

PEDAGOGICAL, ETHICAL, AND ECONOMIC BENEFITS

OF NON-ANIMAL TEACHING METHODS IN SCIENCE EDUCATION



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**Pedagogical, Ethical, and Economic Benefits
of Non-Animal Teaching Methods in Science Education**

Prepared by People for the Ethical Treatment of Animals

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Introduction

Every year in the U.S., an estimated 20 million animals are used for educational purposes.¹ These animals are obtained from a variety of different sources and suffer immensely as a result of being trapped, transported, confined, experimented on, and killed for classroom science laboratories.

Millions of frogs, for example, are captured in their natural habitats every year and are killed for dissection or used while still alive in classroom biology experiments. The U.S. Department of the Interior has even stated that amphibian population declines can be attributed in part to the use of amphibians in dissection.² Fetal pigs are also used in dissection. Biological-supply houses obtain fetal pigs from slaughterhouses; the fetuses are cut from the bodies of pregnant sows after slaughter. These companies also purchase stray, lost, and abandoned cats from animal shelters or "bunchers"—dealers who illicitly obtain animals from back yards and the streets of the U.S. and Mexico. Millions of other animals, such as mice, rats, and rabbits, are bred at facilities that cater to businesses and schools that use animals in classroom experiments and laboratories.

Fortunately, educators can help prevent this suffering *and* enhance students' learning experience by using some of the modern, life-affirming, educationally effective non-animal learning methods that are discussed in this packet.

In addition to the information included here, PETA has launched an online dissection alternatives resource center designed especially for educators. The site contains information on the many pedagogical, economical and ethical benefits of non-animal learning methods (with references to peer-reviewed educational research), physician-narrated video demonstrations of two leading virtual dissection software programs, PETA-specific discount codes for educational software products, comprehensive resource lists, and more. To view the site, please visit <http://www.PETA.org/dissection>.

Educational Efficacy of Non-Animal Learning Methods in Science Education

Nearly all of the more than 40 comparative studies conducted on the pedagogical efficacy of non-animal learning methods like interactive computer simulations have concluded that the learning outcomes of students who are taught using non-animal methods are equivalent or superior to those of their peers who are taught using traditional animal-based methods such as dissection.³

A systematic review published in 2007 in the *Journal of the American Veterinary Medical Association* concluded that "alternatives are a viable method of instruction in the field of biomedical education."⁴ In all 17 studies that the authors reviewed, students using non-animal alternatives learned as well as or better than their counterparts who used

¹L.A. Hart *et al.*, *Why Dissection? Animal Use in Education* (Westport, Conn.: Greenwood, 2007).

²B. Baker, "New federal task force tackles amphibian troubles," *BioScience* 49.5 (5 May 1999).

³Physicians Committee for Responsible Medicine, "Comparative Studies of Dissection and Non-Animal Alternatives" <http://www.dissectionalternatives.org/concerned/dissection_comparative_studies.pdf>.

⁴G.J. Patronek and A. Rauch, "Systematic Review of Comparative Studies Examining Alternatives to the Harmful Use of Animals in Biomedical Education," *Journal of the American Veterinary Medical Association* 230.1 (2007): 37–43.

animals. Another review study reiterated these results, concluding that non-animal methods have been responsible for providing students with "superior understanding of complex biological processes, increased learning efficiency, and increased examination results."⁵ It also reported higher confidence and satisfaction levels in students as well as improvements in their information-retrieval and communication skills and preparedness for laboratories. In terms of the benefits to educators, non-animal methods offer increased teaching efficiency, lower costs, and enhanced potential for the customization and repeatability of learning exercises.

In one series of studies, seventh-grade students "who were taught frog internal anatomy via either traditional frog dissection or CD-Tutorial ... retain[ed] the information equally with an alternative versus traditional dissection."⁶ A study of secondary-level students in which one group of students used animal dissection and the other group used the Net-Frog interactive software found that the two groups performed equally on a test following the exercises.⁷ In another study, a video-disc simulation program was used to teach introductory undergraduate anatomy, and researchers concluded that "students taught rat anatomy via computer-based instruction scored higher on average than students taught using conventional dissection, regardless of how much time each student spent on the class."⁸

In terms of more "hands-on" learning methods, recent studies have found that students who learned anatomy by doing something as simple as building clay sculptures of body systems scored higher than their classmates who performed cat dissections.^{9,10,11,12}

One software developer, Digital Frog International, Inc., conducted an in-depth study to evaluate the ways in which its programs meet the educational needs of American K-12

⁵A. Knight, "The Effectiveness of Humane Teaching Methods in Veterinary Education," *ALTEX* 24.2 (2007): 91-109.

