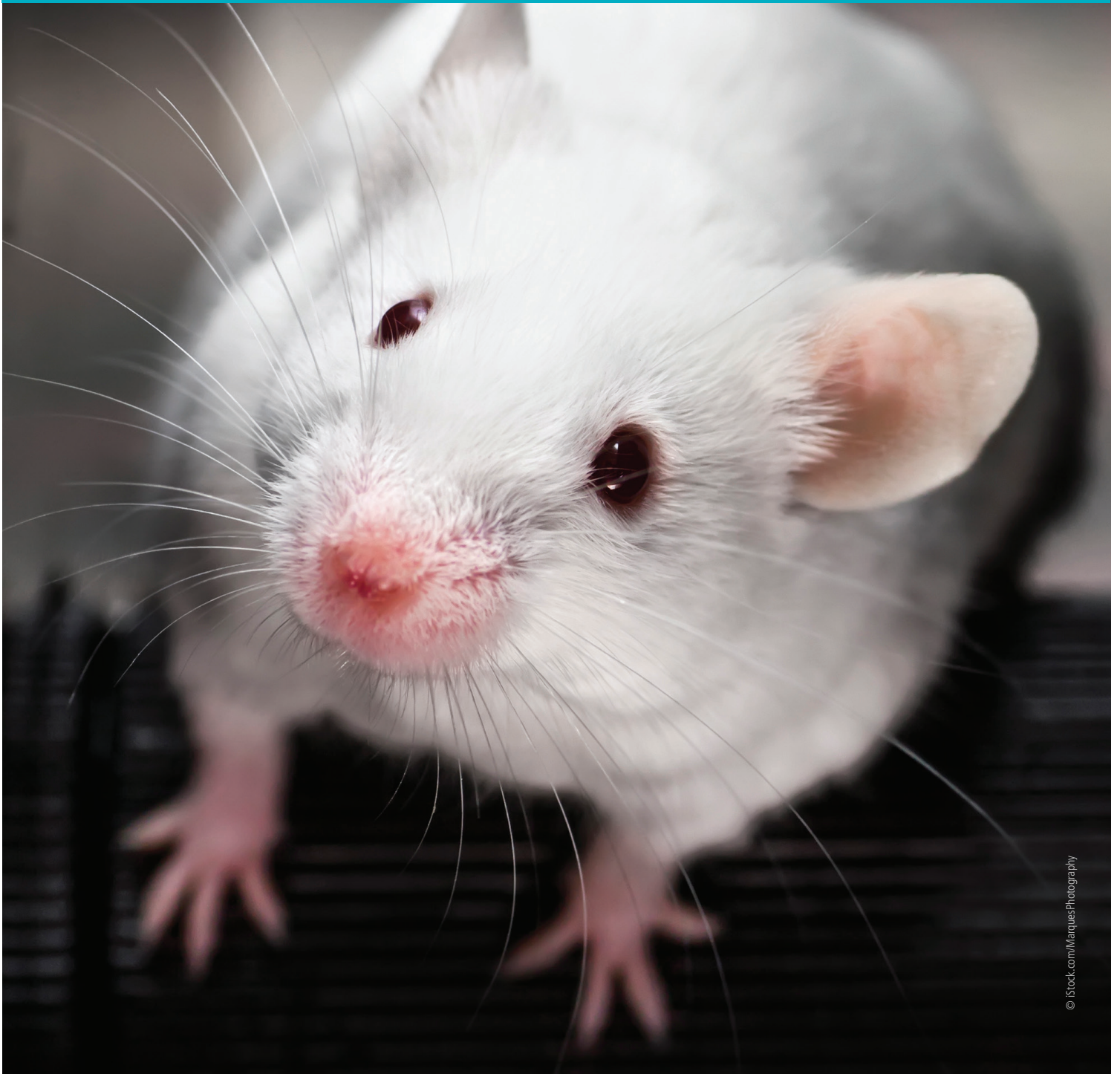


— Humane Alternatives to — **ANIMAL DISSECTION:** A Practical Guide to Cutting Out Dissection



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Introduction

Educators all over the world are modernising their teaching programmes by replacing crude animal dissection with some of the many humane and effective non-animal teaching methods available. Such humane methods will allow students to reach their educational goals and equip them with the scientific skills, knowledge, and understanding required for higher-level learning and progression into the biosciences profession whilst engendering respect for animal life and ensuring that no animals are harmed. As an educational professional, you have the autonomy to choose meaningful activities for your students while meeting the required learning outcomes for your programme. This teaching resource details many of the modern, educationally effective non-animal teaching methods that will help you enhance the education of your students.

