Animal Dissection in the College Classroom and the Case for Student Choice

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ANIMAL DISSECTION IN THE COLLEGE CLASSROOM AND THE CASE FOR STUDENT CHOICE

The dissection of animals in the classroom for purposes of analysis and examination is a traditional, officially sanctioned teaching strategy in college biology courses throughout the United States (National Association of Biology Teachers (NABT), 1995; National Science Teachers Association (NSTA), 1991). Increasingly, however, students, parents, and teachers are questioning dissection on educational, moral, and legal grounds in response to the current societal trend to reduce, refine, and replace the use of animals in teaching, testing, and research (see Hepner, 1994, for a review of the issues). This article addresses the key educational, moral, and legal issues surrounding the modern debate about mandatory animal dissection in undergraduate biology education. In Part I five questions are addressed with rational arguments and empirical evidence to support each side of the debate. (Q.1) Is tradition a valid reason for utilizing dissection in the classroom? (Q.2) Is animal dissection indispensable to biology science education? (Q.3) Does dissection provide necessary research skills? (Q.4) Does animal dissection teach understanding of human biology? (Q.5) Can alternatives meet the educational objectives of dissection?

In Part II this article reveals the prima-facie case for student choice (i.e., permitting alternative learning activities for students who object to dissection). Four topics pertinent to student choice are discussed: (a) Affordability and availability of alternatives, (b) ethical concerns, (c) coercion of students, and (d) religious and civil rights of students. Guidelines are proposed for establishing a student choice policy with access to alternative educational exercises that meet the objectives of undergraduate biology science education. While this article focuses upon the case for student choice in the college classroom, the discussion is also relevant to the high school and graduate school situations.

Animal Dissection in the College Classroom

This section identifies the broad educational and scientific contexts that inform the debate concerning mandatory animal dissection in the college classroom. Five questions are raised and rational arguments with empirical evidence are presented that support each side of the dissection debate.

Q.1. Is Tradition a Valid Reason for Dissection in the Classroom?

Animal dissection was first Introduced into the U.S. biology science curriculum during the 1920's (Orlans, 1988a). Advocates of animal dissection point out that it has been an important traditional component of undergraduate biology curriculum for demonstrating principles of general biology (Hofstein and Lunetta, 1982; Offner, 1993).

Critics of dissection note that back in the 1920's books were poorly illustrated, few visual aids or films were available, far less was known about biology, and not many alternatives existed (Orlans, 1988b). Critics say that animal dissection in the college classroom continues today out of custom and convenience (Leib, 1985). Since animal dissection may be the only “hands-on” experience that some biology instructors know, they continue to teach in the same way that they themselves were taught. A bias toward dissection and over-reliance on its use can become a tradition so deeply embedded in the instructor's belief system that more technologically advanced laboratory exercises are overlooked (Kramer, 1991).

Q.2. Is Animal Dissection Indispensable to Biology Science Education?

Advocates of animal dissection assert that it is an absolutely necessary part of an academically rigorous biology curriculum (Berman, 1984; Hoskins, 1979; Igelsrud, 1986). Without dissection, students' academic achievement and career opportunities in the biological sciences would decline behind that of other students who have dissected animals. According to William Mayer, former Director of the Biological Sciences Curriculum Study (BSCS), "biology may be one of the few opportunities to train citizens to be biologically literate. For this, live animals ... are absolutely necessary” (Rowan, 1984, p. 96).

The National Science Teachers Association (NSTA, 1991) endorses animal dissection as a teaching strategy because "observation and experimentation with living organisms give students unique perspectives of life processes that are not provided by other modes of instruction" (quoted in Textley, 1992, p. 26). The National Association of Biology Teachers (NABT, 1995) states: “No alternative can substitute for the actual experience of dissection or other use of animals” (p. 1). Advocates of dissection declare that “the knowledge gained from dissection has more impact, is retained longer, and is understood better than the knowledge gained when teachers substitute models, charts, or materials from textbooks" (Orlans, 1988a, p. 90).

Critics of dissection, however, assert that the necessity of killing and dissecting healthy nonhuman animals to become “biologically literate” is overstated (Bickleman, 1991; Orlans, 1988a; Smith, 1992). Animal dissection is not always mandatory in biology education at the high school level. According to the Ethical Science Education Coalition (ESEC, 1995a, 1995b), animal dissection is not required by the State Departments of Education in New York or any New England state, not required of high school students by College Board Advancement Placement Courses for advanced standing in the sciences, and not a prerequisite for enrollment in biology science programs at most colleges and universities.

Moreover, all 125 U.S. civilian medical schools make available alternatives in which no healthy animals are harmed or killed in physiology, pharmacology, anesthesiology, and other courses for students who choose not to participate in live animal laboratories (Physicians Committee for Responsible Medicine (PCRM), 1995a, 1996). Thirty-six percent (45 of 125) including Columbia, Harvard, Michigan State, and Yale University do not use live animal laboratories in their medical curriculum at all (Foundation for Biomedical Research (FBR), 1995; PCRM, 1993, 1996). The American Medical Student Association (AMSA) supports the availability of alternatives in medical school education (AMSA, 1993).

