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STUDENT-CENTERED DELIBERATIONS OF Ethical Care & Use of Animals

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Most biology teachers implement animal dissection (real or virtual) and often lead discussions on research involving animal subjects. Such activities provide excellent opportunities to explore ideas about ethical conduct in the care and use of animals. The challenge for teachers is to present information about animal care and use that enables students to contemplate what society considers ethical and lawful, and why. We suggest using a constructivist learning cycle (Yager, 1991) with four main components:

- *Engage* students in the topic by considering everyday encounters between humans and other organisms.
- *Explore* existing ideas about codes of conduct in general and animal use in particular.
- *Explain* federal guidelines about animal care and use.
- *Take action* by considering sample case studies.

The goal of the lesson is not to debate different points of view regarding animal research, but to discuss the scientific ethics of animal care and use. We refer teachers to Chowning (2005) for implementing student debates on science and ethics.

In order to engage students in the topic, a solid understanding of the term *scientific ethics* is necessary. *Ethics* refers to the nature of morals and moral choices made by individuals in relation to other individuals. (Morals are principles of right and wrong.) The prefix, *scientific*, restricts the term to the morals and moral choices made by *scientists* in relation to other scientists and the general public. As such, scientific ethics represent the rules or codes of conduct governing scientists and science educators. A solid understanding of this term helps students recognize that whole societies (not just scientists) decide on the rules governing scientific activities, including animal research.

Being informed about scientific ethics is critical for all members of society. For example, scientists must understand scientific ethics in order to conduct themselves appropriately in their jobs. Science educators must teach students about science, and how to engage in effective dialogue about science and public policy. The general public must make sci-

ence-related decisions (e.g., health care decisions) and must vote based on science-related issues (e.g., for legislators who support using federal income tax money to conduct scientific research). The study of scientific ethics should begin in elementary school and continue throughout the lifespan, particularly during adolescence when advanced decision-making skills are refined.

The goals of teaching scientific ethics via a constructivist learning cycle are:

1. to contribute to personal development by engaging decision-making skills, maintaining student interest in science, and promoting ideas for career development.
2. to create an informed citizenry by integrating science, society, and philosophy, and to smooth transitions to new technologies.
3. to implement the *National Science Education Standards* (NRC, 1996b), including:
 - teaching scientific ethics from a historical perspective (National Content Standard G) to help students learn that science is a human endeavor and the nature of scientific knowledge changes with time.
 - asking students to engage in scientific inquiry (National Content Standard A) when communicating and justifying their case study decisions.
 - having students evaluate the topic of scientific ethics from both personal and social perspectives (National Content Standard F).

Background

To engage students in effective discussions of the scientific ethics surrounding animal research, teachers must acquire a good understanding of related scientific rationales, philosophical points of view, and federal regulations. Members of the scientific community in the United States (U.S.) and most of the world agree that animals should be used in scientific research for several main reasons. First, living organisms provide dynamic systems that can be observed and manipulated experimentally in order to discover mechanisms of normal function as well as problems associated with human and other animal diseases. Second, the use of animals allows humans to obtain a greater understanding of living systems across a wide variety of species. Finally, animal research can lead to the development and use of conservation techniques to save endangered species and maintain species diversity worldwide.

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There are many different philosophical views regarding animal care and use (e.g., Varner & Comstock, 2002). Most scientists maintain the *animal welfare* view, which states that the lives and experiences of animals are valuable. Therefore, humans are obligated to balance harm to animals with benefits to society. In other words, morally right actions and institutions must maximize aggregate pleasure and/or minimize aggregate pain. (Aggregate refers to the entire population of organisms affected, such as all species of animals, including humans.) For example, if sacrificing the lives of several thousand mice in research eventually saves the lives of millions of humans and other animals, then aggregate pleasure has been maximized (human and other animal lives can be lived to their fullest) and aggregate pain has been minimized (humans and other animals no longer suffer from disease). On the other hand, an *animal rights* view states that animals have independent rights and cannot be treated as a means to human ends. Therefore, animal rights proponents oppose animal research, consumption of animals or animal by-products (e.g., beef, chicken, milk, eggs), captive breeding programs (e.g., zoos), wearing animal skin clothing, and even keeping pets (Varner & Comstock, 2002). Some views lie on a continuum between animal welfare and animal rights. For example, while most scientists agree with the use of animals for research, some may disagree on exactly which animals are appropriate for which experiments.

