• Please Make a Name Tag
Effective Laboratory Teaching

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Outline

• General Introduction
• Goals of Laboratory Work (brief)
• Characteristics of an Effective TA
• Areas of Effective Laboratory Teaching
Goals of Laboratory Work

• Learning Scientific information and concepts
• Understanding the process of scientific inquiry
• Developing imagination and creativity
• Learning technical skills
• Developing professional values
• Developing social, historical and philosophical perspectives for the discipline
• Application of knowledge and methods
Goals (continued)

• Developing literature skills
• Learning how to communicate
• Learning to work cooperatively
• Developing scientific attitudes
What are the characteristics of an effective TA?
Characteristics (Uno, 1999)

- Displays working knowledge
- Clearly explains how to use equipment
- Explains fire/safety/WHMIS issues
- Clear and appropriate instructions before and during lab
- Is attentive to student needs
- Answer questions
Characteristics (continued)

- Offers encouragement and useful advice
- Gives fair and consistent evaluation on all aspects of work
- Encourages students to become self-learners and to engage in the discipline
The three most important characteristics according to students

• Know their name

• Treat them with respect

• Care about their learning
Knowledge

• Be prepared – variety of methods

• Be organized – E.g. Session Plan
Example - Session Plan

• Learning Objectives (maximum 3)
• Major Points to be covered
• Minor points to be covered
• Audiovisuals or props needed?
• Supplementary handouts needed?
• Comments about session;
  – Follow up questions
  – Corrections for future labs
  – Points for clarification/review
  – Possible quiz/exam/assignment questions
Knowledge

• Prepare students for active learning through the use of questioning skills
Questioning Skills

• Levels of questioning:
  – Knowledge
  – Comprehension
  – Application
  – Analysis
  – Synthesis
  – Evaluation

• Open vs Closed Questions
Example - Questioning Exercise

Yeast are simple unicellular organisms related to mushrooms, molds and mildews. They are called heterotrophs because they do not carry on photosynthesis, but obtain their food from outside source. They are also classified as facultative anaerobes as they can live in environments with (aerobic) or without oxygen (anaerobic). Under aerobic conditions, yeasts use sugar for energy (cellular respiration) to live and produce carbon dioxide and water as by products. Under anaerobic conditions, yeasts carry out fermentation to produce alcohol and carbon dioxide.
Example – Questioning Exercise

• Prepare a prelab talk (maximum 10 minutes)
• Using session plan as a guide, develop three questions that are key to the successful completion of the lab.
  – Try to use questions from different levels
  – Fit questions into talk
  – Practice getting students to answer effectively, including developing a series of questions to “get at the answer.” (video)
  
https://rowan.biology.ualberta.ca/ta_training
Knowledge

• If possible change presentation of labs from cookbook to either guided inquiry or fully investigative
Example – Moving away from cookbook labs

• Make sure objectives are clear
  – Make connections to previous learning
  – Make sure they can see relevance
  – Brainstorm on how results might be used in real world
Example (continued)

• Simplify experiments so students can do a few things **VERY** well.
• Divide repetitive tasks if they are not key components to the learning objectives.
• If demonstrations, get students engaged by having them “walk/talk” through them.
• Look for ways so students can learn to use equipment or do a skill in a more engaging manner.
Example (continued)

• Introduce an element of student planning into an experiment (while still retaining some control).

• Improve exercise in terms of student interaction by providing a discussion or tutorial phase to the lab work.

• Look for extensions of lab activity and how this might relate to real world.
Example - Guided Inquiry

• Specify the question (instructor generated)
• Provide context (background, tools, supplies)
• Solicit hypothesis (homework?)
• Solicit predictions (homework?)
• Solicit experimental design (through consensus) (homework?)
• Set up student groups (if group work)
Guided Inquiry (continued)

- Formalize hypothesis (in-class)
- Formalize predictions (in-class)
- Formalize experimental design (in-class)
- Conduct experiment(s)
- Collect data
- Report results (oral, poster, written report)
Skills

- Must be 100% confident in your knowledge and understanding of the skills necessary to perform the lab, including safety precautions.
Skills (continued)

• Opportunity to do lab in advance (video)
  https://rowan.biology.ualberta.ca/ta_training

• Understand why mastery is essential

• Prepare a flow chart of steps/skills needed
  (see example)
Appendix D – Sample Flowchart

Prepare cells, Steps 1-6

Take 5 aliquots, Steps 7 & 8

Fix 5' on ice, Step 9

Cool on ice 5', Step 8

Wash by centrifugation and resuspension into final 25 µl, Step 10

Add sodium azide, Step 11

Add FITC anti-mouse IgG, Step 12

Keep on ice, Step 13

Warm 15' in a 37°C waterbath, Step 13

Fix with cold fixative 15' on ice, Step 14

Wash twice by pelleting at speed 5 for 3' and resuspending in 1 ml PBS;
Pellet and resuspend in 50 µl PBS, Step 15

Put 10 µl of each suspension on a microscope slide, cover with a coverslip and count 50 fluorescent cells from each slide for staining pattern, Step 16
Skills (continued)

• Think/anticipate through the exercise

• Test proficiency before students leave the lab (exit quiz on knowledge and/or skills)
Conclusion

• Use the dynamic and exciting nature of the laboratory environment to engage students in active learning.
• Learn their names, care about their learning and treat your students with respect.
• Know the objectives of what you are teaching.
• Use methods that are applicable to achieving those objectives in the lab.