Benefits of Non-Animal Teaching Methods in Science Education

For educational, economic, and ethical reasons, a growing number of educators at all levels are choosing to teach science without harming non-human animals in classroom dissection. This humane curricular decision is supported by extensive research showing the educational efficacy of these non-animal methods.

Nearly every peer-reviewed comparative study published has concluded that the educational outcomes of students who are taught basic and advanced biological concepts and skills using non-animal methods are equivalent or superior to those of their peers who use animal-based laboratories.^{1,2} The authors of one systematic review concluded that students taught using non-animal methods demonstrated “superior understanding of complex biological processes, increased learning efficiency, and increased examination results”.³ It also reported that students’ confidence and satisfaction increased as did their preparedness for laboratories and their information-retrieval and communication capabilities.

Animal dissection is not a core skill considered necessary for pursuing a career in either human or veterinary medicine. Today, many students become registered surgeons without ever having cut into an animal – dead or alive – and the leading veterinary schools have opted for dissection policies stipulating



that only animals who have died of natural causes or have been euthanised on veterinary grounds can be dissected.

Non-animal teaching methods benefit educators by increasing teaching efficiency and lowering costs while also affording enhanced potential for the customisation and repeatability of teaching exercises. There is also no expensive disposal of hazardous material, no set-up or clean-up time, no obligatory safety lessons, and no misbehaviour involving animal cadavers, scissors, and scalpels.

Ethical Considerations and Student Perspectives

Studies show that many students reluctantly participate in animal dissection perhaps out of fear of real or perceived punishment or ostracism from their teachers or peers, and many do not speak up about their ethical objections.^{4,5} For this reason, educators must clearly convey the message that students need not compromise their personal beliefs in order to learn science.⁶ Replacing animal dissection opens the door for a new generation of students who can approach science without harming animals.⁷

Basic ethics teaches us that if there are two ways to accomplish a goal – one that involves causing others harm and one that does not – the ethical decision is to choose not to do harm. When discussing the ethics surrounding the dissection of animals, one must consider the animals themselves. All animals used for classroom dissection were once living and many were killed specifically for classroom use. Schools usually purchase them through biological

supply companies, which may either breed and kill the animals themselves – typically after keeping them in barren cages for the entirety of their short lives – or acquire them from pet shops, abattoirs, or animal dealers. Even the use of animal parts (such as eyes and other organs) obtained from an abattoir, where animals have been killed for another purpose, reflects the notion that animals' lives are expendable and have little value except insofar as they are useful to humans.

Many teachers, too, are opposed to animal dissection in the classroom, citing concerns about health and safety, classroom management, learning and retention, cost, and the inability to justify killing animals for this purpose.⁸ Fortunately, educators can help prevent this suffering and enhance students' learning experience and compassion for animals by using any of the modern, life-affirming, educationally effective non-animal teaching methods that are discussed in this informational pack.

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

Internationally, because of the various benefits of virtual dissection and the inherent ethical concerns associated with animal use, many schools and school districts have ended animal dissection. In addition, several countries –

including Argentina, Denmark, the Netherlands, Norway, and Slovakia – have banned dissection at the elementary and secondary levels, while countries such as Australia, India, and Italy no longer include dissection as a curricular requirement.⁹ The government of India has issued guidelines to the Medical Council of India, the Pharmacy Council of India, and the University Grants Commission, instructing them to halt all dissection and experimentation on animals in both undergraduate and postgraduate courses and instead use non-animal teaching methods. In a January 2012 directive, the government stated that non-animal teaching methods such as computer simulations and manikins are “not only effective and absolute replacements to the use of animals in teaching anatomy/physiology but they are also superior pedagogic tools in the teaching of Pharmacy/Life sciences”.¹⁰

Non-animal methods include prepared histology slides, digital dissection simulations, and videos or images of animal dissection, which are preferable to single-use preserved animals. Indeed, videos and images may be digitally enhanced, expanded to show intricate detail, and viewed by millions of students without harming any additional animals. Please pass this information along to your colleagues and contact PETA if you have any questions or comments.



