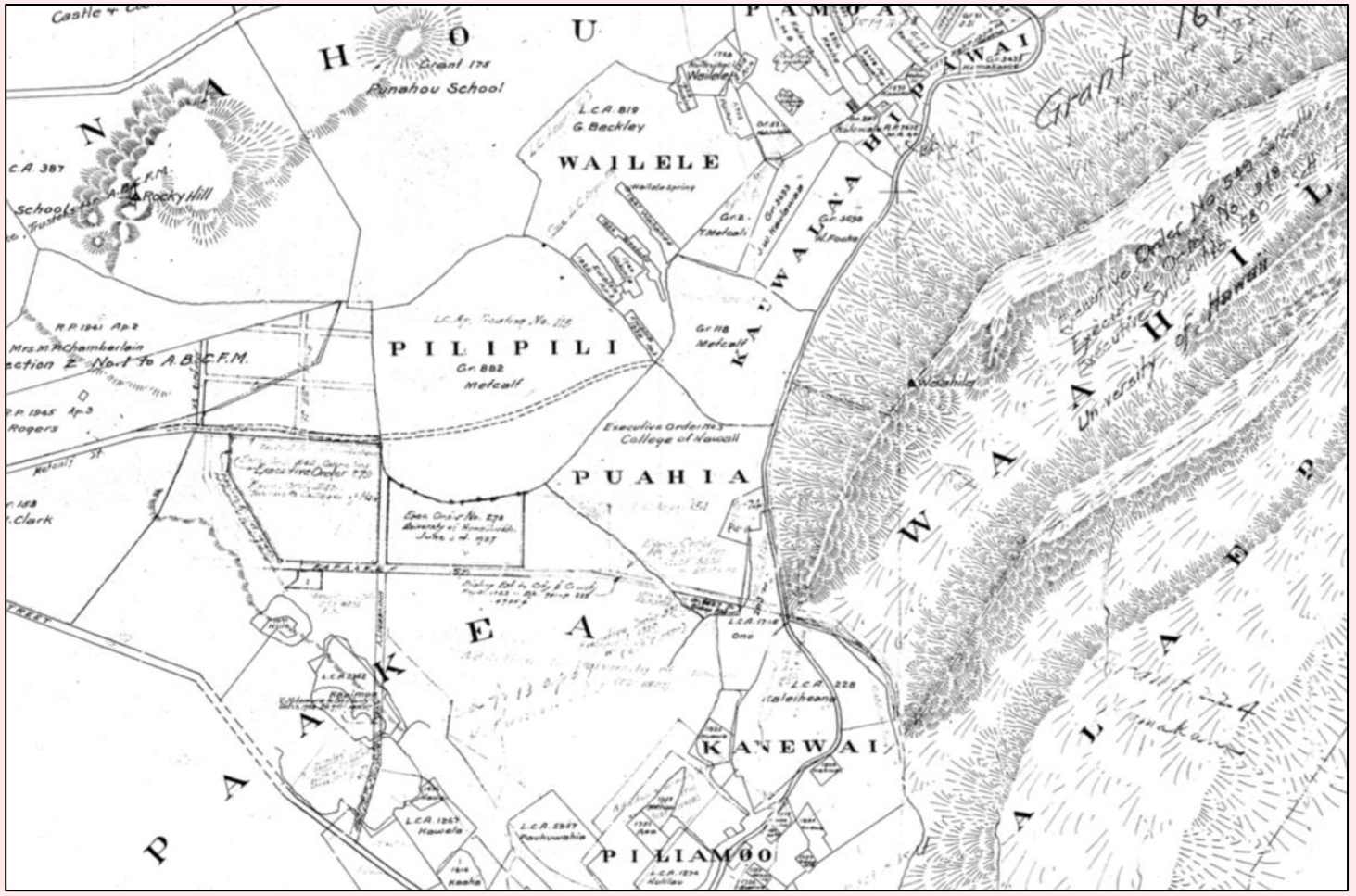
(L) Current map of UH campus, (R) 1882 map of area where campus was built

