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DOING WITHOUT DISSECTION

by Juliana Texley

What's high school biology without frogs? Plenty, says this school administrator.

"I remember biology," parents often begin at their annual conference with the teacher. "That was when I dissected that terrible-smelling frog." The odor and distaste the dissection experience evokes have been among the most pervasive memories of secondary school science for more than a century. But in the 1990s, environmental consciousness, curricular concerns, and political pressure on schools and school boards have changed biology dramatically. Today, teachers often respond to a reminiscing parent, "But we don't do that any more."

The decline of dissection has not come about quickly. Until fairly recently, biology as a secondary school course had changed relatively little since it was instituted at the turn of the century. A short introduction to the microscopic world preceded a frantic race through complex topics in biochemistry for students who had not studied introductory chemistry. Then followed a review of genetics principles discovered in 1864. The course finished with a long, leisurely stroll through the phyla of plants and animals in the context of their evolutionary development — with dissection as a prime tool.

Neither pressure by Creationists [which temporarily caused removal of the term "evolution" from the textbooks but never excised the evolutionary framework from science teaching] nor innovations by post-sputnik curricular projects managed to change that standard pattern of study. In dissection, health concerns about formaldehyde forced a quick change to new packing solutions for specimens [many resembling anti-freeze] and requirements for wearing safety eyewear. But even an environmental plague of a disease dubbed "red leg", which nearly decimated the already slim population of one species of North American frog [a staple of the biology lab], didn't discourage traditional biology teachers.

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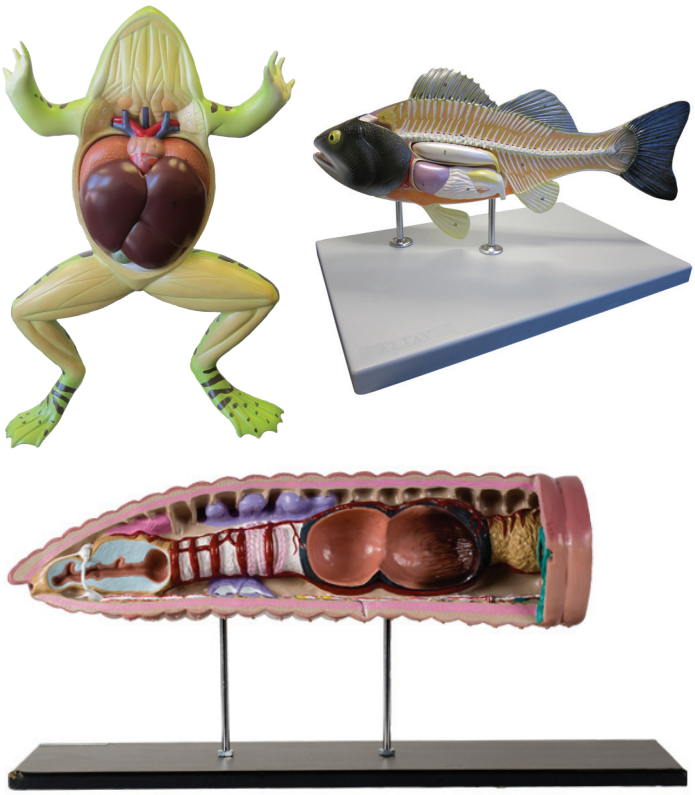
ILL PREPARED TEACHERS

Teacher demographics are partly to blame for this curricular inertia. Until quite recently, many states and school systems required only one science course for high school graduation. That single course was nearly always biology or life science. With science teachers in short supply, many physical education teachers found a life science endorsement within easy reach: All they had to do was take a few zoology classes to add to their health education credits. No other science credential can be obtained by taking courses out of sequence or at random in this way.

Soon, physical education majors who had minors in life science became so commonplace that surveys by the National Science Teachers Association [NSTA] found nonmajors teaching more than half of the life science classes in the United States. Those teachers were far less likely to be prepared in biochemistry, genetics, or microbiology than to have a passing knowledge of zoology. As a result, many biology classes were taught by instructors who were far more comfortable with dissection than with other science activities.

That trend had a marked effect. In the absence of a national curriculum in life science, encyclopedic textbooks became the norm. Less able teachers could select narrative chapters on the animal kingdom and illustrate them by dissection of dead specimens. Groups that led thoughtful challenges to this pattern, such as the Biological Sciences Curriculum Study [a post-sputnik organization that teamed scientists and educators to develop curriculum] seldom had much of an impact on the teaching profession, because of the limited background of so many teachers.



COURT CHALLENGES

What finally forced some changes in traditional biology coursework was pressure from animal rights groups, which supported a series of successful court challenges to dissection during the 1980s.

The first such case arose when Jenifer Graham, a California high school sophomore, refused to dissect a frog but instead offered to substitute college-level research on amphibian behavior. As evidence of her commitment, she demonstrated a personal history of animal rights activism and vegetarianism. After school officials adamantly refused to honor her request, her grade was lowered from an A to a C. Backed by the Humane Society of the United States and other groups, Graham challenged the grade in the state circuit court and ultimately in the state supreme court.