⁶C.S. Marszalek and J. Lockard, "Which Way to Jump: Conventional Frog Dissection, CD-Tutorial, or Microworld?" Proceedings of Selected Research and Development Papers Presented at the National Convention of the Association for Educational Communications and Technology (Houston: 1999).

⁷R.T. Strauss and M.B. Kinzie, "Student Achievement and Attitudes in a Pilot Study Comparing an Interactive Videodisc Simulation to Conventional Dissection," *American Biology Teacher* 56 (1994): 398-402 <<http://frog.edschool.virginia.edu>>.

⁸M. Predavec, "Evaluation of E-Rat, a Computer-Based Rat Dissection, in Terms of Student Learning Outcomes," *Journal of Biological Education* 35.2 (2001): 75-80.

⁹J.R. Waters *et al.*, "Cat Dissection vs. Sculpting Human Structures in Clay: An Analysis of Two Approaches to Undergraduate Human Anatomy Laboratory Education," *Advances in Physiology Education* 29.1 (2005): 27-34.

¹⁰H.K. Motoike *et al.*, "Clay Modeling as a Method to Learn Human Muscles: A Community College Study," *Anatomical Sciences Education* 2.1 (2009): 19-23.

¹¹M.E. DeHoff *et al.*, "Learning Outcomes and Student-Perceived Value of Clay Modeling and Cat Dissection in Undergraduate Human Anatomy and Physiology," *Advances in Physiology Education* 35 (2011): 68-75.

¹²J.R. Waters *et al.*, "Human Clay Models Versus Cat Dissection: How the Similarity Between the Classroom and the Exam Affects Student Performance," *Advances in Physiology Education* 35.2 (2011): 227-236.

students.¹³ Evaluations are available for eight states, including California, New Mexico, Oklahoma, Missouri, Florida, Illinois, Michigan, and Texas. In addition, the California Department of Education-funded California Learning Resource Network has evaluated a virtual anatomy and physiology program—Digital Frog International’s Digital Frog 2.5—and determined that it meets all the science educational objectives for grades 5-12 for which dissection has traditionally been used.¹⁴

Teachers also benefit from using non-animal alternatives. Studies have shown that computer-based teaching methods "saved academic and non-academic staff time, ... were considered to be less expensive and an effective and enjoyable mode of student learning ... [and] contributed to a significant reduction in animal use."¹⁵ Multiple studies have concluded that computer-based learning is more time-efficient than dissection and other animal-based teaching methods.^{16,17}

Additional Pedagogical, Psychological and Sociological Benefits of Alternatives to Animal Dissection

In addition to the aforementioned benefits, it should be noted that replacing animal-based lessons with humane alternatives creates a more inclusive learning environment for students. Research has shown that students at all levels are uncomfortable with the harmful use of animals in classrooms and in science.^{18,19,20,21,22,23,24,25,26,27} A 2003 Gallup youth survey found that 55 percent of people ages 13 to 17 opposed the use of animals in

¹³Digital Frog International, "DFI Software and Curriculum Standards," 2008
<<http://www.digitalfrog.com/resources/curriculum.html>>.

¹⁴California Learning Resource Network, 2008
<<http://clrn.org/search/search.cfm?search=1&publisherid=425>>.

¹⁵D.G. Dewhurst and L. Jenkinson, "The Impact of Computer-Based Alternatives on the Use of Animals in Undergraduate Teaching," *ATLA* 23 (1995): 521–30.

¹⁶M. Predavec.

¹⁷C. Youngblut, "Use of Multimedia Technology to Provide Solutions to Existing Curriculum Problems: Virtual Frog Dissection," unpublished doctoral dissertation, George Mason University, 2001.