Acknowledging occupation of Indigenous land

Conscious recognition of the land you occupy and its Indigenous roots

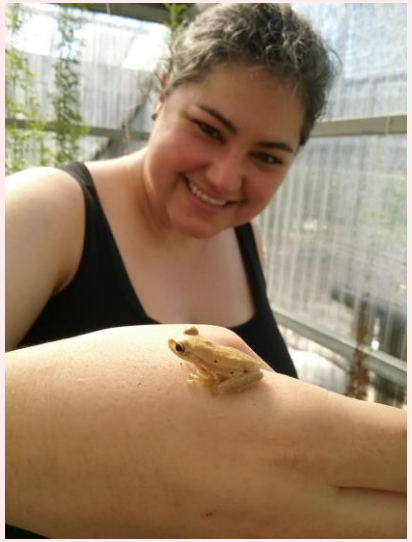
Attention to ongoing damage that settler colonialism causes Indigenous lands

Gratitude for the benefits we reap from the land that nourishes us



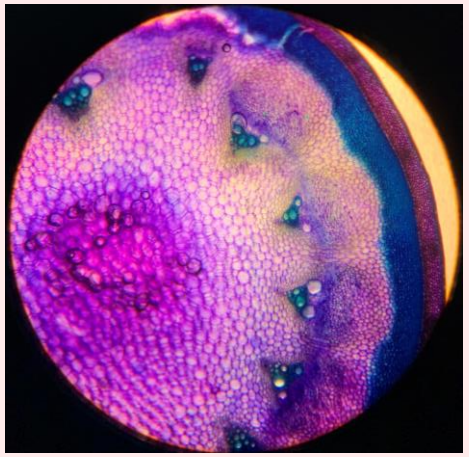
Objectives of this workshop

1. Discuss a better way to teach science, and how labs do that
2. Describe your role as a graduate student TA in UH science labs
3. Get practical advice from current TAs



What is the goal of a science lab?

- Practice & mastery of technical skills
- Experience the scientific process
- Applying concepts from lecture in concrete manner



Science is taught ineffectively

The **‘stand and deliver’ method is passive**, and encourages memorization of facts rather than understanding and application of conceptual information in sciences.

