ern Europe, human rights, emigration policy, Grenada, Nicaragua, Viet Nam, the black urban ghettos, the 23 million without access to health care in the United States, and so forth.

But as individuals, we have brought up the critical issues of human rights in the U.S.S.R., we have placed our support behind Amnesty International, and we have organized Physicians for Human Rights. Those of us who are vigorous supporters of Amnesty International do not ask that it concern itself with the threat of nuclear war. Planned Parenthood is not expected to devote its resources to the struggle against toxic waste. The Sierra Club and Friends of the Earth take no formal position on freedom of reproductive choice. The success of these organizations depends on the sharpness of their focus on a single problem.

IPPNW received the Nobel Peace Prize in 1985 because it concentrated an enormous amount of energy on the international educational project to which it was devoted: the consequences of nuclear weapons and nuclear war. To predicate our dialogue with physicians on the approval of the internal practices of each nation in which they live would have been an exercise of paralyzing futility and an all-consuming diversion from our original goal. We agreed fully with Sakharov's statement in 1980 that "the questions of war and peace and disarmament are so crucial that they must be given absolute priority, even in the most difficult circumstances."

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Response: I see no conflict between my statement and that of Abrams. As he says, the IPPNW gives absolute priority to war and peace issues.—CONSTANCE HOLDEN

Animal Rights

Which makes a more effective entrée into high school science: a lively computer or a dead frog? From his recent (29 Jan., p. 449) editorial "*Homo photosyntheticus,*" it seems that Daniel E. Koshland, Jr., would jump for the frog, but I think that some students would plug for the computer. Aristotle is dragged into the dispute—on the side of computers—because he supposedly "emphasized deductions about science at the cerebral level, devoid of the unpleasantness of actual experiments." A more apposite view of Aristotle's brand of science was given by Peter Medawar (*1*), who characterized Aristotelian experiments as demonstrative: intended to illustrate a preconceived truth and thereby to convince people of its validity.

Perhaps the situation has changed since I endured high school biology, where experiments, when attempted at all, were in the Aristotelian mode. Even this dubious objective often was not attained. My skepticism toward the frog dissection test as a gauge of the adequacy of scientific education traces back to a still-vivid recollection from my high school course. One entire wall of the classroom was covered with glass-fronted cabinets filled with specimen jars. Each jar contained several gallons of pickled animals. I recall with certainty only crayfish and frogs, apparently embalmed at some point in antiquity. After several months it became evident that the specimens were not incorporated into the curriculum as other than props, intended to lend to the classroom a tone analogous to that achieved in executive offices that are lined with books purchased by the yard for their elegant bindings. Nevertheless, during the course of a very dull year several students, less resigned than I, finally shamed the biology teacher into agreeing to dissect a frog. The "experiment" succeeded, after a fashion; we could see that there was stuff inside the frog, but it soon became painfully clear that the teacher was unable to identify a single internal organ. End of demonstration. The rest of the frogs remained inviolate throughout the school year—and possibly to this day.

My point is that dissecting frogs is not inherently a good thing; there must be some scientific end toward which our experiments are directed. Sometimes the objectives will require that animals be used. But in other instances better alternatives may become available. To mention another of Koshland's concerns, some testing of chemicals for carcinogenicity or teratogenicity can now be accomplished with microorganisms (as in the Ames test). Animal testing will remain necessary before new drugs are approved, but rational people in a free society should ask about the relative costs and benefits of the real pain that experimental animals sometimes experience: how much suffering is warranted by a scientific breakthrough that would deliver to humanity a new shade of eyeshadow from a hitherto-unexplored range of the blue-green spectrum?

To return to introductory biology, Koshland is correct that dissection of a frog might deliver a moral shock to the young student who finds that its stomach contains flies and other insects rather than soda and potato chips. But the realities of predatory behavior can be taught far more vividly by a live frog in a terrarium; and caring for such a system would also demonstrate a host of other phenomena, including locomotion and communication—not to mention the challenge of maintaining life under artificial conditions. Elementary comparative anatomy (using fish, frogs, and other available species) could establish a basis for inferences about evolutionary relationships. However, any attempt to introduce evolutionary biology as an organizing principle for a high school curriculum—at a time when literal-minded creationism and "New Age" metaphysics vie for parental and student attention—is likely to require far more fortitude than the mere demonstration that amphibians have indoor plumbing.

For the training of future scientists and a public that must understand their research, the point is not what we can learn about the insides of a frog. Instead we must inquire what exposing the interior of a frog, or performing any other pedagogical exercise, can tell us about the nature of scientific inference. At least some students may have their attention engaged far more effectively by Richard Dawkins' WATCHMAKER program that generates variant biomorphs or by A. K. Dewdney's set of algorithms that explore hypothetical spikophyte-bendosaurus coevolution (*2*). Some science teachers might believe that serious student dissection of real biological specimens is preferable to computer simulation of the evolutionary process; yet others would see at least as much pedagogic value in the dynamic interaction made possible by the computer. But wouldn't all responsible scientists agree that the realm of experimentation, which includes both comparative anatomy and computer modeling, is superior to the world of unexamined speculation that is the common currency of the popular culture around us?

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REFERENCES AND NOTES

1. P. Medawar, *Pluto's Republic* (Oxford Univ. Press, New York, 1982).
2. Both are described by A. K. Dewdney [*Sci. Am.* **258**, 128 (February 1988)].

The vegetarian student discussed in "Apples, frogs, and animal rights" (News & Comment, 4 Dec., p. 1345) says that her beliefs against vivisection are equivalent to a religion and that her school violated her First Amendment rights by requiring her to dissect a frog (*1*). I agree: antivivisectionism is a religion. It is a fervently held coherent belief system, based on a creed about the relative position of humans and other creatures, and generating a strict code of behav-