Graham's case became a forum for long-delayed debate on what was appropriate in a required science course. In that debate, the school officials' least effective argument was that the dissection experience was "necessary for college." Surveys and briefs from college faculty failed to establish that any single experience or the content of any single course was necessary for college success.

Graham persisted and ultimately won her point: The California Supreme Court ruled that teachers could require students to dissect only frogs "that had died from natural causes." [The ruling led biologists to conjure images of frantic teachers hovering in swamps waiting for the untimely demise of amphibians.] Two subsequent court challenges in different states have supported the position that student objections to dissection must be considered in designing biology coursework.

Surprisingly the resistance to these changes came slowly. From a profession that has marshaled the forces of Nobel Prize winners, politicians, and even national church groups to defeat legal challenges to the teaching of evolution, the lack of immediate reaction to this new "intrusion" into the curriculum seems incongruous.

AN OUTDATED CURRICULUM

Why have so few objections been raised to legal decisions mandating changes in biology teaching? The answer, from the best-trained and most active teachers, is that the zoology-plus-dissection pattern of the traditional high school biology course has been outdated for at least 50 years. Comparative zoology has accounted for the lion's share of the curriculum we have offered students for almost a century, but it has played a relatively limited role in modern biological research.

In a study of more than 7,000 science teachers, a joint committee of NSTA and the National Association of Biology Teachers determined that the key concepts of modern biology are cell biology, energy use, genetics, evolution, systems, ecology, animal behavior, taxonomy, and the relationship of science to technology and society. [By "taxonomy" the committee means the science of how biologists identify and trace the evolution of organisms, not the Latin names that were developed as a result.] Note that detailed studies of individual animals are conspicuous by their absence from this list.

Educators agree that science should involve hands-on laboratory experience. But the lack of training and preparation that persists among many science teachers means that dissection is often the only hands-on experience they know. And that raises a disturbing spectre: A move away from dissection that leaves students holding nothing but textbooks would be far from an improvement.

THE NEW BIOLOGY

The uneasy status of litigation and curricular change has left school administrators and school boards uncertain; Can schools offer excellent programs in life science without including dissection? Certainly they can.

The consensus, from recent statements from the National Academy of Sciences, the American Association for the Advancement of Science, and the various professional teacher groups, is that the study of biology should be scientific-active, inquiry-oriented, and geared toward preparation for the 21st century. Studies, whether involving dissection or not, must emphasize their relevance to humans and to the environment.

Laboratories in the "new biology" look far more like chemistry labs and will require more complex equipment, facilities, and safety precautions than found in today's biology classrooms. Many of the rooms designed for biology classes in schools built in the 1950s and 1960s will need major renovation to be suitable environments for learning in the 1990s. And so will many of the teachers; training in labs considered standard today, such as genetic engineering and animal behavior, was completely absent from teacher education programs even five years ago.

Another thorny problem for school administrators is establishing curriculum guidelines that will help fend off student court challenges. A California school system's obstinate response to Jenifer Graham's valid objection to dissection cost the school board thousands of dollars in legal fees. Unless a school system confronted with a similar challenge is willing and able to tap the advice of experts in a specific curriculum, the validity of a student's challenge might be difficult to establish.

Although the issue has no simple answers, several guidelines have emerged from the California case and the curricular discussions that have followed. First, curriculum in required coursework should be directed toward what students will need to know as adult citizens in society —not what college students might [or might not] need to know. Potential applicability to undergraduate work seldom justifies a specific classroom activity; activities must be designed with an eye to their effect on the attitudes and thinking patterns of all students, not just the college-bound.

A second, more practical consideration that emerged from the court challenges is that school officials should consider students' histories in weighing the validity of their objections to a specific school experience. Jenifer Graham's history as an animal rights activist and vegetarian was a strong defense, establishing that her refusal to take part in assigned dissection was not a whim or a rebellion against school. Not every student challenged to a class assignment can be backed by such evidence of commitment.

Finally, cases such as Jenifer Graham's underscore the importance of keeping in touch with trends in the profession through national professional groups. Had Graham's teachers been taking part in the growing dissection debate that was going on in professional meetings and journals, the school system would probably have realized it was trying to defend an untenable position. No single administration or board can keep in touch with all the trends, issues, and controversies in secondary curricula. But professional faculty members who have ties to associations, publications, and meetings can follow the trends in their own subject fields.

In today's life science classes, dissection hasn't become extinct but its role is far smaller than it used to be. Teachers who have chosen to retain selected dissection activities illustrate more advanced ideas. And they are providing alternative activities for students who find dissection unpleasant or unnerving.

The odor of preservatives has not disappeared from life science classrooms, but it is far less pervasive in a curriculum that is looking forward to the next century. When today's students become parents, they will come to parent-teacher conferences with more exciting memories of lively life science.