It is lawful to use animals for research in the U.S., but strict regulatory requirements govern animal care and use. The first regulation was the 1966 Animal Welfare Act, which restricts the transport, sale, and handling of animals (dogs, cats, non-human primates, guinea pigs, hamsters, and rabbits). A more recent law is the Public Health Service (PHS) Policy on Humane Care of Laboratory Animals, based on the 1985 Health Research Extension Act. This policy requires compliance with the *Guide for the Care and Use of Laboratory Animals* (National Research Council, 1996a). The PHS Policy extends to all vertebrate animals (including fish and reptiles; National Research Council, 2005; National Research Council, 2003; National Research Council, 1996a).

To enforce the PHS Policy, any institution conducting animal research must establish an Institutional Animal Care and Use Committee (IACUC; often pronounced “eye-ah-cuck”). An IACUC is responsible for reviewing and approving (or denying) all proposed animal experiments, inspecting research facilities twice per year, and monitoring research projects for compliance with the rules. (If scientists do not comply, they must halt their research immediately.) The committee consists of five members and must include a veterinarian, a professional not involved in research (e.g., ethicist, lawyer), and a community representative (e.g., teacher, member of the clergy). The main criteria for approving animal studies include:

1. a justification for using animals, the number of animals to be used, and the species selected
2. procedures to minimize pain and discomfort
3. justification that no alternative procedures can be used
4. an account ensuring that the research does not unnecessarily duplicate previous experiments (National Research Council, 2005; National Research Council, 2003; National Research Council, 1996a).

Scientists can use the concept of the “3Rs” to enhance the scientific value of proposed experiments. The 3Rs recommend *Reducing* the number of animals needed for the experiment to obtain statistically relevant data, *Refining* the experimental proce-

dures to minimize pain and distress, and *Replacing* subjects with phylogenetically “lower” species (e.g., invertebrates instead of vertebrates), *in vitro* models (e.g., tissue culture), or even computer models, when scientifically valid results can still be obtained with these alternatives (National Research Council, 2005).

Learning Outcomes

The purpose of the present lesson plan is to promote an understanding of ethical guidelines followed by animal researchers. High school students (or some middle school students) will be able to:

- define the term *scientific ethics*
- develop their own sample codes of conduct
- list several benefits of animal research
- consider broad ethical aspects of animal care and use
- participate effectively in informed discussions of scientific issues.

Step 1. Engage: Invite Students To Learn & Identify Prior Knowledge

Begin with a short survey in which students answer by raising their hands. The teacher asks, “In the past week how many of you have ...”

- brushed your teeth?
- taken a bath, shower, or washed your hands using soap or cleanser?
- used deodorant or antiperspirant?

The teacher should explain to students that each of these activities results in the direct killing of thousands of organisms. Humans are large mammals, and in order for us to remain healthy, we must remove colonies of invading organisms that make our bodies their homes. (For example, we brush our teeth to remove bacteria. We wash our hands to remove viral particles. We use deodorant to avoid culturing fungi.)

Continue with “In the past month, how many of you have ...”

- ridden in a car, bus, train or airplane?
- walked across the grass?
- eaten dairy products such as milk, yogurt, or ice cream?

The teacher should remind students that all of these activities result in the direct killing of other organisms or at least disruption of their habitats. For example, millions of mammals, birds, reptiles, and amphibians are killed on U.S. roads each year (Finch, 2000). Millions more insects and microorganisms are also killed each day by vehicular traffic. Again, humans leave big “footprints” on planet Earth as we compete with other organisms for resources and territories.

Continue with the last question, “In the past month, how many of you have eaten ...”

- fish, chicken, pork, or beef?
- eggs?
- marshmallows?

The teacher should point out that all of these products come from animals. Even marshmallows are produced with gelatin which comes from the toenails of cows and pigs. Once again, in order for us to survive and flourish, we utilize animals.

Therefore, each of us makes decisions about how big a “foot-print” to leave. Although some people choose not to eat meat from other vertebrates or not to wear animal skins, each of us kills millions of other organisms each day to remain healthy. Therefore, we may draw the line of animal use at different levels, but we all ultimately draw the same line somewhere.