Suggested Activities

PLANT DISSECTION

Students may dissect a plant stem, such as a celery stalk, to prepare and stain longitudinal and transverse sections prior to mounting on a slide. Using a microscope, students will then be able to locate vascular bundles and the xylem, phloem, and sclerenchyma or collenchyma in addition to developing their scientific drawing skills. Furthermore, students will learn to use traditional dissection tools, such as scalpels, forceps, and a dissecting (stereo) microscope, in a safe manner.

Resources

- **Teaching Plant Anatomy Through Creative Laboratory Exercises** full-colour text

www.amazon.co.uk/gp/

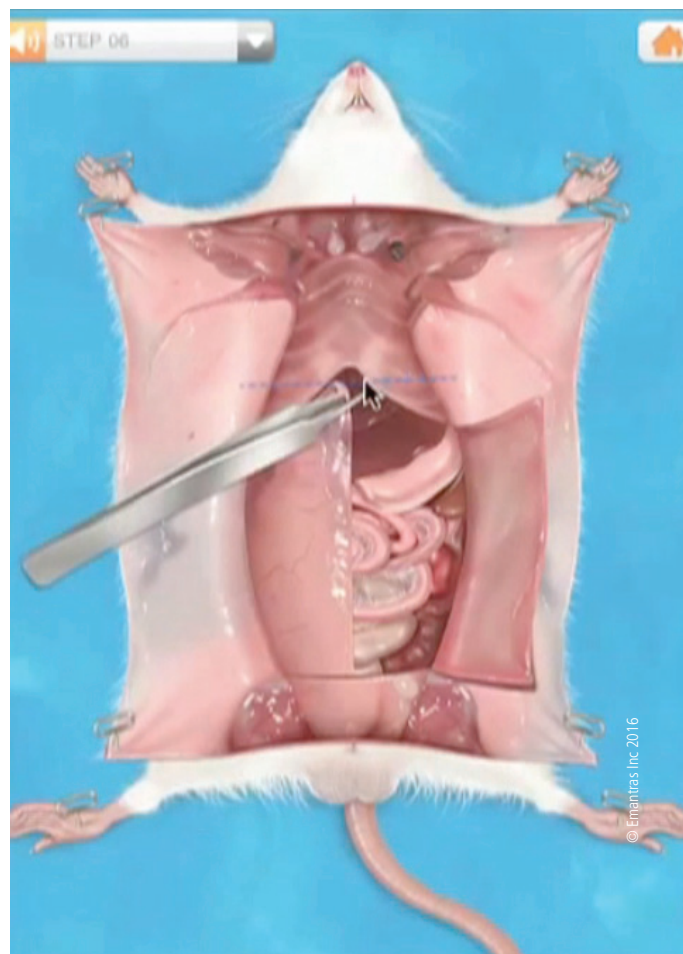
- **'A-Level Set Practicals – Dissection and Microscopy of a Plant Stem'** sample teaching notes for plant dissection

www.saps.org.uk/secondary/teaching-resources/1325-a-level-set-practicals-dissection-and-microscopy-of-a-plant-stem

DIGITAL DISSECTION

Computer software packages offer great benefits, saving staff both time and money and presenting students with an effective and enjoyable mode of learning.^{11,12,13} Unlike animal dissection, in which students have just one opportunity to perform a procedure and learn the requisite content, non-animal methods allow students to repeat the exercises until they are proficient and confident without the distraction of dissecting or harming an animal. Some programmes, such as Froguts, also allow teachers to customise lessons and include built-in test and quiz modules that can track student performance, and some are completely free and available online, including the Whitman College virtual dissection. Furthermore, many software programmes, such as Digital Frog, include modules that demonstrate the inner workings of the living body side-by-side with comparative anatomy modules and content about ecology and behaviour, none of which can be taught with an animal cadaver.