¹⁸D. Solot and A. Arluke, "Learning the Scientist's Role: Animal Dissection in Middle School," *Journal of Contemporary Ethnography* 26.1 (1997): 28–54.

¹⁹M. Stanisstreet, N. Spofforth, and T. Williams, "Attitudes of Undergraduate Students to the Uses of Animals," *Studies in Higher Education* 18.2 (1993): 177–96.

²⁰G. Barr and H.A. Herzog, "Fetal Pig: A Qualitative Study of the High School Dissection Experience," *Society & Animals* 8 (2000): 55-69.

²¹K. Millett and R. Lock, "GCSE Students' Attitudes Towards Animal Use: Some Implications for Biology/Science Teachers," *Journal of Biological Education* 26.3 (1992): 204-208.

²²W. Smith, "Use of Animals and Animal Organs in Schools: Practice and Attitudes of Teachers," *Journal of Biological Education* 28.2 (1994): 111-117

²³A. Bowd, "Dissection as an Instructional Technique in Secondary Science: Choice and Alternatives," *Society & Animals* 1.1 (1993): 83-88.

²⁴R. Downie.

²⁵R. Downie and J. Meadows, "Experience with a Dissection Opt-Out Scheme in University Level Biology," *Journal of Biological Education* 29.3 (1995): 187-194.

²⁶R. Downie and L. Alexander, "The Use of Animals in Biology Teaching in Higher Education," *Journal of Biological Education* 23.2 (1989): 103-111.

²⁷T. Lord and R. Moses, "College Students' Opinions about Animal Dissections," *Journal of College Science Teaching* 23.5 (1994): 257-270.

science,²⁸ and a 2009 Pew Research Center poll found that 58 percent of adults ages 18 to 30 opposed the practice as well.²⁹ In addition, exposing young people to animal dissection as "science" can foster a callousness toward animals and nature and even dissuade some from pursuing careers in science.^{30,31} Students who are forced to take part in actions that they find ethically objectionable (or observe their peers participating in such actions) may also suffer psychological trauma, and placing students in these conflict-laden environments actually hampers their ability to learn new information.^{32,33,34}

Examples of Computer-Based Learning Methods

We are aware that there are many options available and that some, unfortunately, are out-of-date and do not accurately reflect the state of the art of dissection simulation. With such a large selection available, we realize that it can be difficult for educators to navigate the options effectively and find those that suit their needs.

The excellent computer-based simulations listed here can completely replace the use of animals. In addition, these alternatives provide students with a richer, fuller learning experience that enhances their science education; introduce them to ethical, modern science; and teach them compassion for animals and respect for nature. Just a few of the commercially available programs suitable for studying animal anatomy and physiology include DigitalFrog's Digital Frog 2.5, Tactus Tech's three-dimensional V-Frog software, Tangent Scientific's DryLabPlus Fetal Pig or DryLabPlus Suite (frogs, earthworms, rats, fetal pigs, crayfish, and perch), Glencoe's Interactive Dissections (frogs and earthworms), several programs from BioLab (fish, frogs, transgenic flies, fetal pigs, cats, and invertebrates), and Froguts (frogs, starfish, owl pellets, cow eyes, squid, and fetal pigs).

For studying human anatomy and physiology, sophisticated interactive software programs such as Pearson's Practice Anatomy Lab (PAL) and McGraw-Hill's Anatomy & Physiology Revealed are used at many schools to effectively teach human anatomy without harming animals. Some programs, such as PAL, also contain comparative anatomy features with anatomy sections for cat, fetal pig, and other animal species.

Animals (regardless of whether they are alive or dead) can only be used once, while these resources can be used for many years—an added benefit that could result in significant cost savings for teachers, school districts, and state educational systems. For example, a site license for Digital Frog 2.5—which allows educators to install the software on every

²⁸Gallup, "Medical, Biotech Issues Test Teens' Moral Views," <<http://www.gallup.com/poll/9766/Medical-Biotech-Issues-Test-Teens-Moral-Views.aspx>>.

²⁹The Pew Research Center and The American Association for the Advancement of Science, "Scientific Achievements Less Prominent Than a Decade Ago: Public Praises Science; Scientists Fault Public Media," <<http://people-press.org/reports/pdf/528.pdf>>.

³⁰D. Solot and A. Arluke.

