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Until recently, one of the most expected and accepted experiences among students in biology classrooms of the United States has been the dissection of vertebrate animals, from frogs and mice to cats and fetal pigs. Indeed, it has been said that "the odor and distaste the dissection experience evokes have been among the most pervasive memories of secondary school science for more than a century" (Texley, 1992). It was reported in 1988 (Orlans) that 75-80% of the country's biology students dissect frogs.

Resistance to animal dissection grew during the past decade, however, with many objections being raised. Ever since the California Supreme Court supported the refusal of a student to dissect a frog in a high school biology class in 1987 (Holden, 1990), there has been a steady decline in dissection (Texley, 1992). Though some have characterized the practice of dissection in public schools as a political and ideological issue (Gilmore, 1991), others have expressed concerns beyond conscientious objection by students and parents on moral grounds. Concerns range from inhumane treatment of animals by the supply industry and the depletion of natural populations of affected species to concerns about the emotional responses of students who are "turned off" to biology because of a dislike of dissection (Orlans, 1991). It has been pointed out, though, that some essential lessons can be learned through emotional response, such as a healthier regard for life and an increased awareness and appreciation of individual variation (Berman, 1984).

Of primary importance to schools is whether core curricular goals are best served by the inclusion of animal dissection in general life science courses. It has been claimed that time given to dissection comes at the expense of more important topics (Orlans, 1991). In a study involving over 7,000 science teachers it was determined that the key areas of understanding in modern biology include cell biology, energy use, genetics, evolution, systems, ecology, animal behavior, taxonomy, and the relationship of science to technology and society (Texley, 1992). The detailed study of individual animals is conspicuously absent from this list. On the other hand, a major document in the current reform movement in science education, Benchmarks for Scientific Literacy (Project 2061,1993), recommends that "by the end of the 8th grade, students should know that similarities among organisms are found in internal anatomical features" (p. 104).

In the minds of some teachers, dissection provides students with a unique opportunity to observe directly the internal structure of animals while also learning that textbook images do not reflect the variation found in nature (Morrison, 1992). The pros and cons of animal dissection have been presented (Lord & Moses, 1994; Riechard, 1993), with some asserting that typical alternatives are no substitute for dissection (Bowd, 1993; Offner, 1993). Others speak against dissection (Shapiro, 1992), emphasizing the negative memories and messages associated with the experience. Students, however, may not be deeply concerned about the dissection issue (Holden, 1990; Kinzie, Strauss, & Foss, 1993). Both the National Science Teachers Association (NSTA, 1986) and the National Association of Biology Teachers (NABT, 1990) have responded to the dissection issue by acknowledging the appropriateness of dissection in certain cases,

but emphasizing the need to foster a respect for life and find alternatives to dissection wherever possible. To aid teachers in making decisions and implementing alternatives, NABT has produced a valuable handbook, The Responsible Use of Animals in Biology Classrooms Including Alternatives to Dissection (Hairston, 1990). The handbook presents the pros and cons of dissection, an overview of teaching objectives associated with dissection, questions that teachers should ask themselves, guidelines for the use of live animals, and suggested alternatives to dissection.

ALTERNATIVES

Many have proposed substituting the use of computer simulations, realistic models, multimedia presentations, anatomical overlays, and butcher shop "parts" in place of conventional dissection. More creative alternatives include the use of marine "specimens" from the supermarket (Colby, et. al, 1995), use of PlayDoh(TM) to study brain anatomy (Wilson & Marcus, 1992), and use of interactive videodisc simulations (Strauss & Kinzie, 1991). The rapidly expanding resources of the World Wide Web also include many new resources on the Internet (please see the list of related home pages at the end of this Digest). Anzovin (1993) made the point that many alternatives to dissection are cleaner and cheaper than dissection, allow students to learn at their own pace, and reduce safety considerations.

RESPONDING TO CONSCIENTIOUS OBJECTIONS

For many, dissection truly is a moral issue. Snyder and others (1992) have offered a strategy for addressing the concerns, including creation of an Animal Care and Use Committee and developing action plans for affected classes. Readers interested in gaining more information about alternative views may wish to obtain an Alternatives to Dissection file from the Humane Society of the United States. The packet includes the Society's guidelines for the use of animals in schools, listings of studies and statements about the dissection issue, and alternative activity plans. The Ethical Science Education Coalition has also produced a dissection policy and a Frog Fact Sheet that includes both background information and an extensive reading list. The Coalition also publishes an extensive directory, Beyond Dissection: Innovative Tools for Biology Education, of materials providing alternatives to dissection and other traditional classroom activities. Addressing a related issue, the Johns Hopkins University Center for Alternatives to Animal Testing produces a middle-school newsletter, CAATALYST, that presents information in an anime comic book format (World Wide Web access at http://infonet.welch.jhu.edu/~caat.

WORLD WIDE WEB RESOURCES

-The Interactive Frog Dissection
http://teach.virginia.edu/go/frog

Offers an interactive frog dissection designed for use with high school biology classes. For a paper on the purposes and design of the on-line tutorial, see http:www.edu.cn/HMP/PAPER/135/html/paper.html.

-"Whole Frog" Project

http://george.lbl.gov/ITG.hm.pg.docs/Whole.Frog/Whole.Frog .html

Offers a rotating transparent frog movie and other image data.

-The Froggy Page

http://www.cs.yale.edu/homes/sjl/froggy.html

Offers guides, pictures, sounds, background information, and links to other sites with information about frogs and other amphibians and reptiles.

ORGANIZATIONS

Ethical Science Education Coalition, 167 Milk Street #234, Boston, MA 02109-4315 [Phone: (617) 367-9143]
Johns Hopkins University Center for Alternatives to Animal Testing, 111 Market Place, Suite 840, Baltimore, MA 21202-6709 [Phone: (410) 223-1693]

National Association of Biology Teachers, 11250 Roger Bacon Drive, No. 19, Reston, VA 22090-5202 [Phone: (703) 435-5582]

National Science Teachers Association, 1840 Wilson Boulevard, Arlington, VA 22201-3000 [Phone: (703) 243-7100]

The Humane Society of the United States, Youth Education Division, P.O. Box 362, East Haddam, CT 06423-0362 [Phone: (203) 434-8666]

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