Alternative programs in which no healthy animals are harmed or killed in the classroom lab are also available in veterinary medical education (e.g.. Buyukmihci, 1991-1995; Greenfield, Johnson, Smith, Marretta, Farmer, and Klippert, 1994). Franklin Loew (1991), professor at Tufts University School of Veterinary Medicine, notes that “about one-third of the Nation's 27 schools and colleges of veterinary medicine offer ‘alternative’ programs in surgery for (mainly) third-year students” (p. 1), including Auburn, Colorado State, Michigan State, Mississippi State, and Tufts University (Association of Veterinarians for Animal Rights (AVAR), 1989-1996, pp. 17-29). AVAR (1989-1996) identifies one exemplary veterinary school that has developed a full range of fully-accredited alternative programs: "The school of veterinary medicine at the University of Utrecht in the Netherlands does not harm or kill any nonhuman animals in its surgical or other training programs .... [and] is fully accredited by the American Veterinary Medical Association" (pp. 14-15).

The absence of live animal laboratories in medical and veterinary education is not unprecedented. Since 1876 British medical and veterinary surgeons have acquired their skills through apprenticeship programs, studying real human (and animal) patients in controlled and supervised clinical settings or studying cadavers without live animal labs and still compete each year successfully for U.S. residency and faculty positions (Buyukmihci, 1989-1994; Home Office, 1985). Although laboratory use of live animals is still common in most U.S. medical and veterinary schools, it is likely to decline for a variety of reasons: students' concern, expense, changes in curriculum and/or curriculum focus, lack of sufficiently skilled faculty, and lack of teaching space because of research needs (FBR, 1995).

Since the laboratory use of live animals is not critical to graduate medical and veterinary education, how essential is it to undergraduate biology education where the majority of college students do not pursue professional careers in either biology or medicine?

Q.3. Does Animal Dissection Provide Necessary Research Skills?

Advocates of animal dissection state that the behaviors practiced during the standard dissection procedure (i.e., handle, rotate, cut open, spread apart, expose, pin, slit, remove, place, measure, insert, trace, inflate, drop, raise, pinch, unpin, suture, cover, wrap, and wash) help develop perceptual-motor skills important for making scientific discoveries in the biological sciences (Bures, Buresova, & Huston, 1976; Lord, 1990). Advocates point out that "63 of 95 Nobel Prizes in Physiology or Medicine have been awarded for research that relied on animal studies in some way" (FBR, 1996, P. 1).

Opponents of dissection, however, note that the standard dissection procedure as it is performed in the undergraduate biology classroom is used to teach students well-known facts and not to make important research discoveries (Orlans, 1988b). In addition, dissections performed by undergraduates are rarely done well enough to develop any skill. Biology textbooks explicitly acknowledge the typical artlessness of students and routinely caution them to avoid cutting too deeply, cutting organs that should not be cut, and so forth (e.g., BSCS, 1973, pp. 308-312). The sloppiness of a typical college student's performance of animal dissection becomes evident when compared with the performance of a professionally done dissection captured on videotape.

Moreover, the fact that some Nobel Prizes are awarded to individuals who accept animal methods as the main paradigm of research should not obscure the evidence that “many of the recent advances in AIDS, heart disease, cancer, stroke, cystic fibrosis, Alzheimer’s disease, drug designs, multiple sclerosis, Parkinson’s disease, schizophrenia, etc., have benefited and have been accomplished by the use of alternative methodologies” (Kapis and Gad, 1993, p. i; Stephens, 1997). Noting that 32 Nobel Prizes in Physiology and Medicine went to scientists who did not rely on animal studies, colleges can confidently give students the opportunity to learn preparatory skills important for making scientific discoveries in physiology and medicine that utilize sophisticated alternative methodologies. These methodologies include human clinical studies and neurochemical measurements with human volunteers, postmortem human autopsy reports, in-vitro human cell, tissue and organ cultures, bacteria cultures and protozoan studies, gas chromatography and mass spectrometry, brain imaging techniques, structure-activity relationship mathematical models, radioligand binding and radioimmunoassay, quantum pharmacology, physiochemical analysis and mechanical models, genetic engineering, medical microbiology/ mycology/ virology, ethology and other noninvasive techniques (Frazier & Goldberg, 1990; Kapis and Gad, 1993; Office of Technological Assessment (OTA), 1985).

As these alternative learning tools become available in the college classroom, they can be used to introduce "new ideas in biology that are more relevant to the student's educational needs and which better represent the current state of biological information" (Orlans, 1993, p. 3). Prohibition of alternatives or confining students' learning to the limited understanding that dissection provides prevents students from having a truly scientific education (Beardsley, 1992; Russell & Burch, 1959/1992).

04. <u>Does Animal Dissection Teach Understanding of Human Biology?</u>

According to many biology instructors and textbook authors, dissecting the bodies of animals helps students understand human anatomy and physiology. Animals and humans are seen as sufficiently similar for students to extrapolate results of observations of one to the other (Botting and Morrison, 1997). In the following quote from a popular biology science textbook (BSCS, 1973) students are encouraged to reason by analogy from frog to human and from human to frog.

> Your task will be to learn as much as you can about the organs in the frog. There will be few directions -- you must explore and interpret what you find in terms of what you already know about man and other animals. Pretend that you are the first person ever to dissect a frog. Before you begin your detailed study, make a list of the organ systems in man and the main parts of each. This will serve as a checklist of what might be found in the frog.... Do not be concerned with the names for everything that you can see. The names that you already know for human structures will be enough (p. 308) How does a study of the internal organs and their functions in a frog help you understand your own? To what extent was your knowledge of the human body a help in understanding the frog? p. 313)

Critics of dissection point out, however, that such reasoning by analogy overlooks two problems: (a) generalizing on insufficient grounds, and (b) species variation. Biologists cannot completely generalize from one human to another due to genetic, developmental, and environmental differences between individuals; the difficulties are compounded for the biology student who is asked to extrapolate data from one species to another.

