Biology Today

Loving Biology—It's About Time

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It's a good idea for a teacher to be a student. Of course, all teachers are students in the sense that they are always learning something new about their field. But I'm referring to being a real student—going to class, taking notes, sitting at a small desk while someone else stands in front of the blackboard. This is probably the best way to improve a teacher's teaching, not because of the subject matter presented, but because of the effects of role reversal.

As you can probably guess, I am still going to school. After years of procrastination, I'm working toward a Ph.D. in science education. I now think like a teacher during the day and like a student in the evening. I complain about "ambiguous" questions on exams, take furtive glances at my watch to see how close we are to being "released" and worry about how my final grade will be calculated.

It is amazing how rapid and complete this transformation can be—at 2 p.m. I can be firmly stating that an exam will not be postponed; at 5 p.m. I can be asking for just such a postponement from my professor. While I try to look at the situation objectively and think as a teacher while I'm a student, it just doesn't work; the roles are too different.

Going back to school has also made me more tolerant of my teachers. In my college days, sitting in the cafeteria critiquing a professor's dress, speech patterns and grasp of the subject was a favorite indoor sport. Now I can appreciate what it takes to hold a class's interest for two hours, what ability is involved in conducting a lively discussion and how difficult it is to make abstract concepts come alive for students.

I am also more tolerant when things don't go well—when the projector doesn't work or when the lecture is tedious. As a born-again student, I am fully aware that tedious classes are unavoidable. Though I'm more than willing to blame the professor for being boring, I now have enough perspective to see that, just as beauty can be in the eye of the beholder, boringness can be in the mind of the listener. We all find some topics more interesting than others.

This problem points up a basic asymmetry that often exists between teacher and student: the teacher loves the subject and the student may not. Just as two people who are in love enjoy being together as much as possible, teachers love to think about, talk about, teach about their chosen subject.

But just as I can't understand what my cousin sees in her husband (I certainly don't love him!), students may find it hard to fathom what we find so exciting about biology. This is a serious problem that warrants careful attention. This "love gap" between teacher and student is an abyss, an abyss so deep it can't be filled. We cannot expect to make all our students love our subject, but perhaps we should teach as if that were our goal. We may not be able to fill the abyss, but we may be able to bridge it, to allow our students some access to our object of love.

A first step in this direction is to allow our love to show through, to not be afraid to show our enthusiasm for our subject. I took a course in research methods with a professor who reveled in the mechanics of writing a dissertation. Footnotes were endlessly fascinating to him. He could go on for hours about the intricacies of bibliographic citations. As far as I'm concerned, the thought of teaching such a course is about as exciting as a coma. I will never love "idem" and "op. cit.," but I looked forward to that class every week, and I remember and use what I was taught there because the professor enjoyed what he was doing and wasn't afraid to make that obvious.

An editorial in *Nature* some time ago made the point that science teachers seem less willing than other teachers to show their enthusiasm, perhaps because it would make their subject seem less serious and important. This reticence contributes to students' negative attitude toward science ("Understanding Begins at Home" 1985). Cyril Stanley Smith (1981) also believes the joy that scientists and science teachers experience in their subject is "invisible to a student" (p. 234). Ronald Hoffmann (1987), a Nobel prize winner in chemistry, poses a question that could be asked of biology as well as chemistry: "Can we really expect young people to enter our profession given the authoritarian, dulling nature of many introductory courses?" (p. 418). He says we have to talk about what lures us to science if we expect people to appreciate it.

As far as inducing our students to appreciate biology, we may have an advantage that those teaching the other sciences don't have. According to Edward O. Wilson (1984), humans have an innate attraction to other living things. He calls this biophilia,

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"the innate tendency to focus on life and life-like processes" (p. 1). It is the "urge to affiliate with other forms of life" (p. 85).

Wilson is one of the major proponents of sociobiology. He has been critiqued for his over-enthusiasm in attributing a genetic basis to many aspects of human behavior, and he uses biophilia as an example of such behavior. But while he doesn't have a great deal of evidence to support his hypothesis, it is hardly unsubstantiated. He cites the work of Gordon Orians (1980) and Yi-Fu Tuan (1974) in indicating that humans have an innate attraction to a savanna-like environment, probably because the species had its origins in such a habitat. He says that people "are responding to a deep genetic memory of mankind's optimal environment . . . [when,] confined to crowded cities or featureless land, they go to considerable lengths to create an intermediate terrain, something that can tentatively be called the savabba gestalt" (p. 111). Frederick Turner (1988) sees the "passionate zeal" of those working to restore prairie lands as an indication of a deep urge to expunge "ecological guilt" for destroying lands we are so attracted to aesthetically (p. 54).

