Biology Teaching

As a biology teacher with 28 years of experience, mostly in high school, and as a biology textbook author, I wish to join in the great frog debate: dissection versus frog integrity. My students did some dissection, yet I feel that requiring a student to sue in order to avoid participation is silly. If a student of mine occasionally objected to doing dissection, with or without specifying a reason, I retained my equanimity. The student simply retreated to the back of the room and took up another assignment. More often than not, with the rest of the class happily (and noisily) engaged, the dissenting student would edge forward to see what all the excitement was about. Sometimes the boy or girl would have second thoughts and ask to join in the dissection. When such an activity has to depend on legal sanctions, its educational value is likely to be nil.

Why excitement at frog dissection? The reason is that I used live frogs, never pickled specimens of any kind. Just before class I pithed them—in a preparation room out of the students' sight. Thus the tissues and organs remained fresh and functioning. Excitement was generated by seeing the beating heart alternately flushing and paling. Often an enthralled boy or girl called me over and said in wonder: "Look, it's still beating!" Students marveled at an isolated heart continuing to pulsate in saline, at the intestine slowly writhing in peristalsis, at the gastrocnemius responding to nerve stimulation. These close-ups of glistening, functioning, living tissues generate a perception of life processes not matched by reading a textbook, by computer simulation, by audiovisual media, or by classroom lectures or discussions, however lively.

Yet dissections were not numerous in my course. I depended much more on behavioral studies of living animals, and to a lesser extent on studies of plants and microbes. Before the frog dissection lesson the students were given live frogs to observe in a variety of situations. An even more intriguing animal was the edible Burgundy snail, *Helix aspersa*. As science chairman in a high school on New York City's Lower East Side, with funds for supplies very limited, I had the task of providing 1500 biology students with living materials. But the Italian fish stores on Second Avenue provided snails at $1 a pound (100 snails). With 2 pounds of snails and a few heads of lettuce, the student body had a fascinating lesson.

Frogs and snails, alas, are no longer available. Frogs have become scarce and expensive. *Salmonella* infections have restricted the importation of Burgundy snails, and when they are available they cost far more than a penny apiece. But we should not despair. Resources of living materials are almost unlimited; the limiting factor is teacher ingenuity. If three or four beans are put in a jar of water and incubated overnight, on the next day the culture will be swarming with bacteria. Students seemed never to tire of watching the swarming culture, with spirilla and bacilli vigorously swimming about. Nor did I ever tire of watching the bacteria through the microscope.

These activities were not "experiments," and I did not call them that. We referred to them as "lab exercises." In a large high school class, with limited resources, a rigid time limitation, and a limited student background, it is difficult to do genuine, honest, scientific experiments. Many so-called student experiments are faked or fudged; or the results are determined a priori. The common pressure on students to get the "right answers" also destroys the scientific validity of the "experiments." In the kinds of activities described above there are no "right answers." Any function of an organism or of its organs that a student observed and accurately reported was the right answer.

Are these activities "science"? I think not. They are more in the nature of natural history or "pre-science." For this I offer no apology. James Watson began as a bird watcher. As a boy Charles Darwin collected beetles and birds' eggs. As the Chinese proverb puts it: "Tell me and I hear. Show me and I observe. Involve me and I understand." It is a standard axiom in education, honored more in the quotation than in the observance, that students learn by doing; learning is an active process. I tried to have my students "do," and many of them have gone into science as a profession or vocation.

Robert B. Eckhardt reports that he found his biology course dull (Letters, 18 Mar., p. 1361). Horrors! Living creatures are endlessly fascinating to people and especially to young people. Give students live animals or living tissues to work with and they cannot help but find biology interesting. More than a few of my former students have told me that they were first attracted to biology when they watched and tested the beating heart of a freshly pithed frog.

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Erratum: In Mark Crawford's story "Budget crunch stalls Super Collider" (News & Comment, 1 Apr., p. 17) the caption accompanying the photograph was incorrect. The superconducting magnet pictured was 4.5 meters long, not 17 meters, as stated.