Problem of Generalizing on Insufficient Grounds.

Analogical reasoning can yield a valid argument only if the two concrete situations exhibit no significant dissimilarity (Getner & Markman, 1997). While frogs and humans are similar in certain respects, they also have many major differences (Kent, 1987). Quadruped amphibians do not represent many of the functional properties or causal mechanisms underlying the anatomy of bipedal mammals. The frog has a three-chambered heart whereas the human's is four-chambered. Frogs do not have the same metabolism as humans do. They have different adrenaline flow, different thyroids, different brains. There are size, shape, and weight differences as well. Because there is a significant difference in the data, there must be a difference in understanding the data (Lonergan, 1957).

When students are mapping structural or functional similarities between frogs and humans during the process of analogical reasoning, the important cardiovascular, metabolic, hormonal, immunological, and nervous system differences in causal mechanisms between amphibians and mammals are ignored (e.g., Gentner & Markman, 1997). By focusing upon certain superficial similarities, the student becomes programmed to perceive information that fits into preconceived patterns established by his or her prior knowledge of human anatomy, to be aware of certain characteristics within certain conditions, so that what is dissimilar or contradictory becomes psychologically invisible. Facts are proven by excluding what does not agree. The process of analogical reasoning from nonhuman to human animals can lead to erroneous conclusions by overlooking what is disanalogous.

Problem of Species Variation.

Critics of dissection state that intrinsic differences among species make it difficult to understand human anatomy and physiology by dissecting nonhuman animals (AVAR, 1989-1996; Barnard & Kaufman, 1997; PCRM, 1995a). Historically, starting with Galen (130-200 AD) when human dissections were forbidden and animal dissections accepted in their place, animal dissections caused numerous misunderstandings of human anatomy and physiology (Knight, 1980). It was not until 1543 with the publication of Vesalius's book describing his observations of human corpses that the development of modern anatomy began (Bram & Dickey, 1986).

Animals are poor models of humans for the same reason humans are poor models for animals: species variation. Species variation is the reason why people do not go to a veterinarian when they get sick (Buyukmihici, 1991-1995). There is a difference in overall health patterns of humans and animals because of the quite diverse nature of their physical existences and evolutionary histories (Krebs, 1985). All species of amphibians, mammals, fish, and birds are different from humans and from each other in important genetic, biorhythmic, biochemical, immunological, metabolic, histologic, anatomical, physiological, reproductive, behavioral, psychological, and social aspects (BSCS, 1973; Kent, 1987; Prosser, 1973).

The individual and mass psychological reality of humans, for example, is dramatically different from that of other animals which results in a wider variety of biological and behavioral reactions to stimuli than non-human animals show (Walker, 1983). Subtle systemic differences in biological organization and functioning between human and non-human animals can also result in widely divergent responses to the same stimuli (i.e.. biochemical effects vary widely depending on animal species used (e.g., pain in cats may be similar to that in dogs, yet aspirin kills cats but does not kill dogs) (Davis, 1979)). Intrinsic systemic, causal disanalogies between species resulting from divergent evolutionary histories undermines the direct utility of animal models of human biology (LaFollette & Shanks, 1996).

Q.5. Can Alternatives Meet the Educational Objectives of Animal Dissection?

The Institute of Biology, the Association for Science Education, and the Universities Federation for Animal Welfare (1984) in Great Britain, identify four educational objectives of animal dissection: (a) to gain knowledge and understanding of internal structures and of variation between individual organisms of the same species; (b) to appreciate the organism as an entity rather than as a collection of organ systems; (c) to improve learning through active involvement of the pupil; and (d) to gain personal experience of both the fragility and strength of fresh tissue. In other words, animal dissection provides students the opportunity to study comparative anatomy (O'Donoghue, 1990). Students develop higher level thinking skills (e.g., analytic, organizational, and practical investigative skills) as they obtain experience in the design and execution of biological experiments (Igelsrud, 1987). Students also obtain hands-on appreciation of the complexity and intricacy of organisms and develop practical, manipulative, and surgical skills (Lord, 1990). Students learn how the tissues and organs look and feel and how they are interrelated (Mayer, 1980).

Alternatives for Objectives 1 and 2.

What makes for a “good alternative” to traditional animal dissection? Alan Bowd (1989), professor of educational psychology at Lakehead University in Canada, writes: “For a technique to function as an alternative it must meet one or more of the objectives in science education traditionally claimed for dissection” (p. 90). Research indicates that commercially available alternatives can meet the objectives of actual animal dissection in teaching students about the anatomical and physiological characteristics of different species in the animal kingdom (Fawver, Branch, Trentham, Robertson, & Beckett, 1990; Huang & Aloi, 1991; Kramer, 1991; Prentice, Metcalf, Quinn, Sharp, Jensen, & Holyyoke, 1977; Samsel, Schmidt, Hall, Wood, Shroff, & Schumacker, 1994).