Active learning is the best instructional tool

Any method of instruction that goes beyond just listening or reading

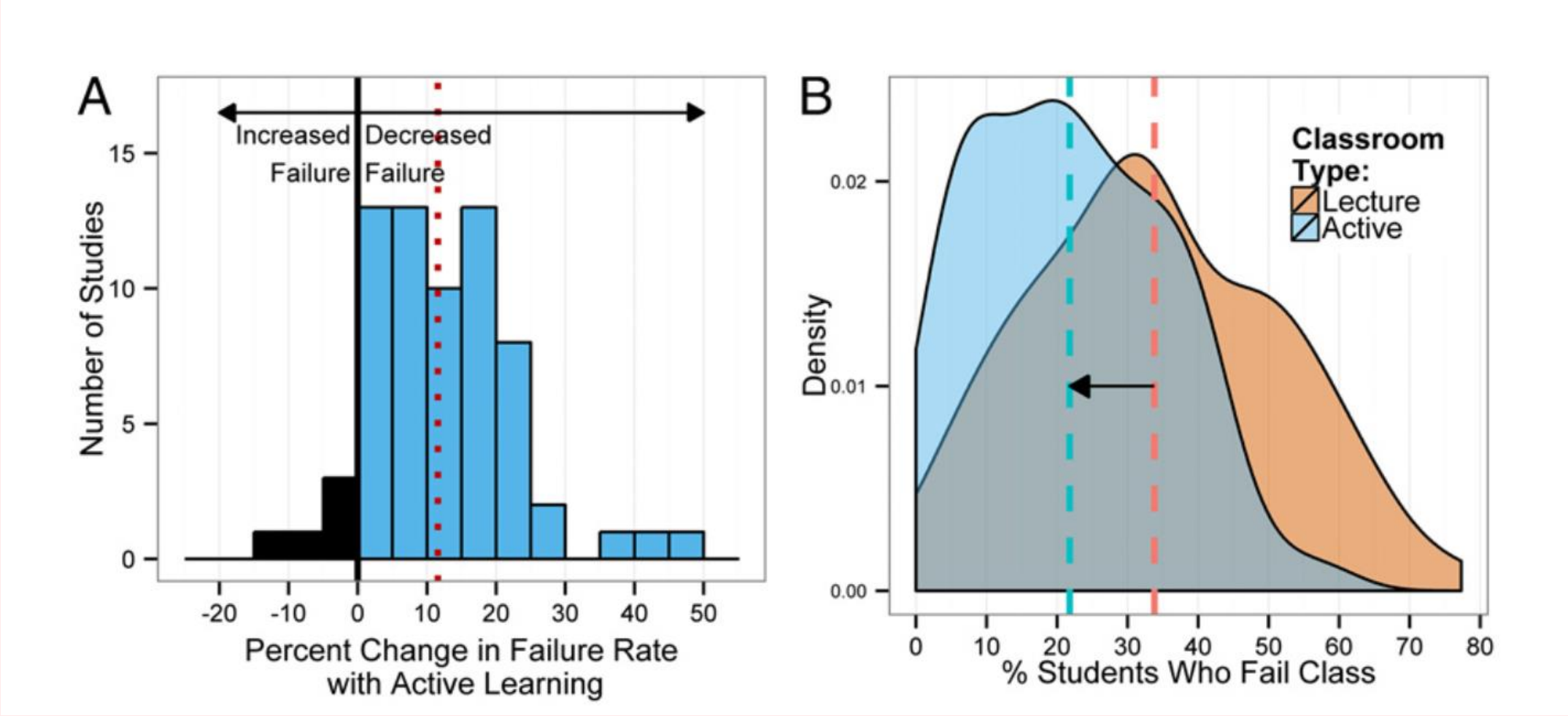
Science labs inherently active

Use several AL tools to reinforce concepts

Teaches skills

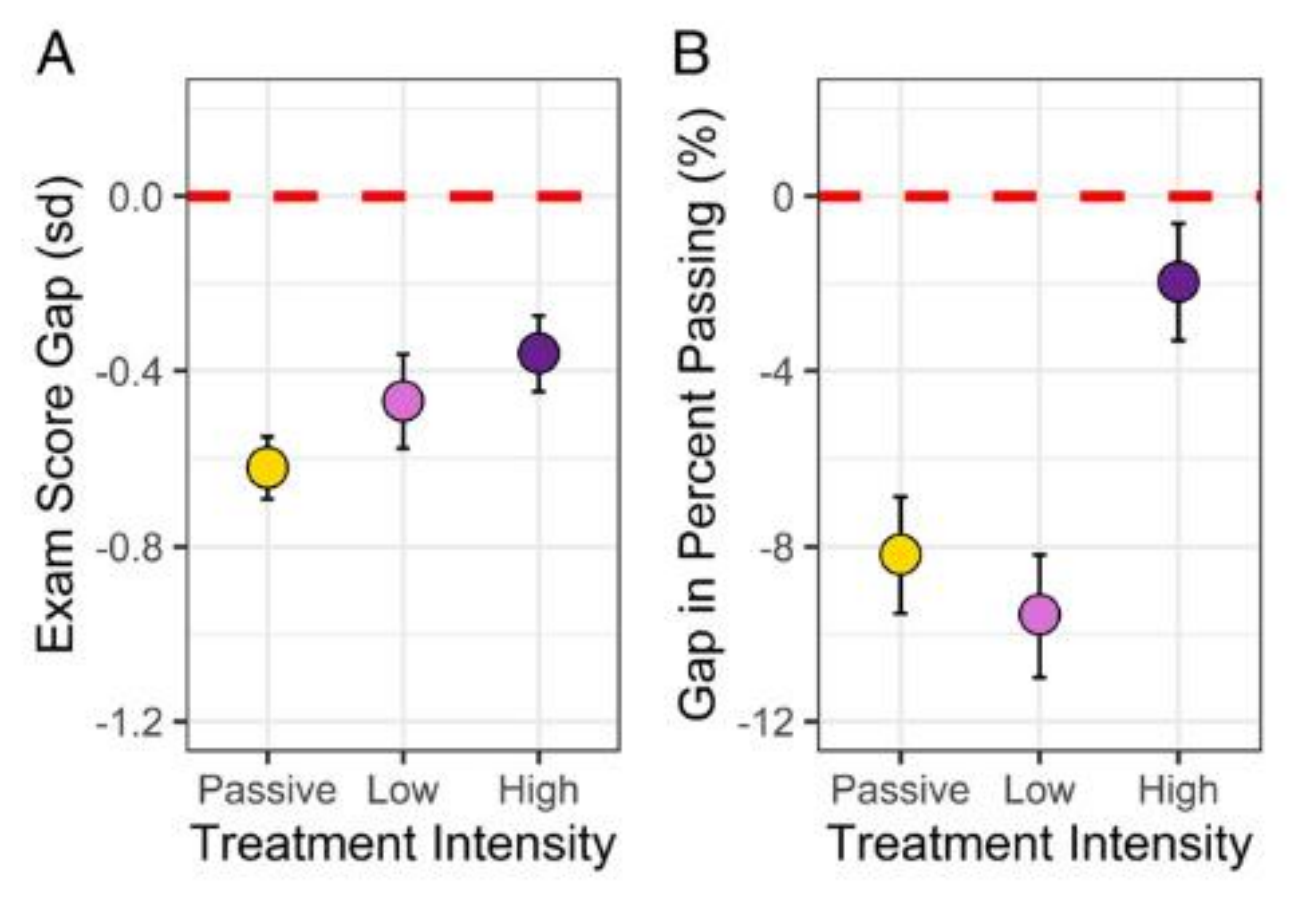
Engages students in problem solving

AL reduces failure rate compared with passive



Freeman et al 2014

AL reduces performance gap for under-represented groups



Theobald et al 2020

- Narrows the gap in performance: exams and passing grades
- Effectively reduces the impact of economic and educational disparities
- Improves retention of UR students

Passive learning example – scientific method

Teaching undergrads how to **develop hypotheses and design experiments** to test them, is common in nearly all science classrooms

A *hypothesis* is more than a random guess. It requires that you pay close attention to the observations you made and pull from previous knowledge to develop a probable explanation. In many cases, scientists