By using an interactive computer programme, students can complete the digital dissection of an invertebrate and a mammalian heart and kidney; compare and contrast the



structure and function of arteries, arterioles, capillaries, venules, and veins; and investigate respiratory rate, capillary flow, and dissolved oxygen levels in fish through virtual physiology experiments. Students can also view prepared/fixed microscope slides of different tissue types.

Free Resources

- **Cornell University tracheal systems of insects**
www.biog1445.org/demo/05/tracheasystems.15.html
- **'How Do Insects Breathe? An Outline of the Tracheal System'**
bioteaching.com/how-do-insects-breathe-an-outline-of-the-tracheal-system/
- **Whitman College virtual dissection of foetal pig urinary system including high-quality images of the kidneys**
www.whitman.edu/academics/departments-and-programs/biology/virtual-pig/excretory-system
- **Niagara Community College virtual anatomy lab covering the urinary system in detail with images and discussion**
www.niagaracc.suny.edu/academics/shm/val/urine.html

Commercially Available Resources

- **eMind Fish** software programme includes the investigation and dissection of three fish, the lamprey, the dogfish, and the yellow perch as well as a section comparing and contrasting the features of these three types of fish. Three minilabs allow students to investigate respiratory rate, capillary flow, and dissolved oxygen levels.
www.emindweb.com/
- **eMind Invertebrate** software programme provides an in-depth study of four common invertebrates. Students will observe and dissect three views of the squid, earthworm, crayfish, and sea star and can also compare and contrast the major systems of each of the four invertebrates. In the minilabs, students will inquire into the effects of different drugs on the heart rate of a daphnia. Also included is a survey of over 20 other different invertebrates.
www.emindweb.com/
- **Froguts** software covers the sea star, cow eye, squid, frog, owl pellet, and foetal pig as well as Mendelian genetics. The foetal pig module includes an interactive and detailed dissection of the circulatory system.
www.froguts.com/
- **Digital Frog International** includes a module on the circulatory system of frogs, comparative anatomy, and a detailed comparison of the structure and function of arteries, arterioles, capillaries, venules, and veins.
www.digitalfrog.com
- **Emantras Inc** iPad rat dissection software app allows students to virtually dissect a rat using digital tools, such as pins, scalpels, and forceps, and has high-definition images of the mammalian heart that may be manipulated in three dimensions.
itunes.apple.com/gb/app/rat-dissection/id418516605?mt=8
- **eMind Cat** is an in-depth study of the anatomy and physiology of the cat. Students will identify and label the muscles in four different views. They will also dissect the digestive, cardiorespiratory, urogenital, and skeletal systems.
www.emindweb.com/

VIRTUAL EXPERIMENTS

As with virtual dissection, interactive computer software allows students to investigate the respiratory rate, capillary flow, and dissolved oxygen levels in fish by collecting and analysing data. Students may also complete virtual neuromuscular experiments, collecting and analysing



data, which can be supplemented by viewing a video of preserved rabbit muscle fibres reacting to the addition of ATP and examining prepared/fixed microscope slides of skeletal muscle in comparison to other muscle types.

Free Resources

- **Rabbit muscle fibre video** allows students to view a prepared skeletal muscle fibre react to the addition of ATP.
www.youtube.com/watch?v=BqCj-S6cQgk