Huang & Aloi (1991), for example, found that average undergraduate grades for an introductory biology course were higher for five semesters following implementation of an interactive video disk (IVD)-based computer program than the average grades of eleven prior semesters using traditional dissection methods. Kramer (1991) found that Colorado State University students using Omega Ware computer software twice a week performed significantly better ($p<.05$) on exams than a comparable group of students in the traditional two-hour biology dissection lab. Samsel et al. (1994) reported that students at the University of Chicago medical school rated a cardiovascular computer simulation as more effective pedagogically than an animal laboratory. Prentice et al. (1977) reported that students using a stereoscopic slide-based auto-instructional unit as an alternative to animal dissection in teaching of human anatomy performed just as well on tests of anatomical knowledge as students performing dissections. Fawver et al. (1990) found that students at the College of Veterinary Medicine at Auburn (GA) who used an IVD-based alternative performed just as well on a multiple choice/short answer physiology test as those students who performed animal dissections.

<u>Alternatives for Objective 3.</u>

Research indicates that IVD simulations can be just as effective or even better than dissection in actively involving the student and developing higher thinking skills (Bosco, 1986; Guy & Frisby, 1992; More & Ralph, 1992; Reeves, 1986). British educator P.J. Kelly (1980) reports that “the use of dead specimens helps to develop some skills of observation and dissection. It possibly helps understanding of morphology and anatomy and provides some insights into functions. But it is debatable as to whether it does much more” p. 53). Whereas traditional dissection tends to encourage rote memorization (Bickleman, 1992), IVD-based alternatives have proven effective in promoting interest, understanding of principles, perceived value in learning and a positive attitude toward science (Leonard, 1985). The crucial element assuring success in generating student interest and excitement is “whether or not the simulations are interactive” (Strauss & Kinzie, 1991, p. 156). There are two important advantages of IVD-based alternatives that dissection does not allow: (a) simulations can be repeated (i.e., practiced) as many times as necessary with no waste and at no additional cost, and (b) simulations permit making up missed classes and working outside of class on the student's own time (Barnard & Baron, 1989).

Sophisticated imaging technology and alternative teaching tools such as The Digital Frog (Digital Frog International (DFI), 1996), for example, can facilitate the formidable task of ensuring that students are both biologically literate and computer literate. This IVD computer program allows students to study the parts of frog anatomy from an interactive video screen display of a fully-colored dissected frog. Students direct dissecting scissors, probe, forcepts, and magnifying lens to remove organs and investigate frog body systems, one step at a time, with the computer explaining where to cut, how to cut, and what the student is seeing. When an organ is exposed, it can be magnified, shown in full-motion animated sequence or still diagram of the organ and its body systems to detail each step.

In-depth text pages can be

accessed for more complete information. Difficult-to-locate anatomical structures are easily and accurately identified by graphics and pointers.

Alternatives for Objective 4.

A student can develop the important clinical skills of manual dexterity, fine psychomotor skills, and visual-spatial ability and get experience with fresh tissue without purposely killing healthy nonhuman animals in the process. Nedim Buyukmihci (1989), professor of opthamology at the University of California School of Veterinary Medicine and President of AVAR, offers this example from veterinary education: “Experience with knot-tying boards and suturing foam rubber models can provide practice of basic skills fundamental to proficiency in more complex procedures, especially when combined with visual aids such as photographs or videotapes” p. 96; see Smeak, Beck, Shaffer, & Gregg, 1991).

In addition to disassembling and reassembling intricately detailed models or handling and suturing objects (e.g., foam rubber models) or plant structures (e.g., flowers, fruits, and vegetables), students can manipulate human “life-like simulators -- complete with pulses, heart and breath sounds, EKG, and pulmonary pressure readings that respond to the simulated administration of dozens of different drugs – [that] allow trainees to learn, make mistakes, and start over in a realistic context” (PCRM, 1995a, p. 1). Or students can conduct physiological and kinesiological studies on their peers (e.g., measurement of blood pressure, respiratory processes, and study of skin culture) (Orlans, 1974; Russell, 1978). Moreover, skills developed through exercises with sophisticated virtual reality programs are highly relevant to surgery performed with computer-guided optically equipped instruments (PCRM, 1995b). Virtual reality technology is likely to make such interactions even more life-like in the future (Reingold, 1992). For example, beginning summer

1997, Beth Israel Hospital (Boston, MA) will begin using the “Virtual Patient” interactive program that follows an actual patient from diagnosis to cure or death and autopsy to train physicians.

Cadavers of animals acquired from local animal hospitals could be used by students to obtain experience with fresh tissue's appearance and texture. These cadavers would come from animals who either died at the hospital from a fatal illness or injury, or were euthanized for medical reasons (AVAR, 1989-1996; Carpenter, Piermattei, Salman, Orton, Nelson, Smeak, Jennings, & Taylor, 1991). In veterinary medical education “cooperative arrangements (may be made) with local animal shelters where the shelter's cats and dogs are sterilized by students in order to develop surgical skills” which in turn benefits the sterilized animals by increasing their adoption rate (AVAR, 1996, P. 1).

Clearly, all the educational objectives of animal dissection can be met by quality alternatives without harming or killing healthy animals. To insist that it is “dissection or nothing” is to make a false dichotomy that disallows alternatives. It is an oversimplification of the complex objectives of biological science education to allow only one course of action -- the killing and dissection of healthy animals -- where multiple other possibilities actually exist.

The Case for Student Choice

This section identifies the broad economic, environmental, moral, and legal contexts that inform the case for student choice. Four topics relevant to making the case for student choice are discussed -- affordability and availability of alternatives, ethical concerns, coercion of students, and the religious and civil rights of students. Policy guidelines are proposed for establishing a student choice policy.