³¹M. Stanisstreet, N. Spofforth, and T. Williams.

³²P. Cunningham, "Animals in Psychology Education and Student Choice," *Society & Animals* 8.2 (2000): 191–212.

³³E.S. Paul and A.L. Podberscek, "Veterinary Education and Students' Attitudes Towards Animal Welfare," *Veterinary Record* 146.10 (2000): 269–272.

³⁴J.A. Kelly, "Alternatives to Aversive Procedures With Animals in the Psychology Teaching Setting" *Advances in Animal Welfare Science* (Boston: Martinus Nijhoff Publishers, 1986) 165–184.

computer in their school as well as burn up to 20 CDR copies—costs less than \$900 and can be used indefinitely, while the cost of setting up animal dissections for 300 students over a period of five years can add up to \$6,850.³⁵ Educators will receive a 30 percent discount on the Digital Frog 2.5 site license when it is purchased through the PETA Web site.³⁶ PETA has also worked with Digital Frog International to offer a 30 percent discount on all products at Digital Frog's Web site (use discount code **PETA30** at checkout).³⁷

Dr. Nancy L. Harrison, a board-certified anatomic and clinical pathologist at Scripps Memorial Hospital in California, gave a presentation ("Virtual Dissection: The Best of the Best") at the National Science Teachers Association (NSTA) national conferences in November 2007 and March 2008 in which she offered demonstrations of Digital Frog 2 and DryLabPlus's Fetal Pig software. Evaluations of these sessions by educators who attended showed that they strongly agreed that the sessions were useful; that they intended to use the material in their classrooms, and that the presentation should be offered at future NSTA conferences.³⁸ Dr. Harrison's narrated video demonstrations of both Digital Frog 2.5 and DryLabPlus Fetal Pig are available at peta.org/dissection.

Endorsements of Non-Animal Methods by Scientists, Educators, and Legislators

The growing consensus in the science education literature is that non-animal learning methods are equivalent or superior to animal dissections, whether measured by objective criteria or by student and teacher preferences. As a result, the NSTA amended its official position statement on animal dissection in 2008 to approve the use of non-animal alternatives as complete replacements for dissection.³⁹

The position statement of the National Association of Biology Teachers (NABT) has also recently been amended to support student dissection choice policies and the use of non-animal alternatives.⁴⁰ The NSTA supports students' right to opt-out of animal dissection as well.

As of 2009, 15 U.S. states had enacted dissection-choice laws or policies that allow K-12 students to opt-out of dissection and require teachers to provide non-animal assignments. Many school districts, universities, and secondary schools have similar policies in place. Additionally, in response to ethical concerns about animal dissection and the availability of effective non-animal alternatives, several countries—including Argentina, Denmark, the Netherlands, and Slovakia—have banned dissection at the elementary and secondary

³⁵Digital Frog International, "Comparison to Real Dissection and Other Virtual Dissection Software," 2008 <<http://www.digitalfrog.com/products/frog-price-comparison.html>>.

³⁶<<http://www.petamall.com/PLPShop.asp?RecordID=509>>.

³⁷<<http://www.digitalfrog.com/products/frog.html>>.

³⁸Nancy Harrison, "Virtual Dissection: The Best of the Best," NSTA National Conference Session Evaluations, Nov. 2007 and Mar. 2008.

³⁹National Science Teachers Association, "Responsible Use of Live Animals and Dissection in the Science Classroom," 2008 <<http://www.nsta.org/about/positions/animals.aspx>>.

⁴⁰National Association of Biology Teachers, "NABT Position Statement: The Use of Animals in Biology Education" <<http://www.nabt.org/websites/institution/File/docs/use%20of%20animals.pdf>>.

levels, while countries such as Australia, India, and Italy no longer include dissection as a curricular requirement.⁴¹

The use of non-animal learning methods also improves preparedness of students who are pursuing careers in the medical professions by better reflecting the learning methods that they can expect to encounter in graduate schools. Nearly 95 percent of U.S. medical schools—including such prestigious institutions as Harvard, Yale, and Stanford—have discontinued the use of animals to teaching medical students and no U.S. medical schools expect or require students to have participated in animal dissection.⁴² Furthermore, the American Medical Students Association (AMSA), the oldest and largest independent association of physicians-in-training in the U.S.,⁴³ passed a resolution in 2007 stating that it "strongly encourages the replacement of animal laboratories with non-animal alternatives in undergraduate medical education."⁴⁴ Today, one can become a board-certified surgeon without ever having dissected an animal, live or dead.