Commercially Available Resources

- **Pearson's PhysioEX** includes virtual experiments on skeletal muscle physiology and neurophysiology that allow students to collect and interpret data.
catalogue.pearsoned.co.uk/educator/product/PhysioEx-90-Laboratory-Simulations-in-Physiology-with-91-Update/9780321929648.page
- **Sheffield Biosciences** offers multiple software programmes that provide virtual physiology experiments, including blood physiology, blood coagulation, nerve physiology, muscle physiology, frog heart, exercise physiology, intestinal absorption, cellular respiration, guinea pig ileum, Langendorff heart, intestinal motility, Finkleman preparation, and rat blood pressure.
www.sheffbp.co.uk
- **Virtual Physiology** programmes include several completely customisable classical laboratory simulations: SimNerv, SimHeart, SimVessel, Drug Laboratory, SimMuscle, and SimNeuron.
www.virtual-physiology.com/
- **Benjamin Cummings' PhysioEx 9.0** is a software set that includes 63 lab activities, covering topics such as cell transport, skeletal muscle contraction, irritability

and conductivity of neurons, hormones and metabolism, cardiovascular dynamics, respiratory processes, digestion, glomerular filtration, acid/base balance, serological testing, and more.

catalogue.pearsoned.co.uk/educator/product/PhysioEx-90-Laboratory-Simulations-in-Physiology-with-91-Update/9780321929648.page

- **A.D.A.M. Interactive Physiology System Suite**

Interactive Physiology 10-System Suite Student Edition covers anatomy and physiology of the cardiovascular, muscular, respiratory, nervous, urinary, endocrine, digestive, and immune systems. Each physiological concept is preceded by a set of goals and an anatomy review and is followed by a thorough quiz that tests mastery of those goals through engaging activities that ask students to predict outcomes, manipulate variables, and measure responses.

www.adameducation.com/ip10s

- **The British Pharmacological Society's "pharmacology"**

is a state-of-the-art, computer-assisted teaching platform that features more than 50 software and teacher-workbook titles produced by pharmacologists. The titles cover various areas of study, including drug metabolism, drug targets, neuropharmacology, the cardiovascular system, simulations, clinical development, asthma, and inflammation.

www.pharmacology.com

- **EduMedia** offers a software set that covers human anatomy, physiology, and metabolism. The trial version is free and available online.

www.edumedia-sciences.com

- **eMind Fish** software programme provides three minilabs that allow students to investigate respiratory rate, capillary flow, and dissolved oxygen levels in fish.

www.emindweb.com/

- **eMind Invertebrate** software programme provides an in-depth study of four common invertebrates. In the minilabs, students will inquire into the effects of different drugs on the heart rate of a daphnia. Also included is a survey of over 20 other different invertebrates.

www.emindweb.com/

- **eMind Frog** software programme provides a muscle contraction experiment that allows students to collect, plot, and interpret data.

www.emindweb.com/

THREE-DIMENSIONAL ORGANS, MODELS, AND PREPARED SLIDES

Forming clay models of organs or examining plastinated specimens, such as the mammalian heart or kidney, can help supplement information learnt during a lecture and offers significant educational advantages over animal dissection. For example, three recent studies at universities across the United States found that students who modelled body systems out of clay were significantly better at identifying the constituent parts of human anatomy than their classmates who performed animal dissections.^{14,15,16} Another study found that students preferred clay modelling over animal dissection and performed just as well as their cohorts who dissected animals.¹⁷



Resources

- **Free lesson plans and detailed instructions for creating a clay model of the human heart and other organs**
lessonplanspage.com/make-3-dimensional-model-of-human-body-parts/
- **Human heart models available through science education vendors**
- **Practice Anatomy Lab 3.0 (PAL), which includes high-quality images of human anatomical models and mammalian organs**
catalogue.pearsoned.co.uk/educator/product/Practice-Anatomy-Lab-30/9780321682116.page
- **Health and Care plastinated hearts and other organs**
www.healthandcare.co.uk/embedded-specimens.html
- **Prepared microscope slides of arteries, arterioles, capillaries, venules, and veins, available at various science education vendors**
www.brecklandscientific.co.uk/Prepared-Animal-Slides-s/7300.htm
www.inds.co.uk/slides/slides.php?category=240&class=500

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PETA International Science Consortium Ltd.

Society Building, 8 All Saints Street, London N1 9RL, United Kingdom
+44 (0) 207 837 6327
PISC@piscLtd.org.uk
PISC Ltd.org.uk