Affordability and Availability of Alternatives

An advantage of alternative materials over traditional dissection supplies is their cost effectiveness in the long run (Sundberg & Armstrong, 1993). Alternatives represent an investment that can result in substantial savings and a buildup of institutional assets over time. Consider, for example, alternatives to the use of bullfrogs for general biology courses. Suppose the instructor teaches three sections of Introductory Biology with 24 students in each section. To purchase 36 frogs (12 frogs per section) would cost about $250 (Nebraska Scientific 1994 Catalog, p. 6). At the end of class, the resource is "used up" and no assets remain. Moreover, there exists the cost of safe disposal of the chemically-treated remains of dissected animals. In contrast, to purchase one fully dissectible Great American Bullfrog model ($500), one interactive video display program The Digital Frog ($170), and one Dissection and Anatomy of the Frog videotape ($180) would cost a total of $850 and would be reusable year after year (ESEC, 1995c). Over several years these reusable tools would have paid for themselves, would not be used up, and would remain assets for years to come. Table 1 lists selected alternatives and their costs; Table 2 lists a diversity of booklets and catalogs where department chairs, faculty, and students can find affordable replacements that meet the educational objectives of dissection.

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Ethical Concerns Raised by Dissection

“The [ethical] case against animal dissection in biology education rests on several concerns -- unnecessary slaughter of living creatures, the moral revulsion over the killing and desecration of dissection, and the suffering of animals before they are put to death” (Orlans, 1991, p. 12). Another concern is the potential for doing physical or psychological harm to the student.

Unnecessary Slaughter of Living Creatures.

According to Orlans (1988a): “An increasing number of people consider dissection morally offensive because it involves unnecessary killing” (p. 12). Andrew Rowan (1984), Director of Tufts University's Center for Animals and Public Policy, estimates that 5.7 million animals are bred, bought, and sold for use in education in the United States. Orlans (1988a) identifies one moral consequence of this consumptive use of animals in life science education: “The killing of millions of animals each year for...education fosters an impression that animal life is cheap” (p. 12). Animals used for dissection are obtained from a variety of sources: shelters, the wild, breeders, biological supply houses, slaughterhouses, and class B dealers of animals from random sources. Animal habitats, ecological systems and the environment can also be harmed by the removal of animals.

Animal shelters. Several unfortunate consequences follow the practice of obtaining animal cadavers from shelters (rather than animal hospitals), Although the practice is often justified by the argument that “they are going to be killed anyway, so why not utilize them for some meaningful end.” (a) society becomes formally dependent on the euthanizing of unwanted pets, (b) the public's attention is directed away from solving the pet overpopulation problem, and (c) the fate of sheltered animals becomes tied to financial gain (Buyukmihci, 1989-1994).

Wildlife. Other animals used for dissection are obtained from the wild. Millions of bullfrogs, grassfrogs, and toads (whom Berman Helmholtz in 1845 called “the old martyrs of science” because so many were used in life science research at the time) are still wild-caught and killed annually to be used in a variety of biology courses, ranging from comparative physiology and endocrinology to developmental and molecular biology (Balls & Balls, 1989). Because amphibians are difficult to raise in captivity, frog breeders must periodically restock their captive frog populations by taking more frogs from the wild. A major biological supply house informs buyers: “Live frogs are not available between April I through May 31 due to closed season for frog collecting” (Nebraska Scientific Catalog, 1994, p. 44).

Theoretical arguments that frog populations can sustain themselves in the face of heavy human predation have proven false (K. Phillips, 1994). The resultant depletion of frog populations has already caused unfortunate ecological consequences in Bangladesh and India where insects, which frogs once kept in check, are now increasing in number and spreading human disease, a phenomenon caused in large part by the frog trade (ESEC, 1995d). As insect populations have risen, there has been a corresponding increase in the use of pesticides which has caused additional harm to the environment (Barnard and Baron, 1989). A strong environmental protection argument, therefore, now exists for not using frogs in biological science education today. Moreover, it is not just frogs that need protection from human predation, but other species of animals as well that are taken from their land and ocean environments in vast quantities (e.g., earthworms, sharks, snakes, starfishes, and turtles) initiating serious ecological repercussions (ESEC, 1995e).

Biological supply houses. Animals used for dissection are also obtained from biological supply houses, such as Charles River Breeding Laboratories

(Boston, MA), "the largest commercial breeder in the United States [producing] more than 20 million animals" for research, testing, and educational uses annually (Rowan, 1984, p. 69). Two categories of animals are generally available from biological supply houses: "Live" animals (e.g., ants, beetles, chicken eggs, cockroaches, crabs, crayfish, crickets, frogs, fruitflies, leeches, mosquitos, moths, snails, and worms) and "preserved" animals (e.g., cats, clams, crayfishes, earthworms, grassfrogs, grasshoppers, honeybees, perches, pig embryos, rabbits, rats, sheep organs, and starfishes). Colleges and universities must safely dispose of hazardous chemicals and the chemically-preserved carcasses of animals in order to prevent such chemicals from harming the environment.

<u>Moral Revulsion Over the Killing and Desecration of Dissection</u>.