Joseph Wood Krutch (1929) also thought our attraction to the beauty of nature is inborn. He saw it as a relationship with other living things. He argued that this shared life made us more responsive to the beauty of organisms than to the beauty of the inorganic world. More recently, Alexander Skutch (1985), a botanist and naturalist, has taken a similar view. He sees an aesthetic sense existing in animals which allows them to appreciate their own existence and their participation in the life of the earth. Humans also have this sense, but in a more fully developed form: "We seem made to contemplate beauty; in the natural world we see it everywhere, from the creatures that, through a microscope, we watch swimming in a drop of water to the most stately trees" (p. 140). He says that "we seem to have been created to enjoy beauty" (p. 145).

Both Wilson (1984) and Skutch (1985) see this innate aesthetic attraction to natural beauty as adaptive; that's why it has become such an integral part of human nature. Skutch explains how a sense of beauty could be important to animal survival:

> If blue sky and green land were as depressing to an animal as certain drab colors can be to us, its vital processes and its will to live might be adversely affected, so that in the struggle for existence it would be less successful than some related animal who, instead of being depressed was pleasantly excited by these colors. (p. 147)

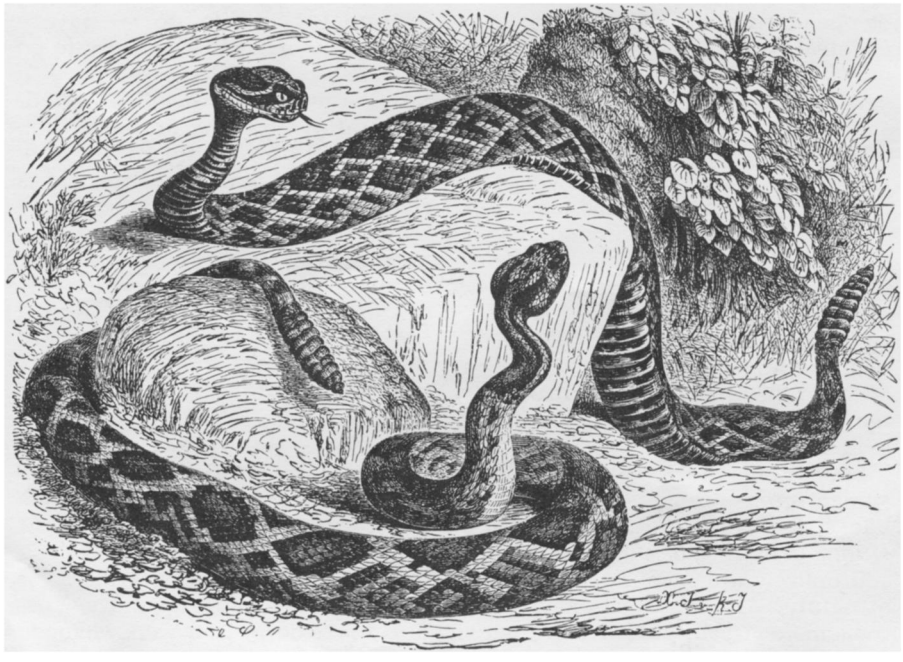
Wilson calls the "naturalist's trance" adaptive (p. 101). The human response to snakes—a mixture of horror and fascination—is an example of this type of trance. The response reveals "the complexity of our relation to nature and the fascination and beauty inherent in all forms of organisms. Even the deadliest and most repugnant creatures bring an endowment of magic to the human mind" (p. 84). For early humans a vivid response to nature was important, he says, because

> snakes mattered. The smell of water, the hum of a bee, the directional bend of a plant stalk mattered. . . . The glimpse of one small animal hidden in the grass could make the difference between eating and going hungry in the evening. And a sweet sense of horror, the shivery fascination with monsters and creeping forms that so delights us today even in the sterile hearts of the cities, could see you through to the next morning. (p. 101)

Other observers do not see the human response to nature's beauty as genetically determined. They see it as a product of culture. David R. Wallace (1986) says that because of its particular culture, "Japan has perhaps come closer than any other nation to making nature the center of its aesthetic" (p. 79). In the United States, however, only some forms of natural beauty are appreciated. In this country, Wallace says, flatlands are not considered beautiful. But this prejudice can hardly have a genetic basis since a hundred years ago, before urbanization, such a prejudice did not exist. But while Skutch and Wilson's view may be overly idealistic, it seems to be a useful idea for biology teachers to keep in mind. Any natural tendency toward a love of nature and nature's beauty should be nurtured fully rather than ignored. While this is hardly the only solution to the problems of biology education, it is definitely an avenue worth exploring.