To begin another engaging discussion, the teacher divides the class into small groups at random. One suggestion for grouping students is to construct several small 3-5-piece puzzles out of pictures of organisms. Provide several widely different organisms such as rodents used in research (mice, rats, rabbits), dogs used in human safety (seeing eye dogs, fire rescue dogs), food source animals (cows, chicken), and disease-causing microorganisms (species of viruses and bacteria). On the back of each puzzle-piece, write a role for each student to assume: veterinarian (facilitator—keeps the group on task), animal research scientist (materials manager—gathers supplies), neutral citizen (negotiates between group members to achieve consensus), university professor (communicator—speaks for the group), and non-animal researcher (recorder—writes down group ideas). Hand one puzzle-piece to each student and form small groups by completing the puzzles. Ask them to consider the following questions:

- What is the organism on your puzzle? How would you classify the organism?
- Where can your organism live?
- What would you do if you encountered this organism in a field, in your house, or your bed?
- List at least two ways your organism benefits humans or has benefited from humans?

Give students five minutes to ponder these questions individually, then to discuss them in their small groups. Meanwhile, write the following words on the white board or poster paper: diabetes, depression, leukemia, polio, and blindness. Finally, ask students if they can make connections between their organisms and any of the words. Help them discover:

- Research with dogs, rabbits, and mice in the 1920s led to the discovery of insulin injections, saving millions of human and animal lives from disability or death associated with diabetes.
- Research with primates and mice in the 1950s led to the discovery of a polio vaccine that has eradicated polio from the western world.
- Research with rats, guinea pigs, and rabbits in the 1960s led to the development of drugs now used to treat depression and other mental disorders.
- Decades of research with mice has enabled eight out of ten children with leukemia to be long-term survivors of the disease.
- Service animals help blind and disabled individuals lead more independent lives.
- Humans and other animals, including pets, eat animals as part of the natural food chain.
- Microorganisms including viruses, bacteria, and fungi can cause toxic diseases in humans, other animals, and plants. (For example, the rhinovirus causes the common cold; the bacterium, *Treponema pallidum*, causes syphilis; and fungi such as molds cause crop rot in wheat, corn, beans, and other staple crops.) Other microorganisms contribute to good health. (For example, intestinal

bacteria help break down nutrients from foods in the human digestive tract.)

Students may wish to express their views about animal research. Table 1 can help teachers identify student misconceptions during this lesson. If students express misconceptions, probe further by asking “Why do you think that?” Use this initial phase of the lesson to identify what students think and why. However, wait until the explanation phase of the lesson (Step 3) to clear up student misconceptions.

Step 2. Exploration: Facilitate Exploration of Ideas

Implement an excursion exercise by facilitating a class discussion about whether people should have pets, raise farm animals, or conduct animal research. (Remind students to value and respect opposing viewpoints.) Ask students to justify their thoughts. Ask “What is scientific ethics?” and “Who decides if something is ethical?” With these questions, students can begin to design working definitions for the term *scientific ethics*. Ask if we should have rules to protect animals and what these rules should be. On the board, list some of the rules with which most students agree, and describe this list as your class “code of conduct” (rules for behavior) for animal care and use. Facilitate further discussion by defining the terms, *scientific ethics* and *code of ethics*.

If time permits, students can experience firsthand how challenging it is to develop codes of ethics. Encourage each small group to devise a code of conduct for any familiar activity, such as playing at the pool, playing a sport, or caring for a pet. After about ten minutes, let each group present its code of conduct and discuss whether or not everyone would agree with it. Students should see how rules are made to clarify what to do in certain situations. However, not everyone always agrees on which rules are necessary or appropriate, and codes of conduct often balance safety concerns with personal freedoms.

Step 3. Explanation: Presenting a Scientific View

The goal of the explanation section of the lesson is to enable students to learn about scientific codes of conduct for animal research. Start by explaining to students that current law stipulates that research scientists who want to perform experiments using animals must submit a proposal to an IACUC. (Table 2 summarizes information about the IACUC and can be used as a student handout.) Use a teacher-facilitated discussion of the handout and the background topics to resolve related student misconceptions at this time (e.g., from Table 1). Place special emphasis on the following ideas:

- Animal research should benefit the health or welfare of humans or other animals.
- Animal discomfort should be minimized.
- Animals reared in the laboratory should not be released into the wild. In most cases, releasing laboratory animals could result in their death and/or could be harmful to the natural wildlife and fragile ecosystem.

During the facilitated discussion, some students may express opinions based on the animal rights point of view. Entertaining these ideas respectfully provides a good model of effective discourse. Table 3 can be provided to help students understand how the animal welfare and animal rights views differ.

Table 1. Myths and Facts of Animal Research.