There is evidence that animal dissection produces revulsion and negative emotions in some students (Harbster, 1992; Heim, 1981). Orlans (1988a) reports that

> There is strong evidence that the act of dissection can be emotionally disturbing for some students. They recoil at the prospect of handling a dead body. Some view the cutting up of a body as a desecration; even watching it being done is unpleasant. They have been taught to be kind and caring toward animals, not to kill them. (p. 12)

Firsthand evidence that dissection is emotionally disturbing for some students can be obtained by observing students during an actual animal dissection and interviewing them afterwards about their experience and behavior. Observe behaviors such as laughing and joking, shaking while handling the animal, tossing dissected portions into the air and at each other, or cutting class on the day of dissection. These may be signs of ethical disturbance rather than simply squeamishness, sentimentality, or callousness in students who cannot rationally articulate their moral objections to dissection (Allchin, 1991; Callahan, 1995). The experience of dissection can be so emotionally disturbing that students may cease to pursue biology as their major, avoid biology courses and take other science courses instead. Some students may compromise their ethical principles and abide by course requirements because they fear ridicule or a lower grade for objecting (Hepner, 1994, pp. 139-156). Some instructors resort to “not telling the students prior to the day of dissection in order to reduce the apprehension experienced by some of them” (Leib, 1985, p. 2). One can only wonder what consequence this practice has on the unsuspecting student.

Suffering of Animals Prior to Death.

The industrial process used to preserve animals and the classroom procedure of “pithing” live animals are two examples of animal suffering perpetuated by animal dissection. Animals purchased by some biological supply houses from Class B dealers are put into a gas chamber to die and afterwards pumped full of preservatives, sometimes before they are completely dead (e.g., see People for the Ethical Treatment of Animals (PETA)’s 1990 investigation of Carolina Biological Supply).

Live animals, such as frogs used in college introductory biology courses, are often pithed by instructors just before class. Pithing is the severing of the brain and spinal cord at the connection between the vertebral column and the skull accomplished by striking the animal’s head sharply on a hard surface, apparently killing the animal. Many who pith frogs, especially students, fail to correctly perform the technique. Do frogs suffer as a result of pithing? Amphibians show avoidance and escape responses to stimuli that is known to be painful to humans (Pratt, 1980). Since amphibians also possess higher brain centers, opiod receptors in the brain and spinal cord, and neural elements associated with stress and anxiety in mammals (e. g., benzodiazepine receptors in the central nervous system) (D. Kelly, 1986), it is logical to infer that frogs feel the pain of being pithed (Balls & Balls, 1989).

Not all parts of the pithed frog appear to die at once as some of the processes commonly associated with life continue. A popular college biology textbook explains that this is precisely why frogs are the chosen species to begin with:

> Various separate life processes continue for varying lengths of time after pithing, depending on temperature, humidity, and other environmental factors. If a pithed frog is placed in a refrigerator it may be possible to observe the heart still beating after a day. The student can also cause muscle twitching by nerve stimulation several days after storage. (BSCS, 1973, p. 309)

The instructor explains that despite what the students see, the frog is dead at the moment of pithing. The student must accept that the frog is technically dead because the student would not want to knowingly dissect a living animal.

Physical and Psychological Harm to the Student.

Potential biological risk to students comes from handling preserved animals that are pretreated with hazardous aldehyde-based chemical preservatives. Formalin, a commonly used preservative, is an aldehyde-based chemical made from formaldehyde.

> Formaldehyde is a chemical preservative linked to cancer of the throat, lungs, and nasal passages. Formaldehyde can also damage the eyes, cause asthma attacks and bronchitis, and severely irritate the skin. So far, people can only speculate how breathing the fumes from handling

> formaldehyde-treated corpses affects the long-term health of students and teachers. (PETA, 1995, p. 5)

Prior to dissection it is prudent that teachers warn students of potential health effects and get their informed consent.

While some students will be “turned on to” and some “turned off from” biology due to animal dissection, most students will have mixed emotions about dissecting an animal (Orlans, 1991). How do biology instructors deal with students who have mixed emotions about animal dissection? According to Gabor Kaley, chairperson of the New York Medical College physiology department: “We talk to them (the students) first, and explain why it is important. We try to desensitize them” (Hershenson, 1996, p. 1). The desensitization process has three negative consequences for student learning: it (a) encourages the object-ification of living beings, (b) fosters a disrespect for life, human life included, and (c) creates a conflict of values in the student (Bowd, 1993; Orlans, 1988a; M. Phillips, 1993; PSYeta, 1994).

Objectification of living beings. Educational psychologist, Alan Bowd (1993), writes: “There is evidence that dissection [not only) creates negative emotional reactions in some students, [but also] distances them affectively from animals, and teaches them to regard animals as expendable tools” (p. 84). The psychological problem for students is that they must reduce a living being to the status of an object in order to learn. In order to do this, the animal must be conceptually isolated in the mind from all influences that may individualize or “animate” him (e.g., grant rich psychological activity to our own species but deny it in animals) (M. Phillips, 1993).

Language is one device used to introduce and reinforce conceptual distancing from the animal in both student and teacher (Birke & Smith, 1995). One major supplier of dissection materials redefines the word “death” to make the dissection of fetal pigs less morally objectionable: “Since the fetal pig was never born it did not ‘die’ for dissection purposes” (Nebraska Scientific Catalog, 1994, p. 9). Or consider the wording in some syllabi of general biology courses: “Laboratory exercises make use of living and preserved materials.” Animals are referred to as “materials.” The language of dissection acts as a reductive lens for perception whereby animals become regarded as objects without intrinsic value or worth, meaning or purpose, except as carriers of information and bearers of scientific data (M. Phillips, 1994). The animal loses his vital individualism and becomes an object to be categorized, numbered, torn apart, and examined. The animal’s individual life almost seems beside the point.