But love of living things, like any kind of love, cannot be forced. There must be time and opportunity for it to develop. The more I think about it, the more I realize that, in terms of teaching resources, the one that is in shortest supply is not laboratory equipment or audio-visual materials, but time. I'm reading a book by Bob Samples (1976) in which he writes that our culture is ruled by the concept of linear time—time cut up into little pieces and apportioned for various activities, time as a progression leading somewhere. The opposite view of time—as a cycle, as rhythmic and constantly returning—is less important in our culture. Thus we see time as something to spend, to use up. George Lakoff and Mark Johnson (1980) argue that the metaphor "time is money" illustrates the value we put on time and indicates our attitude toward it. Time is a commodity that shouldn't be wasted; we should get the most for our money by packing as much as possible into a period of time.

I live in New York City, the time-is-



money capital of the world, so this observation makes sense to me, but Americans in general seem to take this approach to time. A trip to almost any foreign country, however, will show that this attitude is far from universal. My parents were from Ireland, and on several visits "home" we stayed with relatives who couldn't understand why we were rushing around. To them time was cyclical; if the job wasn't finished today, the dawn would be returning soon to signal a new day. If dinner wasn't ready "on time," so what? The hour hand on the clock would return to its upright position soon and we'd have a whole new hour to work with.

But most of us are teaching in a culture with a far less luxurious attitude toward time. Yes, lab time will roll around again soon, but another exercise is scheduled. There is not enough time for the last lab to be rerun, rehashed, or reconsidered—no matter how valuable the experience might be. Most teachers must follow syllabi that are overloaded, to say the least. And if we feel pressed, it is inevitable that our students will also feel the pressure. These are hardly ideal conditions for the development of a love affair.

One of my favorite quotes from science education literature is from Arnold Arons (1983):

> I think it is essential to back off, to slow up, cover less, and give students a chance to follow and absorb the development of a small number of major scientific ideas, at a volume and pace that make their knowledge operative rather than declarative. (p. 97)

By declarative knowledge Arons means "knowing facts," while operative knowledge involves "understanding the source of such declarative knowledge."

He argues "there is increasing evidence that our secondary schools and colleges are not doing a very good job of cultivating operative knowledge" (p. 94). "Cultivating" is a good word to use here; it illustrates my point. Cultivation can be defined as the fostering of growth—in this case the growth of a love and understanding of living things. Any cultivation, any growth, is a slow process and cannot be rushed. Arons' argument is persuasive, but it has yet to affect policy makers who could mandate syllabus changes.

Students need time. They need time to think, to absorb the information we pour over them, to develop operative knowledge. They also need time in the laboratory to savor the biological materials they work with. Love is a pleasurable experience; it involves enjoyment of the object of love. It is unlikely to develop when there is no time for enjoyment, when students are pressured to do the required exercises, record the results and clean up. In the lab, time may not literally be money, but it is still treated as a commodity in short supply. Love involves an intimacy that is inhibited under such conditions.

Perhaps it is not a coincidence that the naturalists who have made the most careful observations and who have given us the most luminous accounts of those observations are people who could see time as rhythmic rather than linear, who were not concerned with the constant ticking of the clock.

Yet, such intimacy is an essential part of the process of science. If students are to have any feel for science in general, let alone for biology, they should have ample opportunities for such experiences because, as Michael Polanyi (1962) has said, "a detached manner of observing life would dissolve altogether our knowledge of life" (p. 373). Robert Root-Bernstein (1988) agrees: "A scientist is wise to know intimately, even to identify with, the things or creatures he studies" (p. 33). The reward for such internalization is intuition, or what Stephen Jay Gould (1987) calls an "integrative insight" (p. 165). Jacob Bronowski (1978) has said that it is this personal engagement in the object of study that separates the scientist from the technician. Devoting several laboratory periods to studying the same organism, stressing the need for close observation, or just giving students time to "get to know" some specimen are all ways to encourage such personal engagement. Even if the syllabus doesn't allow for much intimacy with the things of nature, just being aware of the problem should make us more open to those opportunities which are available.

Besides time restraints that inhibit a student's romance with biology, textbooks don't help much either. The writing in most texts is dry, fact-laden and unlikely to inspire awe or a love of nature. Although texts have become more visually attractive over the years and diagrams have become more frequent, clearer and more illuminating, the written word is still what students must study for exams, and this prose is enough to quench any but the most raging fires of interest. The best writing on living things, the writing most likely to fan the fires of ardor for nature, is that done by naturalists. According to David R. Wallace (1986), himself a gifted observer of nature, naturalists create "appreciative responses to a scientific view of nature" (p. 112). He says that naturalists, and especially nature writers, are a special breed who can translate information into feelings and visions. His description of "A Dunk in the Eel" River is one such translation:

> Being attacked by a school of minnows is a curious experience. It tickles, which can be enjoyable or annoying according to one's mood. Like all expert ticklers, minnows go for the toes, although I don't suppose they intend to inflict torment; and they nibble at other exposed parts of the body as well. The bites of even the largest—three or four inches long—don't even begin to break the skin. Apparently, what the minnows are after is the film of dead cells that constantly sloughs off the human epidermis. (p. 59)

Wallace's combination of vivid imagery and information makes the reader want to experience nature in a personal way. It emphasizes the affinity with other living things that Wilson and Skutch stress. But such acute observation requires time. Someone taking a quick dip in the Eel River would never have an experience like the one Wallace describes. You have to be willing to lazily float around for awhile, to let nature happen to you, rather than try to go after nature. And then you have to take the time to translate that experience into words. According to Bob Samples (1976), poetry comes from the part of the mind that sees time as rhythmic and cyclical, not the part—so well-developed in our culture—that looks at time as linear. Poetry, beautiful imagery, cannot be rushed.

And so we are back to the issue of time. Perhaps it is not a coincidence that the naturalists who have made the most careful observations and who have given us the most luminous accounts of those observations are people who could see time as rhythmic rather than linear, who were not concerned with the constant ticking of the clock. They were willing to make the necessary sacrifices for love, perhaps because their love of nature was so deep. They were willing to

go against the tide of culture and view time as something to be experienced rather than spent. In *The Outermost House,* Henry Beston (1928) chronicled a year spent in a bungalow on a Cape Cod beach. Using telling imagery, he provides a great deal of information on flora, fauna and weather conditions, as well as vivid impressions of his experiences with nature. Beston devoted a year to this project. He took time off from his job in New York as a magazine editor and spent it in the presence of nature, the object of his love. Thoreau (1962) isolated himself at Walden Pond, and Gilbert White (1949), one of the first nature writers, settled at Selborne and led a quiet life observing nature.

In an introduction to White's *The Natural History of Selborne,* R.M. Lockley (1949) says that White "seems to find beauty everywhere, but especially in those objects nearest to him. He loved the Sussex Downs. He thought he saw new beauties every time he traversed them. These downs and the neighboring forest wastes were the limit of his wanderings." He did not need more to satisfy his love of nature. Present-day naturalists may be principally writers, like Wallace (1986), or researchers, like Bernard Heinrich (1984) and Jane Goodall (1971), but they, and many others, have all made love of nature their life's work. They have structured their work so they can spend many hours in the field, oftentimes alone, observing the organisms they are studying.

Niko Tinbergen (1958) says that he finds "studying the behavior of animals in their natural surroundings fascinating. It allows one to live out of doors and in beautiful scenery; it gives free scope to one's urge to observe and to reflect, and it leads to discoveries . . . [which] cause intense delight" (p. 285). "Free scope" means that there is ample time to observe animals at their own pace. There is also time "to reflect," to allow the mind to work on what is observed. Thus, linear time loses its meaning. Human time is replaced by the more cyclical animal time.

Such a change in time perception allows an opportunity for the "intense delight" of discovery. June Goodfield (1981) likens such a moment of discovery to the moment of fulfillment in a human relationship; it is a moment of love. In fact, Michael Polanyi (1962) argues that at all levels of biological investigation, researchers are sustained in their work by a love for the organisms they are studying.

Which brings us back to biophilia. Wilson (1984) contends that "to the extent that each person can feel like a naturalist, the old excitement of the untrammeled world will be regained" (p. 139). He sees the widespread development of such feeling as the starting point for a deep conservation ethic; appreciation will lead to concern. If people were given the opportunity—and time—to explore the "mysterious and little known organisms which live within walking distance of where you sit" (p. 139), their innate reverence for life would develop into a feeling of stewardship for living things.

Such a desire to "affiliate with other organisms" will lead to a desire to know more about them, and "as biological knowledge grows the ethic will shift fundamentally so that everywhere, for reasons that have to do with the very fiber of the brain, the fauna and flora of a country will be thought part of the national heritage" (p. 154). Skutch (1985) argues that if we followed our innate tendencies, we would view the earth not as a farm to be exploited but as a garden "that is cherished, not because it yields food or wealth, but because it uplifts the spirit with its loveliness" (p. 25).

Wilson and Skutch are obviously idealistic, but there is no better place to try out these ideas than in a biology course. Last spring, I told my class to observe the changes in nature at that time of year and write an essay about them. Some of the essays were beautiful. In one, a student described spending time watching a spider build a web at the bottom of a flower pot. She became fascinated with this creature as she took time to observe its work, to be with this organism. I'm not sure that such an experience will make her a conservationist, but I do think it made her a little more sensitive to the organisms she could find "within walking distance." I think it made her feel a little more positive about biology. Perhaps she could appreciate a bit more why I love the subject.

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