formulate multiple hypotheses to cover many possible outcomes. Generally, scientists regularly use two types of hypotheses -- the null hypothesis and the alternate hypothesis. The *null hypothesis* states that there is no significant relationship between a variable being tested and the observed outcome. The *alternate hypothesis* states that there will be a significant relationship. Depending on the original observations or questions, there may be several alternate hypotheses.

Passive learning example – scientific method

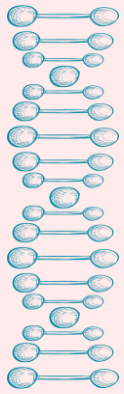
Teaching undergrads how to **develop hypotheses and design experiments** to test them, is common in nearly all science classrooms

Scenario 1: You spill a large amount of sauce on your shirt and want to remove the stains. In your laundry room you have two stain removers -- StainAction and BriteWhite. You want to know which stain remover will do a better job.

Null Hypothesis (H_0):

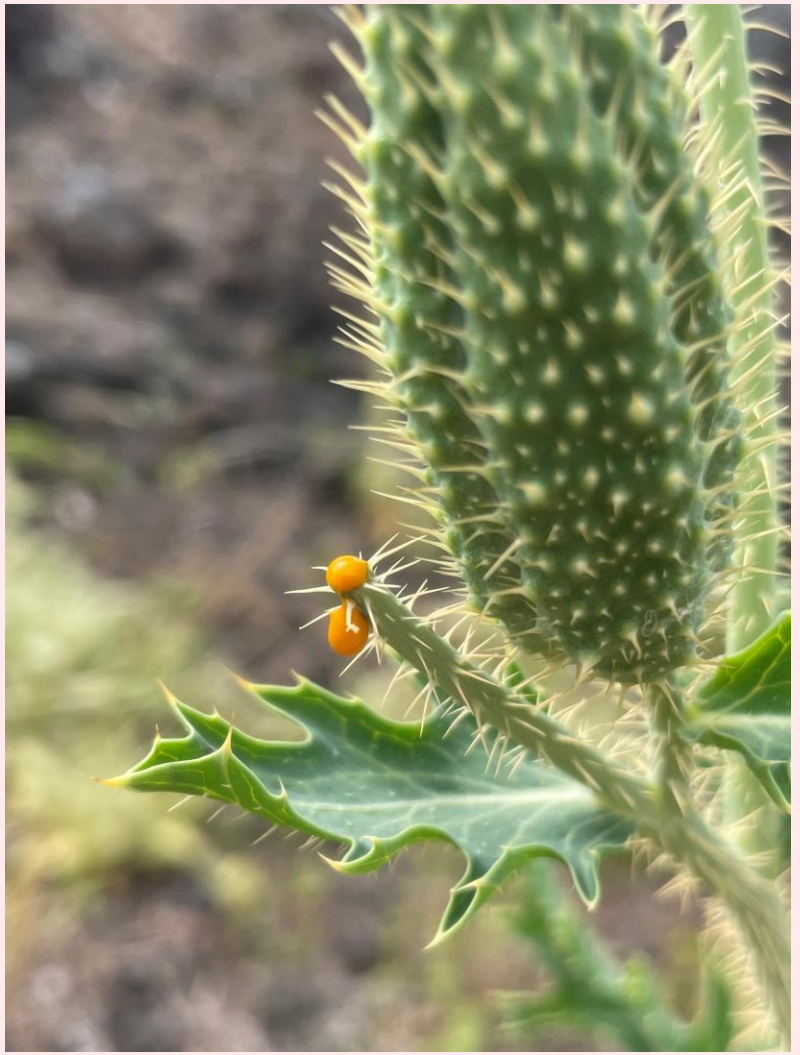
Alternate Hypothesis I:

Alternate Hypothesis II:



A better way – use AL tools (an example)

1. Make an observation about the image
2. Ask a question about your observation
3. Form a hypothesis – **a plausible explanation based on strong rationale**
4. Make a prediction based on hypothesis



A better way – use AL tools (an example)

Observation: There is a yellow substance coming out of the stem

Question: Why is the plant producing this yellow substance?

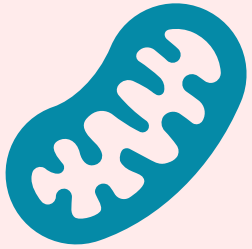
Hypothesis: Some plants produce latex, a secondary chemical in their tissues that help seal or protect injuries from damage or herbivory

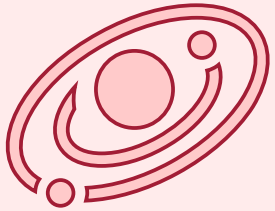
Prediction: A plant that produces latex when damaged is less vulnerable to attack from herbivores, than one that does not produce latex.

Experiment: HOW WOULD YOU TEST THIS?

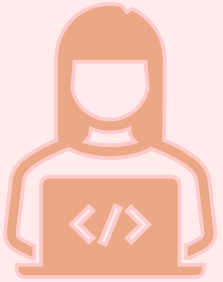
College of Natural Sciences has a lot of labs

Biology



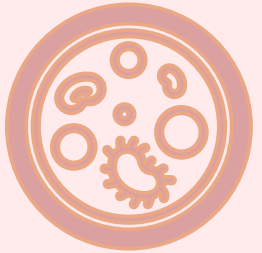


Astronomy



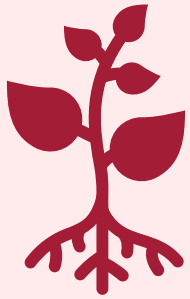
Computer Information, GIS

Chemistry

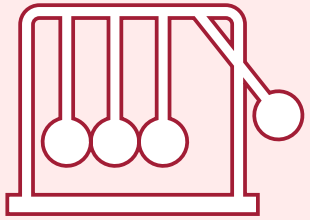


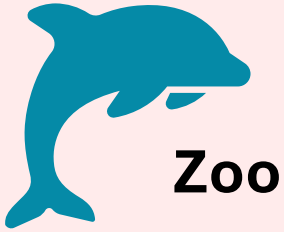
Microbiology

Botany



Physics





Zoology

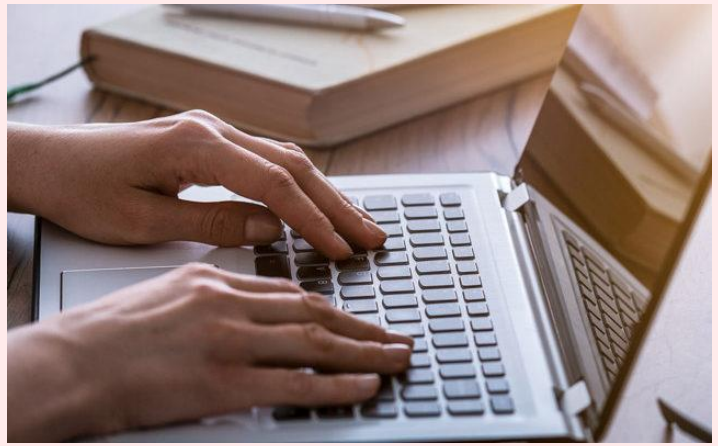
Structure and schedules are similar across sciences