Conclusion

Replacing the use of animals in education with one or more of the many non-animal learning methods available today offers numerous benefits, including reducing the number of animals who are captured in the wild or bred to be killed for dissection; providing a more effective and inclusive learning experience for students; encouraging students to show respect for animals and nature; and conserving the valuable resources of schools and their educators. We encourage you to visit <http://www.PETA.org/dissection>, pass along this information to your colleagues and to contact PETA if you have any questions or comments.

Additional Resources

Software can be obtained, in full and/or demo formats, in several ways. Several organizations offer educational-technology loan programs, including the following:

- ***The Science Bank***

- ***Animalearn***

- The Science Bank will ship loaned items free of charge; educators pay return shipping only. Some items have limited availability, so educators are advised to send in their loan agreements at least a month ahead of time and allow one week for shipping. (<http://animalearn.org>)

- ***Biology Education Advancement Program (BioLEAP)***

⁴¹Physicians Committee for Responsible Medicine, "Dissection Alternatives" <<http://www.dissectionalternatives.org/concerned/education.cfm>>. See also, "Frequently Asked Questions About Dissection," The Humane Society of the United States, 2008 <http://www.humanesociety.org/issues/dissection/qa/questions_answers.html>.

⁴²Physicians Committee for Responsible Medicine, "Medical School Curricula with Live Animal Laboratories" <http://www.pcrm.org/resch/meded/ethics_medlab_list.html>.

⁴³The AMSA is made up of more than 68,000 medical students, premedical students, interns, residents, and practicing physicians from across the U.S.

⁴⁴American Medical Student Association, "House of Delegates 2007 Resolution" <http://www.amsa.org/AMSA/Libraries/Exec_Docs/PPP2010.sflb.ashx>.

National Anti-Vivisection Society

The BioLEAP program's library of non-animal learning methods includes dozens of high-relief, three-dimensional plastic models, computer software programs, color transparencies, videotapes, and other materials. A wide range of species is included in the library, from invertebrates to frogs, starfish, perch, sharks, rats, cats, fetal pigs, and humans.

(http://www.navs.org/site/PageServer?pagename=ain_edu_dissection_loan_program)

- ***Ethical Science & Education Coalition (ESEC) Lending Library
New England Anti-Vivisection Society***

The ESEC Lending Library offers a variety of educational materials, including computer software, videos, and monitoring equipment. Items can be borrowed for a two-week period and, depending on demand, subsequently renewed. Educators pay return postage only.

(http://www.neavs.org/esec/alternatives/alt_dissectionalternatives_ESEC_availability.htm)

- ***Humane Education Loan Program (HELP)
The Humane Society of the United States***

HELP's materials are available for the cost of return postage, although fines are levied for damaged or missing items. Valid credit-card information and an approximate return date are required before materials are released. Educators should contact HELP at least two weeks prior to the anticipated use date.

(http://www.humanesociety.org/parents_educators/humane_education_loan_program.html)

- ***InterNICHE Alternatives Loan System
InterNICHE***

The InterNICHE Alternatives Loan System is an evolving library of multimedia CD-ROMs, videos, models and mannequins. It covers fields such as anatomy, physiology and surgery. Teachers and students from anywhere in the world can borrow items from the Loan System to trial them. Products are listed by discipline, then medium, and finally alphabetically. Details of each product can usually be found by clicking on the link to the producer. (http://www.interniche.org/alt_loan.html)

There are also online resources that educators can use and/or download free. Some of the programs are provided in full while others are demo versions of software that can be purchased in complete form. Two sites that provide extensive hyperlinks to these resources are the following:

- ***The Physicians Committee for Responsible Medicine Dissection Alternatives Web Site*** (<http://www.dissectionalternatives.org/alternatives/online.php>)
- ***Andrew Knight—Humane Learning Web Site*** (http://www.humanelearning.info/links_and_lists/alternatives.htm)