DISSECTION QUIZ

1 How many animals are killed in dissection classes each year?

a. 150,000 b. 500,000 c. over 2,000,000

2 How many turtles are caught from the wild each month to replace breeding stock on turtle farms (where dissection supply companies get their supply)?

a. 500 b. 10,000 c 100,000

3 What percentage of frogs used for dissection are wild-caught?

a. 100% b. 15% c. 70%

4 It was recently discovered that cats for dissection were being bought from Mexican children. How much did each cat cost biological suppliers?

a. S4.50 b. S1.00 c. $15.00

5 The period from the mid — 1950's to the early 1970's found the U.S. focused on science education because of the space race. During this time frog dissection became the popular method to teach vertebrate anatomy. How much did the U.S. frog population drop during the years 1956 —1971?

a. 85% b. 50% c. 15%

6 What is the species of turtle most often used by the biological supply industry?

a. snapping turtle b. box turtle c. red eared slider

7 Turtles have to be wild caught because the market price for them is so low that is economically unfeasible to raise them. What is the wholesale price of a turtle used for dissection?

a. $1.00 — S2.00 b. S5.00 — S7.00 c. S3.00 — S5.00

8 Cats and dogs used in the dissection industry often come from business people who have been accused of stealing pets. What is the title of these people?

a. Bunchers b. B Rated Dealers c. Class B Dealers

9 How many alternatives to dissection are presently available?

a. 300 — 500 b. 30 — 50 c. 100 — 200

10 Where do the majority of turtles used for dissection in the U.S. come from?

a. Louisiana b. California c. Maine

ANSWERS: 1c 2b 3a 4b 5b 6c 7c 8c 9a 10a

WHAT IS THE FUTURE OF LIFE SCIENCE?

It is rare when a profession can come together to establish high standards for itself through consensus. The new National Science Standards [published by the National Science Research Council in 1995] represent just such an effort. They define a great vision of what science classrooms should be like in the next century.

The Standards' vision for life science will require real changes in mindsets. They emphasize inquiry in six areas of content:

- cell biology
- molecular genetics
- evolution
- biochemistry
- environmental science
- animal behavior

Veteran biology teachers have been shocked by the list—not at what is there, but at what is missing. Gone are the long weeks of study of comparative invertebrate and vertebrate anatomy! Where will the dissections fit?

The Standards ask that teachers help their students inquire and construct strong ideas about science process and content. They ask that exploration occur every day, in an open environment. There is no clear statement about the traditional experiences of dissection. But it is easy to infer that old style dissections, performed as they were in average classrooms, simply don't make it as Standards-based science.

Over the past century, there have certainly been many high school classrooms where exciting, high-level studies of anatomy have occurred through dissection. There are many master teachers who encourage advanced students to consider evolutionary adaptations, intraspecies variation, evidences of niche through digestive studies, and studies of pathology through examination of specimens. But in most secondary biology classrooms, the experience of cutting open a sacrificed specimen has been any-thing but intellectual!

Pull the specimen from the bucket. Make the appropriate sounds of disgust. Assume the proper gender role [girls wither, boys act aggressive]. Then quickly open the specimen and label the parts on a ditto. Get the desk cleaned up before the bell rings...

In classrooms where life science is moving toward more inquiry, the issue is not the subject of the lab but how the lab is structured and accomplished. Students are encouraged to generate and explore questions — not to simply memorize answers. That's why many teachers have abandoned dissection.

Meanwhile, in their journey toward the Standards, high school biology teachers have had to adjust to thoughtful abandonment of many treasured units. "Less is more" is not just a cliche! It is the reality if you want to spend significantly more time on difficult topics such as molecular genetics or photosynthesis. And there is one major content area that is totally new to many teachers — the behavior of live, healthy organisms!

Behavior is an area of intense fascination to most students. From the simple tropisms of plants to the complex vestigial patterns of the family pet, the science of behavior is a great subject of inquiry for high schools. But maintaining the cultures and learning the techniques to quantify observations will all require time — time taken from traditional assignments like dissection.

Teachers must also resist the natural adolescent impulse to "experiment on" organisms. Behavioral studies involve appreciation of the natural activities of organisms in as close to native settings as possible, not their reactions to stress. Students who have grown to associate scientific investigations with the traditional controlled experiment often expect to "do something to something and see what happens." Behavioral studies encourage observation and appreciation.

For teachers moving toward the Science Standards in the 21st Century, there simply isn't time for traditional dissection routine.

The old-fashioned experiences were just too memory-oriented and did not allow students to explore and construct big ideas about science. They encouraged the impression that science was just a bunch of facts — labels on diagrams — that needed to be stored and repeated on tests.

When I meet students from the 70s and ask them to reminisce about my biology class, they often describe a dissection. What a memory! My students from the 80s and later usually describe their independent investigations which were sustained over many weeks. I am much prouder of the latter —experiences that are much closer to my vision of what I hoped to accomplish then and in the future. Tomorrow's students will have far more excitement and more memories of exciting inquiry to take with them from biology classrooms.

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