

Bringing the Lab into your Lectures

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Biography

Martha Jack has been teaching in the Biology Department at Indiana University of Pennsylvania since 1982; in 1996 she became the director of the General Biology program, a multi-section, two-semester laboratory course for non-science majors. In addition to teaching the lecture and lab portions of General Biology, she teaches Cell Biology and Microbiology. Her previous ABLE mini-workshop was “Student-selected Biology Lab Activities“ (2001).

Introduction

The Document Camera as an Ideal Lecture Tool

Performing demonstrations and bringing fascinating materials into a biology lecture invariably generates an increase in student interest and attentiveness, and these activities can provide a real boost to students' understanding of the concepts under discussion. However, with the increase in class sizes that has occurred at my institution over the past few years, it is now nearly impossible for the entire group to get a clear view of demonstrations performed in the front of the room. Having students pass specimens around the classroom was also becoming less than effective, for two reasons: in large lecture rooms many students will view the item long after the topic has been covered, and passing the items around from student to student and across aisles adds some distraction to the classroom. Another drawback --- regardless of class size --- is that some materials simply should not be circulated among students, for a variety of reasons:

- it is too delicate for so much handling (such as a butterfly with startle coloration, or a fragile fossil);
- it is too valuable and you may not get it back if a student decides to pocket the item;
- it is not recommended for the health or safety of the students (such as blood-typing slides that show antigen/antibody agglutination);
- it is a specimen (such as a dead animal) that would not be well-received by the more squeamish students in the class.

As soon as document cameras were installed in the large lecture rooms, all of the above problems were solved. It is an ideal tool for allowing students to watch a "live" demonstration that is projected onto a large screen for all to see, or to view projected specimens in great detail (the camera has a zoom lens). Some camera models include a back-lighting feature as well, which allows an instructor to place a Kodachrome slide on the base and zoom in so that the image on the small slide is illuminated well and fills the entire (large) screen. Of course, this document camera is so-named because it will project text and photographs onto the screen, which is ideal for those instances when you come across a timely Science News article or the perfect photograph to illustrate a point in your lecture just minutes before your class begins, and you don't have time to scan it into your PowerPoint presentation.

Practical Applications

The document camera can be used in a multitude of ways to enhance your teaching, and the following examples of "bringing the lab into the lecture" are taken from my personal experiences. All can be carried out with very little prep time. The examples are arranged into three categories: sharing specimens or items of interest with the class, providing simple demonstrations, and carrying out mini-experiments during lecture. Activities that carry over from one lecture period to the next (or

several) are especially helpful for generating student interest and hopefully will give some of them an added incentive to attend class more regularly.

Sharing specimens or items of interest

- If you are discussing the fossil record, bring some of your favorite fossil specimens to project to the class. They seem to have much more validity with students who are viewing “the real thing” as opposed to pictures in a textbook. For ecological succession, bring in some samples of lichens and mosses growing on rocks or tree bark. Germinated corn seeds are excellent for showing root hair development. When covering plant pollination, I place a lily under the camera and ask why the pistil is always higher than the stamens by the time the flower is producing pollen. When discussing predator-prey interactions, I have had great success with a stalk of milkweed plant and a Monarch caterpillar that is feeding upon it. Sometimes I merely explain that the milkweed toxin is stored in the tissues of the caterpillar, and remains there through the adult stage of the butterfly, then I follow up with two photographs of a Blue Jay: (1) eating the butterfly and (2) getting sick afterwards. Other times I have maintained the milkweed plant and caterpillar in a small aquarium throughout the metamorphosis process, aiming the camera at it for the start of each class so the students can follow its progress during the various stages.
- Take advantage of serendipitous opportunities to enliven your presentations. The year my husband needed to have an aortic valve replacement, he was given a plastic replica of the valve that had been implanted in his heart. This proved to be a successful prop when I was covering heart anatomy later that month, and it sparked a lively discussion about heart murmurs. Another fortuitous event occurred during the week I was to cover adaptive radiation: my cat frequently captured and killed flying squirrels, and that week he laid a perfectly intact (dead, but not mangled) specimen on the front porch. I promptly bagged it and placed it in the fridge until the day I needed it. Lo and behold, the morning I planned to use it in class, a beautiful (but dead) gray squirrel had been deposited on the porch. What a perfect opportunity to compare the two animals and discuss their adaptations to different niches. The buzz of excitement in class that day spilled over beyond class time as I heard students in the halls talking about those squirrels. (Yes, the flying squirrel was still soft and pliable; I had no trouble stretching out the sides of the body to illustrate why they are able to glide.)
- Start collecting photographs that will add interest and illustration to your lectures. Of course they could be scanned into an organized, wonderfully-prepared PowerPoint presentation, but students can be lulled into a stupor with one slide after another. Breaking in with another format now and then can break up the monotony (as perceived by students) of PowerPoint.