UHM chemistry lab

Structure and schedules are similar

- Labs held weekly
- 2 types of labs
  - **3 hours**, relatively independent from lecture
  - **50 minutes**, closely tied with lecture (3rd lecture meeting that week)
- TA : Student = **1:40** (average)
- Each TA does 1-2 sections, **20-25 students/section**
- Instructions, demonstrations, then work in teams/partners

Duties vary slightly with the lab you teach



TA duties across the board

- Prepare for and lead lab activities
- Grade assignments
- Provide feedback and answer questions
- Give instructors progress on students

The science TA's week at UH Mānoa

Teaching .....6 hours

Lab cleanup or prep .....1 hour

Prep (reading, slide edits, etc.) .....4-5 hours

Meet with IOR .....1 hour

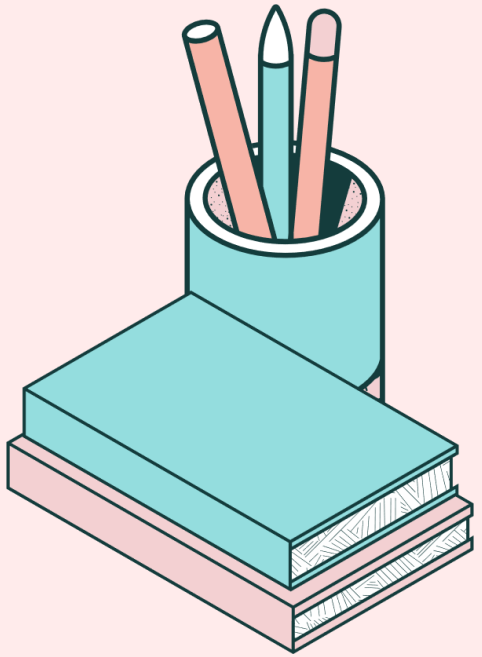
Grading .....5 hours

Office hours .....1-2 hours

Misc. tasks (emails, etc.) .....1 hour

TOTAL ..... ~20 hours

Previous and current TAs give you advice



Topic: Potential bias in grading

We all bring our unconscious bias into the classroom. For example, t's relatively easy to bias your grading: Students that are more vocal or attentive or that you are more familiar with get higher scores. Or your favorite topic gets more attention." – Ana

Mitigate **confirmation bias** by:

- Standardizing grading (rubrics)
- Facilitating discussion when possible
- Check-in during lab activities
- Integrate culturally diverse and relevant examples
- No judgement

Topic: Teaching outside your research expertise

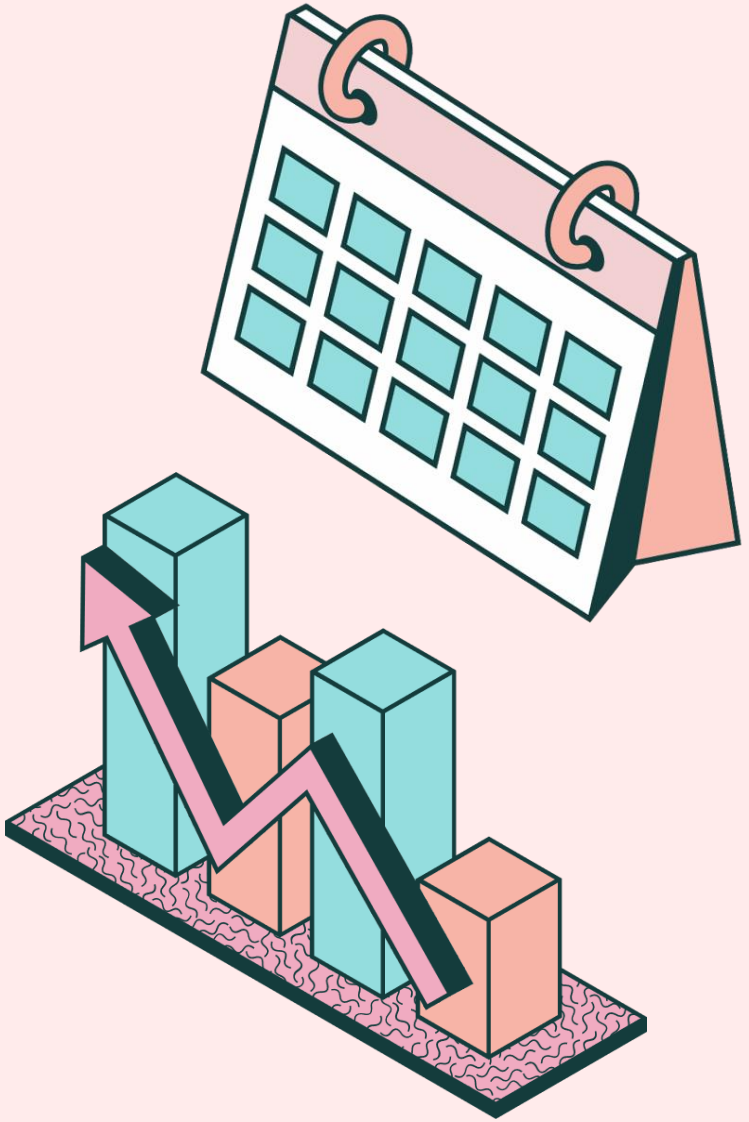
"It is so important to **familiarize yourself with the information first**, by watching videos or reading articles. It can be superficial knowledge at first, so you can feel confident when talking about it.