MYTHS	FACTS
1. Myth: Research on animals is not relevant to people because animals are different from people. People and animals suffer from different illnesses.	Humans are biologically very similar to other animals (particularly other mammals) and have the same organs performing the same functions.
2. Myth: Animal testing is unreliable, because drugs have different effects in people and animals. The result is that drugs passed as safe in animals are found to have serious side effects in people.	Drugs pass extensive screening prior to being tested on humans and other animals, giving valuable information on how drugs react and reveal potential problems such as liver or nerve damage.
3. Myth: Animal research has not made any contribution to medical progress.	The contributions of animal research to medical progress include the discovery of insulin, antibiotics to treat bacterial infections, vaccines to control viral infections, advances in surgery, and treatments of leukemia, asthma, and ulcers, to name a few.
4. Myth: The use of animals in biomedical research is unnecessary because equivalent information can be obtained by alternative methods.	Non-animal methods are very useful when they have been previously studied in animal systems; however, new avenues of research and treatments must first be tested on animals because it is unethical and illegal to expose patients to new medicines without investigating the medications' benefits and potential harm.
5. Myth: Vaccines and antibiotics have achieved nothing. Public health measures such as clean water and good sanitation are the solution to the problem of infectious disease.	Vaccines and antibiotics have alleviated considerable human and animal suffering. Society still faces new diseases caused by viruses such as HIV, West Nile, and malaria which kill millions of people a year. The most effective way to reduce these deaths is through vaccination.
6. Myth: Many pointless, unnecessary animal experiments are carried out.	Unnecessary animal research is unlikely because of strict regulations, high associated costs, labor intensiveness, and limited funding.
7. Myth: Animal research is carried out for profit.	Most animal research is carried out by non-for-profit organizations such as universities.
8. Myth: Most research animals are cats, dogs, or monkeys.	More than 80% of the animals used in research are rodents such as mice and rats. Dogs and cats represent .005%, while primates (monkeys and apes) represent less than .002%. The remaining subjects are invertebrates.
9. Myth: There are no laws or regulations protecting laboratory animals.	Both national and international legislation protect the welfare of animals in research.
10. Myth: Researchers do not care about the well-being of laboratory animals.	The use of unhealthy, stressed, or frightened animals reduces the reliability of experiments. Therefore, it is in the researchers' best interest to be concerned about the welfare of the animals.
11. Myth: Laboratory animals suffer great pain and distress.	Most experiments cause insignificant amounts of pain or distress involving something as simple as a change in diet or taking blood samples. In the few experiments that could cause significant discomfort, pain is minimized through the use of anesthetics or pain-killing drugs.

Modified from the Web site <http://www.rds-online.org.uk/pages/page.asp?i=2&i=48>.

Addressing the differences may help students to be open-minded during this explanation phase.

Step 4. Take Action: Apply & Expand Student Knowledge via Case Studies

Give each group a case study and questions (e.g., from Radford, 1992). A case study is usually a fictional, but realistic, scenario involving an ethical dilemma to consider and solve. Each group can have a different study, or two groups can separately consider the same study to see how different groups arrive at different conclusions. A key to case study discussions is that students participate with open minds and work through cases together. (If roles were assigned to students on puzzle-pieces, use them now.)

Sample Case (modified from Radford, 1992)

You have been appointed to a five-member animal care and use committee to review a proposed science fair research project that involves the use of animals. Please read the proposal carefully and prepare to answer the following:

1. What is the ethical dilemma? (Describe the case.)
2. How is the proposed research important?
3. What are some of the facts that need to be considered for scientific ethics purposes?
4. What aspects of the proposal meet the code of ethics for animal research?
5. What questions pertaining to the code of ethics does the researcher need to answer?

Table 2.

INSTITUTIONAL ANIMAL CARE AND USE COMMITTEE (IACUC)
Committee members consist of five members and must include: ▼ A veterinarian ▼ A professional (ethicist, lawyer, etc.) not involved in the research ▼ A community representative (clergy, teacher, etc.)
Role of the committee: ▼ Review and approve or deny all proposed animal experiments ▼ Inspect research facilities twice a year ▼ Monitor the project for compliance
Main criteria for approving studies: 1. A justification for using animals, the number of animals to be used, and the species selected 2. Procedures to minimize pain and discomfort 3. Explanation of a search for methods and sources for alternative procedures that are not painful 4. Account ensuring that a previous experiment is not being unnecessarily duplicated
The 3 Rs ▼ Reducing the number of animals needed for the experiment to obtain statistically-relevant data ▼ Refining the experimental procedures to minimize pain and distress ▼ Replacing animals with phylogenetically “lower” species or even computer models when scientifically valid results can still be obtained.