Simple demonstrations

- After attending an ABLE workshop on blackworm circulation (Bohrer, 2005) I was very interested in using the worms for one of our weekly labs, but couldn't fit it into our lab sequence. Instead, I added a demonstration of blackworm pulsations to my lecture on

circulatory systems and the students could clearly see the “pulse rate” of the worm, captured by the document camera.

- Students understand the concept of “good bacteria” growing as normal flora much better after a quick throat culture is performed on a student volunteer. Most students expect bacteria to be present on their skin (which is why I don’t do a skin culture), but they don’t expect the tremendous amount of bacterial growth that results from a throat culture of a healthy individual. Placing a 48-hour throat culture grown on a blood agar plate under the document camera and turning on the back-lighting feature (if available) will surely impress on the students that there is a veritable microbial zoo inhabiting their throats (as there should be). This is a wonderful enhancement to a lecture covering the immune system, or symbiotic relationships.
- An explanation of why the “Y” shape of antibodies is important for causing agglutination can be accomplished effectively by doing a quick blood typing in view of the class. This always rivets their attention, and showing the difference between a smooth suspension of *microscopic* red blood cells versus *macroscopic* clumps of red blood cells drives the point home. No one would pass blood typing slides around the classroom unless synthetic blood was used --- but using real blood (from the instructor’s fingertip) and showing the agglutination on the slide magnified by the document camera makes the results evident and easy for the entire class to interpret at once.
- Hydrophobic / hydrophilic properties figure into many biological topics, and letting students view the natural tendency of oil droplets to coalesce when placed into water and helps them to grasp these concepts. It leads to better understanding of how cell membranes form, and how endocytosis and exocytosis occurs.

Mini-experiments

- The classic geotropism experiment with corn seeds nestled between damp paper towels within a Petri plate can be set up within view of the entire class, and it adds an element of suspense if the students must wait a week before the Petri plate is opened up and the results are viewed. Simply tape the plate shut after placing the corn kernels in four different orientations inside, and clearly mark an arrow on the lid to indicate which end is “up.” Tape the plate (in an upright position) to the inside of a front desk drawer for a week. Before viewing the results, ask the students to predict how the seedlings will be oriented. While the results are displayed on the screen, ask the students to hypothesize how the seeds “know” which way is up or down.
- Using saliva (collected by student volunteers into test tubes) and crushed saltine crackers to illustrate the effect of amylase on starch brings the students into the action. This also puts abstract concepts (catabolism, enzymatic catalysis) into a “real life” application. A few drops of iodine will be added to test for the presence of starch in a series of test tubes: crackers + saliva, crackers + water (control), crackers + saliva + lemon juice (inhibitor). Once the reaction tubes are lined up and held under the camera, the results are clearly

visible: either the starch has been digested, or it has not. (Do a trial run on your own beforehand to be sure you don't overload the substrate concentration.) Students are always engaged during this experiment, and readily come up with explanations for the results.

Once you become familiar with the versatility of a document camera the possibilities are endless!

Camera Model Information

There are several brands of document cameras on the market; my institution has installed two of the models produced by Canon: Canon RE-455 Document Camera, (\$1490.00) and Canon Visualizer RE-450X, (\$1590.00). The latter model is preferred, since it includes the backlighting feature). Both can be found at www.usa.canon.com/consumer/ by using the product search for RE-450X. The camera is tied into a multimedia classroom unit which is typically used to house a PC and monitor for PowerPoint presentations, but includes a VCR and a DVD as well. The images are projected via a ceiling-mounted Mitsubishi XD1000U Projector.

Literature Cited

Bohrer, K. E. 2005. Effects of drugs on pulsation rate of blackworms (*Lumbriculus variegates*). Proceedings of the 27th Workshop/Conference of the Association for Biology Laboratory Education (ABLE), pp. 127-146.