The object-ification process continues during the standard dissection procedure when animals are literally separated from themselves. Dissection divorces students from their daily practical experience with animals (i.e., students would not dissect their pet frog or pet cat) and from the experience of interrelatedness with the environment and kinship with animals. The act of dissection pulls both the animal and the student out of the web of life.

Fosters disrespect for life. Dissection separates students from nature in a way that can lead to some contempt on their parts of individual living beings, human as well as nonhuman (PSYeta, 1994). Ethics professor Orlans (1988a) writes: “Students may become desensitized. Heavy exposure to dissection can harden attitudes toward animal suffering and foster disrespect for life” (p. 12). Since it is the human’s vulnerability to pain and capacity for identification that helps people to sympathize with others (Scarry, 1985), then if people deny themselves the direct experience of their own emotions and muffle them through deadening their sensitivity to pain or repressing their emotions, then people can hurt others much more easily (Batson, Polycarpou, Harmoin-Jones, Imhoff, Mitchener, Bednar, Klein, & Highberger, 1997; Milgram, 1974, pp. 32-43). Students can become conditioned and programmed to see human life in somewhat the same fashion they see animal life by generalizing the analogical reasoning employed to justify using animals as models of human beings in the first place. “Learning one helps prepare us psychologically to learn or accept the other” (PSYeta, 1994, p. 5).

Conflict of values. Clinical psychologist Kenneth Shapiro (1991), executive director of Psychologists for the Ethical Treatment of Animals, identifies another consequence of the desensitizing process: “Students are taught obedience to authority as they take a life under the direction of a teacher” (p. 20; see Milgram, 1974, pp. 1-12). Veterinarian Rowan (1984), director of Tufts University’s Center for Animals and Public Policy, notes that “protests from students concerning humane issues takes a great deal of courage in the absence of explicit leads from lecturers” (p. 103). Lisa Hepner (1994), a former biology major at the University of New Mexico, says forcing a student to dissect

> creates a conflict for the student who feels that dissection is morally wrong but that has a teacher who feels that animal use is justified. The anxiety over questioning the teacher’s authority or being ridiculed by peers compounds the issue, especially at a time when a student is trying to gain acceptance by authority figures and peers. (pp. 88-89)

What message are we giving students when we tell them they must go against their beliefs to fulfill a course requirement? Unwilling students who are forced to participate in animal dissection receive the message that their beliefs and value system do not hold up in the academic world. It teaches students that knowledge is more important than morals and that personal ethics can be booted aside by an indifferent scientific foot.

One source for the conflict of values inherent in dissection comes from the fact that children are regularly taught to be kind and caring toward animals, not to kill them (Rowan, 1984, pp. 93-108). Students become torn between contradictory values: “Be kind to animals” contradicts “kill animals to learn.” Dissection conveys the strange idea that one can perceive the life mechanism of an animal by killing it and that in order to understand what makes animals live one must first rob them of their life (Roberts, 1980). Orlans (1988a) calls attention to the failure of biology to deal with the contradictory values inherent in the use of animals in life science education:

> In the word biology, ‘bio’ means ‘life’.... Isn’t it time for curriculum to be brought more into keeping with the subject that is being taught? Cannot the lessons from dissection be learned without killing the animals (p. 14).... In times when we are struggling to reduce violence in our society, the practice of harming and killing sentient creatures to conduct an ‘educational exercise’ seems out of place. (p. 12)

Coercion of Student

If dissection violates a student’s values, should s/he be forced to perform animal dissection? Orlans (1991), professor of ethics, writes:

> There is a place for dissection in the training of mature students who have made a career commitment where dissection can assist in the acquisition of necessary knowledge and skill. But even here, there should be a provision for conscientious objection, as provided in several leading medical and veterinary schools. Blanket requirements that dissection should be a rite of passage through undergraduate education have no place in our educational system. (p. 14)

The National Association of Biology Teachers (NABT) concurs in their position paper on the use of animals in biology education:

> The Association encourages teachers to be sensitive to substantive student objections to dissection and to consider providing appropriate lessons for those students when necessary (NABT, 1995)…. NABT calls for] alternatives to dissection and vivisection wherever possible in the biology curriculum...Cavalier justifications on the grounds that ‘we have always done this’ are unacceptable (NABT, 1990)

Clearly, many professionals are against coercing students to perform dissection (Mayer & Hinton, 1992).

A societal trend toward greater acceptance of student choice at all educational levels is indicated by recent legislation enacted in support of students’ right to refuse dissection and lawsuits won by students to change academic policies (Dodge, 1989; Francione & Charlton, 1992; Hepner, 1994, pp. 65-76; Moyer, 1979). “Currently, California, Florida, Pennsylvania, and Rhode Island, all have laws which acknowledge a (high school) student’s right to not dissect. Legislation in Illinois and Massachusetts is pending” Hepner, 1994, p. 70).

Maggie McCool of New Jersey and Jennifer Graham of California, for example, sued their high schools’ Boards of Trustees for the right to refuse dissection and won with the courts holding that the First Amendment’s freedom of religion clause covers ethical objections to dissection (Balcombe, 1996). A first-year medical student, Saffia Rubaii, won a $95,000 lawsuit against the University of Colorado School of Medicine (UCSM) for the right to be granted an alternative to the required dog lab in a freshman physiology course (McCaffrey, 1995). UCSM now accommodates all students whose religious beliefs prevent them from conducting lethal experiments on live, anesthetized animals (Romano, 1995). Two veterinary students, Gloria Binkowski and Eric Dunayer, sued the University of Pennsylvania School of Veterinary Medicine for the right to refuse to operate on and euthanize healthy dogs. The students won the case and the University now offers alternatives to surgery on healthy animals (Francione & Charlton, 1992, P. vii). As an undergraduate biology major, Hepner (1994), without litigation, successfully persuaded University of New Mexico administrators and department heads to offer alternatives to dissection.