Information obtained from the National Research Council, 2005.

6. What are some options or recommendations to give the researcher? (List at least three.)
7. What is the group’s consensus regarding the course of action to be taken?

Chris, a 17-year-old high school student, would like to conduct an experiment on white mice to investigate the effects of caffeine on memory. After giving mice different doses of caffeinated soft drinks, Chris plans to make behavioral observations of the mice finding their way through a maze. For about two years, Chris has successfully raised and taken good care of white mice. The experiment will be carried out in a heated and lighted room located in the basement of Chris’s home.

In this particular case, students might question if the research is beneficial to humans or other animals, if a limited number of mice will be used, if the mice would be exposed to any pain or discomfort, and if the mice would be released back into the natural environment after the research. The essential question for every case is: What are the ethical codes of conduct confronted by the characters?

We agree with Chowning (2005) that “case studies make excellent starting points for ethical discussions.” She suggests a decision-making framework consisting of (1) determining known and unknown facts, (2) identifying stakeholders and their values, (3) generating possible solutions, (4) providing a decision with logical justification, and (5) acting on and evaluating the decision.

Therefore, as a closure to this lesson plan, enable students to present their case studies and solutions to the class. Along with clarifying the ethical dilemma and presenting a recommended course of action, groups should address the questions

Table 3. Comparison of Animal Welfare and Animal Rights Views on the Care and Use of Animals.

STATEMENT	BELIEFS
1. Animals should be used to conduct medical research only in experiments that follow the Guide for the Care and Use of Laboratory Animals.	Animal welfare proponents and various laws regulating research support this view. Animal rights proponents do not support the use of animals in research under any conditions.
2. Performing research with animals benefits humans.	Animal welfare proponents recognize the medical discoveries (vaccines, medicines, etc.) developed through animal research to save human and other animal lives. Animal rights proponents do not support this view.
3. People should be allowed to keep pets.	Animal welfare proponents support this view and suggest that humans are stewards of animals and as such are responsible for taking good care of the pets they keep. Animal rights proponents tend to oppose this view.
4. Captive breeding programs for endangered species are important for their continued survival.	Animal welfare proponents recognize the value of captive breeding programs as a method of preserving species diversity especially for endangered species. Animal rights proponents do not support this view and believe that animals should not be maintained by humans for any reason.
5. Consumption of animals and animal by-products such as milk and eggs is acceptable.	Animal welfare proponents support this view. Animal rights proponents do not support the consumption of any animal or animal by-product.
6. Animal research should be conducted if the benefits to humans outweigh the costs to the animals.	Animal welfare proponents support this view. Animal rights proponents do not support the use of animals in research under any conditions.
7. It is acceptable to destroy property or harm other humans (and possibly even animals such as guard dogs) if this results in the disruption of animal research or farming activities.	Animal welfare proponents, and the laws, oppose such terrorist tactics. Some extreme animal rights proponents support this view and may engage in this behavior.

provided in each individual case. Presentations can be assessed by whether students identify and understand the issues, including the importance of IACUC function and the application of scientific ethics.

Conclusions

Overall this lesson plan uses a non-threatening, constructivist approach to challenge students to examine scientific ethics regarding animal care and use. Case studies are non-threatening because there are many acceptable answers. By the end of the lesson, students apply new knowledge about federal regulatory guidelines. They also learn to participate in group discussions with open minds and to draw conclusions on the basis of consensus.

Additional Resources

A 2005 National Academy Press publication, *Science, Medicine, and Animals*, presents background information, six lessons, and a teacher's manual for extension activities. (Order through the National Academy Press or download from <http://darwin.nap.edu/books/0309088941/html/R1.html>.)

The Web site "Understanding Animal Research in Medicine" provides short articles on the benefits of animal research to human health and/or life expectancy, including information on vaccines for polio, diphtheria, whooping cough, and meningitis; medicines for asthma, diabetes, penicillin, and leukemia; and surgical methods for anesthetics, heart lung machine, replacement valves, and transplants. The site can be found at <http://www.rds-online.org.uk/> and also describes current research on breast cancer, pain prevention, HIV/AIDS, and depression.

Members of the scientific community can also serve as excellent resources. Invite members of your local IACUC to your class and ask them to discuss their work. (Also see <http://www.sfn.org/index.cfm?pagename=neuroscientistTeacherPartners> for ideas on forming partnerships with scientists.)

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