

Teaching a Science Laboratory

A short presentation to help you be an
effective teacher at the University of
Hawai'i at Mānoa

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Your role as a TA

- You represent the university
- You are a role model for your students
- “This is a scientist—you can be one too!”
- You offer hand-on-experience; your lesson starts where the lecture ends
- Engage your students, encourage active learning, problem solving, and being prepared

Safety First

- Always wear personal protection--you will discuss this with your class
- NO EXCEPTIONS!!
- Your class is the first exposure students will have to laboratory work and our goal is to instill good habits in the students for their entire career.
- Especially challenging in Hawai'i where students wear board shorts and slippers...

You're the Boss

- Your students look to you as an example of proper behavior.
- Be professional, no inappropriate jokes.
- Don't tolerate harassment of any type.
- Treat all the students with respect.
- If you have a problem student, pull them to the side and talk to them alone. This one-on-one discussion lets them know you have noticed them and often stops the behavior.

Be Professional

- You are an example to all of your students.
- Be early and prepared in class.
- Always wear your own personal protection.
- Command Respect. You are a teacher not their friend.
- Be strict, especially in the beginning. It is much easier to be more lenient at the end of the semester, but if you start in the beginning the students will walk all over you.
- Make sure you understand the lab and the protocol before you start the class. Be prepared to answer off-the-wall and random questions, but never make up an answer. It is ok to say you don't know. I like to show the students where they can look up the information.

Building Fundamental Skills

- Science Labs are the foundation of how we do science.
- Less is more. Don't try to teach them everything, instead reinforce skills, the knowledge will follow!
- Focus on teaching students important skill they will constantly use in school and in research
 - Lab Safety
 - Lab Notebooks
 - Library research
 - What is a hypothesis and the scientific method
 - Scientific theories
 - There is no such thing as bad data (as long as collected properly). In science we often don't find the results we expected.

Building Fundamental Skills

- Focus on what a scientific article is, how it is structured
 - *Introduction*-proper research and putting your experiment in context
 - *Methods*-these must be repeatable...repeatable!
 - *Results*-what did you find?
 - *Discussion*-did the results meet expectations, if not why?
- Remember for some of your students this is the first time they have done an experiment.
- Experienced students? Beware of false security...

Focus on the Principles

- Most science labs are designed to illustrate a fundamental principle.
- Reinforce that we are studying this principle.
- Ask the students how else we might test this principle—find alternative real world examples
- It is important that they know that each lab has a purpose, they are not there to just follow the methods and go home.
- Also, videos can help you engage students

Generate Discussion

- Getting your students to respond to questions is often very challenging.
- Put the topic into modern context. Ask questions about topical issues:
 - for instance: genetics—ask the students to discuss their opinions on GMO. Some topics have no right answer, often these are the best to discuss in class.
e.g., *What is a species??*
What distinguishes weather vs. climate??
- Encourage students to discuss the answers and illustrate their understanding *and* how to arrive at the correct answer

Encourage Participation

- During a lecture include questions along the way. Take a break from the lecture and interact with your students.
 - If you are losing your audience, recognize this—engage them with questions and pull them back in.
- Don't let the same student answer all the questions encourage participation by calling on other students.
- Weekly quizzes can be helpful in encouraging preparedness (can go towards “participation points”)
- Make students write on the board. They don't like this but it is an important way to test their knowledge.
- It is ok to be wrong, this happens all the time in science. You learn better when you make a mistake!

Interact One-on-One

- During the Lab, don't just sit at the back of the room and do your homework
- Leverage this time to go among the groups to ask specific questions of individual people or groups.
- I try to ask questions about trends in the data as the students are collecting it
 - E.g., Photosynthesis: measuring $\Delta p\text{CO}_2$ over time
 - the slope of the line is going up—what does that mean for $p\text{CO}_2$? If CO_2 increases what is happening to O_2 !? What process are we testing?! Net or gross??

Building Good Habits

- Use assignments to build good habits.
- Encourage your students to do their homework early.
- Require complete sentences, and “proper writing”.
 - You aren’t an English and grammar teacher, but help where you can.
 - One-on-one discussions with struggling students can mean a lot!
- When writing ensure the students edit their writing before they turn it in. Give visual, specific examples of how to improve writing, and proper formatting.
- Set standards!
 - no late assignments, period. Don’t even try

Grading and Timely Feedback

- Make sure you grade the homework as soon as possible. You should return homework the next time the class meets. This is how the students learn.
 - BUT beware, spend an appropriate amount of time grading, this is something you must tackle
- At the beginning of class go over any homework problems that the entire class had a problem answering.
- Grade hard. It is easier to assign extra credit, or raise a grade at the end of the semester than trying to explain why all of your students got A's. You can curve up, not down.

Teaching!

- You are there to teach, not to baby sit!
- Some students are slower than others, ensure that you take the time to help all of your students.
- Encourage them to do extra work and reading that will help them understand the concepts and learn.
- Answer e-mails and questions as soon as you can.
- The students will like and respect you if they realize you are there to help them learn.

Be Aware!

- Most students are honest and want to do a good job, but be vigilant for the few that want to cheat the system.
- The biggest problem is plagiarism.
- There are multiple resources on the world wide web to check for plagiarism:
 - <http://smallseotools.com/plagiarism-checker>
 - <http://www.quetext.com/>

GOOD LUCK!