Religious and Civil Rights of Students

Current U.S. law recognizes that the only valid reason for objecting to dissection is sincere religious belief, a stance strengthened by the 1993 Religious Freedom Restoration Act. If a court decides that a student is sincerely expressing a religious belief (i.e., “the student is a sincere adherent of traditional religious belief or otherwise holds a belief that adresses ‘an ultimate concern’ of the believer” (Francione & Charlton, 1992, p. 87)), then the student’s claim falls within the scope of the First Amendment (i.e., the free exercise of religion and freedom of speech) and the student is entitled to an alternative. Since the ethical principles of “reverence for life and respect for the sanctity of being are basic ethical and moral principles of all the world’s religions” (Francione & Charlton, 1992, p. 29), they also may serve as an “ultimate concern” in the student’s life and could be considered a stand-alone non-theistic religion. The question of sincerity of a student’s belief would be a separate inquiry resolved on a case-by-case basis.

The right to refuse dissection is not only a religious issue but also a civil rights issue. Francione and Charlton (1992), professors of law at Rutgers University, write:

> Whether a student has a right to refuse to participate in the use of nonhumans as part of a course requirement is, strictly speaking, a civil

> rights issue and not an animal rights issue (p. ix) .... [The student may charge that she is being] discriminated against based on the content of her belief and penalized when other students who are similarly situated in other colleges are being accommodated with alternatives to dissection. (pp. 83-84)

Academic policies already exist at many colleges granting exemptions from certain course requirements for the “special needs” of students (e.g., allowing alternate modes of testing such as in-office or take-home tests for test anxious students, use of bi-lingual dictionary for foreign students, extended test time for “slower” students). The academic policy can be extended to grant exemption for students with religious, ethical, or scientific objections to animal dissection in the college classroom.

> A helpful analogy comes from the issue of abortion. In medical education, no student is required to perform an abortion if he or she finds that practice objectionable, raising the question as to their right to decline on ethical grounds without penalty. (Barnard & Baron, 1989, p. 92)

Guidelines for Establishing a Student Choice Policy

If coercion is inappropriate, then the challenge becomes how to establish a student choice policy in the college classroom, one that also protects faculty’s academic freedom. The goal is two-fold: (a) to write a clear and practical institution-wide policy and (b) to guarantee that alternatives are available.

It is important that a student choice policy not hinder faculty’s academic freedom. A good policy does not take anything away from the teacher, but adds a choice for the student. According to Francione & Charlton (1992):

> The student who objects to dissection is not trying to stop the instructor from imposing the requirement on students who do not object

> and…. [and] is not challenging the right of the instructor to structure the course in the way that the instructor chooses -- the student is only challenging the right of the instructor to violate the student's first amendment rights. (p. 85)

With a student choice policy, biology instructors are free to continue presenting their courses as they have in the past. The only change would be the additional availability of substitute materials for students who choose such an alternative. The academic freedom of faculty is not absolute; the academic freedoms of students are protected as well (e.g., freedom from sexual harrassment, freedom from discrimination).

A basic student choice policy guarantees three freedoms (ESEC, 1995f): (a) The student would be allowed an alternative exercise of comparable time and effort investment as a replacement for the actual animal dissection; (b) Any student requesting an alternative would not be reprimanded, penalized, discriminated against, or ridiculed for her/his decision not to dissect; and (c) The course requirement of dissection and the availability of alternatives would be stated in the course syllabus and announced to students at least 10 days prior to the day of dissection so that timely, appropriate alternatives could be arranged.

The choice policy needs to assure the availability of quality alternatives which replace the harming or killing of animals in the classroom. Not all alternatives are created equal. "The source of the animal is important if one is proposing an alternative for moral or ethical reasons" (Buyukmihci, 1989-1994, P. 2). Some alternatives are entirely non-animal and completely replace them (e.g., static and dynamic plastic models). Other alternatives are animal-based and at one time involved the death of an animal (e.g., videotapes of professionally done dissection). Many human-based alternatives are also available (e.g., videotape of dissection of human model) (see Table 2).

To insure that the rights of students to alternatives be sustained in all courses, colleges and universities need to create a policy that extends institution-wide and affects all relevant courses. In order for the affected departments to build up their store of alternatives to dissection, institutions could encourage them to spend some of their funds for the purchase of quality alternatives that meet the educational objectives of dissection.

Conclusion

The dissection of healthy animals (living or preserved) in the college classroom is neither an indispensable element for quality biology education nor a necessary requirement for a successful professional or research career in the biological and medical sciences. Non-animal alternatives exist that are as pedagogically sound, class-time efficient, and cost effective as the standard dissection procedure. There exists a strong ethical case against dissection due to unnecessary slaughter and suffering of animals and harm to the environment, physical risk to students from handling chemically-treated animals, and psychological risks to students associated with negative emotional reactions, moral revulsion, emotional hardening effects of desensitization, and conflict of values. Coercion being inappropriate if not illegal, a student choice policy with access to alternatives to dissection is reasonable. The author thinks that a strong argument for student choice has been made and hopes that student choice will become widely established at colleges and universities across the United States.

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