"When you're not familiar with something, and get a hard question you can't answer, **it's okay to say 'I'm not sure' or 'I don't know',** and let the student know you can look into it. It shows that you care, and gives you the chance to learn something new." – Natalie

Topic: Time management

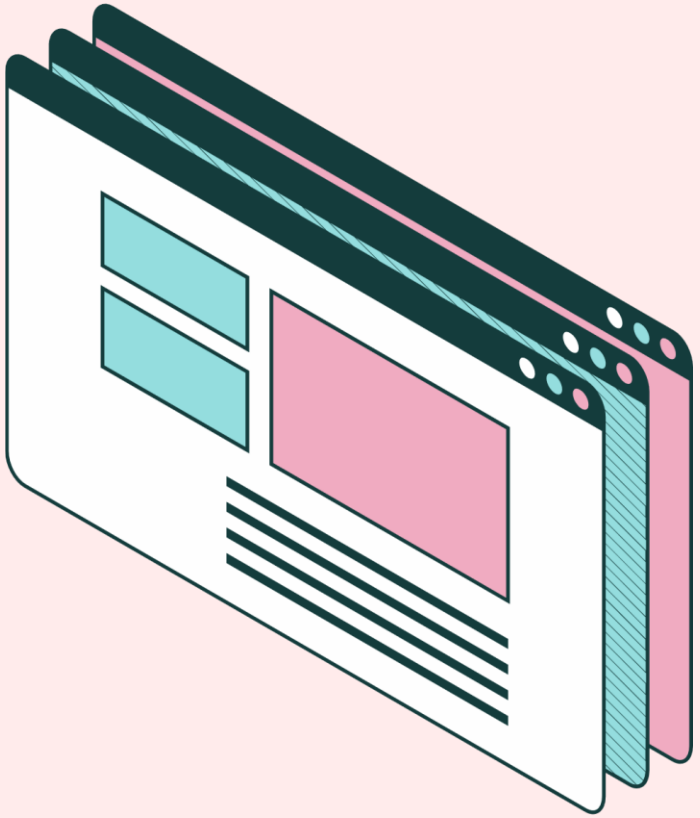
"TAs often give much more than what is required by our position, and that comes at a cost of our own education/research. **I recommend tracking hours.** Nobody will ever ask or give a sh*t, but it has helped me in two ways…

"I get a **better idea of how to divide my time** between grading, doing prep, answering emails. And, **I can estimate my overall workload** over a 2-week [pay] period because it fluctuates weekly." – Brandon

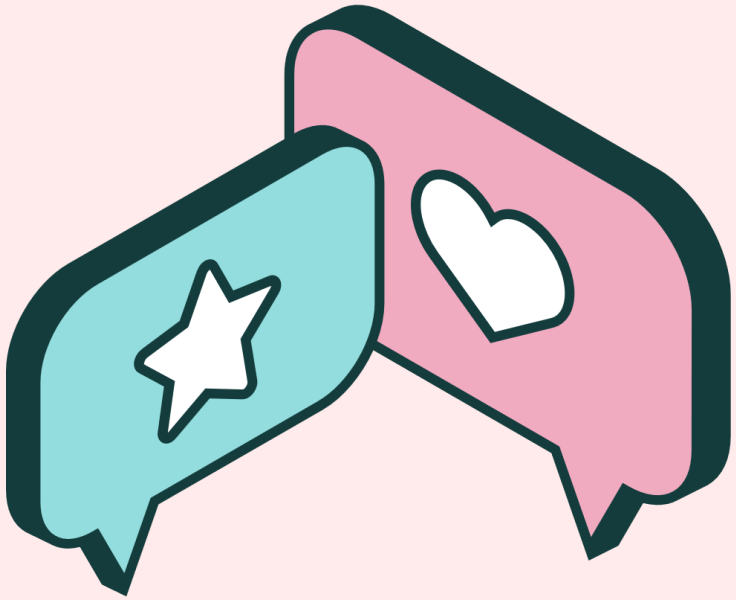


Topic: Preparing lab slides, materials

"You should review and customize and edit the slides you are provided to give before each lab. A lot of times those slides are all text, and that's not a good way to teach the material. **Use figures and images, etc. to make the slides more engaging to keep the student's attention**." – Amanda



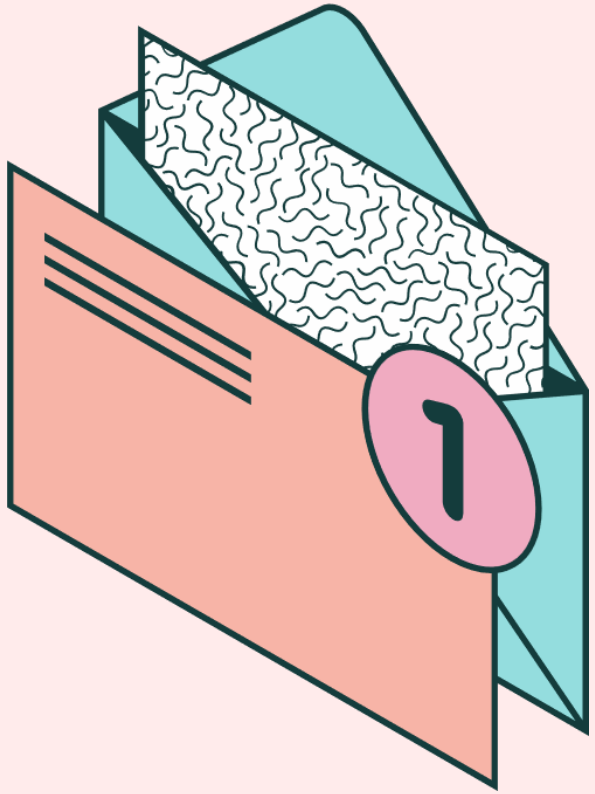
Topic: Helping students do well



"It's **as simple as answering any (reasonable) question they have by email,** or even giving them guidance for an upcoming exam with a study guide or learning game during class. As a TA you can only do so much without overextending yourself, but **making yourself available when you can, I think, means a lot.**" – Natalie

Back to that question you had

Did the workshop address your main question from earlier?



Some parting thoughts

Check your awareness of inequity in science

NEWS&ANALYSIS

SCIENTIFIC COMMUNITY

U.S. Study Shows Unconscious Gender Bias in Academic Science

Most U.S. professors like to think that they are working hard to overcome the persistent gender imba… They certainly d… students," the authors write. They note that it's also the first attempt to directly measure the…

Unconscious Bias in the Classroom: How Cultural Stereotypes Affect Teachers' Assessment of Students' Math Abilities

…ncturk, Ph.D., *Assistant Professor, Teacher Education*, University of Southern …

…n.D., *Associate Professor, Economics and Education Policy*, New York University …ski, Ph.D., *Professor, Mathematics Education; Associate Dean, School of* …ersity Bloomington

…sistant Professor, Educational Psychology, University of Texas at San Antonio

› Mol Biol Cell. 2021 Apr 1;32(7):507-510. doi: 10.1091/mbc.E20-09-0616.

We need to address ableism in science

Raven J Peterson [1]

Affiliations + expand

PMID: 33793322 PMCID: PMC8101468 DOI: 10.1091/mbc.E20-09-0616

Some parting thoughts

Recognize that **modern science is the consequence of exclusionary Western approaches to knowledge**.

The decolonization movement is essential to overcoming these historical constraints for a **just future** in scientific theory and practice.

Trisos et al., 2021

Science decolonization resources

Decolonizing Science Reading List – Medium

Decolonizing science toolkit – Nature

Decolonize science – time to end another imperial era – The Conversation

You got this!

More resources here:
linktr.ee/anaifrs

Email me: flores29@hawaii.edu