Credits

AUTHORS AND CONTRIBUTORS

Dawn Brown, MIT
Science Teacher, Truman Career Academy, Federal Way, WA

Jeanne Ting Chowning, MS
Director of Education, Northwest Association for Biomedical Research, Seattle, WA

Elise Cooksley, MS
Faculty, Two Rivers High School, North Bend, WA

Joan Griswold, MIT
Curriculum Design Lead, Northwest Association for Biomedical Research, Seattle, WA

Rosetta Eun Ryong Lee
Faculty, Seattle Girls School, Seattle, WA

Alaron Lewis, PhD
University of Washington

Jodie Spitze
Faculty, Kent-Meridian High School, Kent, WA

FIELD TEST TEACHERS

Dawn Brown, MIT
Science Teacher, Truman Career Academy, Federal Way, WA

Jamie Cooke, MIT
Faculty, Mercer Island High School, Mercer Island, WA

Elise Cooksley, MS
Faculty, Two Rivers High School, North Bend, WA

Rosetta Eun Ryong Lee
Faculty, Seattle Girls School, Seattle, WA

Deborah North, BBA, MIT
Teacher, Technology Access Foundation Academy, Federal Way, WA

Dawn Tessandore
Science Teacher, Highline High School, Burien, WA

Dianne Thompson, NBCT
Biotechnology Teacher, Kent Meridian High School, Kent, WA

EXPERT REVIEWERS

Susanna Cunningham, BSN, PhD, FAAN, FAHA
Professor, Department of Biobehavioral Nursing & Health Systems
University of Washington, Seattle WA

Carrie La Jeunesse, DVM, CT, CCFE
Immediate Past President, Washington State Veterinary Medical Association

Cynthia Pekow, DVM, DACLAM
Chief, Veterinary Medical Unit
Veterans Affairs Puget Sound Health Care System

PROJECT MANAGEMENT, EDITING, AND CURRICULUM PRODUCTION

Kristen Bergsman, MEd
Laughing Crow Curriculum LLC

COVER DESIGN

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Designed by Clayton DeFrate Design

GRAPHIC DESIGN

Clayton DeFrate Design

COPYEDITING

Polly Freeman, MA

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COLLABORATIONS TO UNDERSTAND RESEARCH ETHICS (CURE) LEADERSHIP TEAM

Jeanne Ting Chowning, MS
Principal Investigator, CURE
Director of Education
Northwest Association for Biomedical Research

Susan Adler
Co-Principal Investigator, CURE
Executive Director
Northwest Association for Biomedical Research

Joan Griswold, MIT
Curriculum Design Lead
Northwest Association for Biomedical Research

CURE ADVISORY BOARD

Bill Cameron, PhD
Associate Professor, Dept. of Behavioral Neuroscience
Oregon Health and Science University

Carolyn Cohen, MEd
Cohen Research & Evaluation

Susanna Cunningham, PhD
Professor
Dept. of Biobehavioral Nursing & Health Systems
University of Washington

Nora Disis, PhD
Director, Center for Translational Medicine in Women's Health
Institute for Translational Health Sciences
University of Washington

Kelly Edwards, PhD
Associate Professor, Dept. of Bioethics and Humanities
Director, ELSI/Outreach Core, Center for Ecogenetics and Environmental Health
University of Washington

Judy Fenyk-Melody, DVM, DACLAM
Director, Preclinical
Amgen

José Lopez, MD
Executive Vice President for Research
Puget Sound Blood Center

Dana Riley Black, PhD
Center for Inquiry Science
Institute for Systems Biology

Louisa Stark, PhD
Director, Genetic Science Learning Center
Eccles Institute of Human Genetics
University of Utah

Beverly Torok-Storb, PhD
Senior Scientist
Fred Hutchinson Cancer Research

Reitha Weeks, PhD
Program Manager, Science Outreach
Northwest Association for Biomedical Research

Elaine Woo
Science Program Manager
Seattle Public Schools

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The Science and Ethics of Animal Research

CURRICULUM OVERVIEW

Why do scientists use animals in research? Few topics elicit such a strong reaction as that of animal research, and many teachers are hesitant to address the subject. Yet every vaccine, breast cancer treatment, heart surgery technique, and prescription drug developed has used animal models and subjects. How do ethical considerations influence the use of animals? What does the history of animal research tell us about current views and policies? Furthermore, how can we discuss this topic in a respectful manner?

This curriculum introduces students to the way animal research is conducted, the numbers and types of animals used, alternatives to animal research, rules and regulations involved, and the bioethical frameworks used by those in support of, and in opposition to, this research. Throughout the unit, students are encouraged to consider how their own actions reflect their position on the issue. Lesson strategies and bioethical discussions engage students in science content, as well as promote an understanding of the role of science in society.

RESEARCH ETHICS SERIES ENDURING UNDERSTANDINGS

- The biomedical research process is complex and dynamic, requiring information and tools of reasoning.
- The biomedical research process is driven by potential benefits to humans and animals.
- The biomedical research process has evolved as scientists and other members of society have reflected on acceptable practices. It continues to do so as our knowledge expands.
- The biomedical research process requires active participation by scientists, consumers, voters, and research participants.

The Science and Ethics of Animal Research curriculum is part of NWABR's Research Ethics Series.

LESSON OVERVIEW

The ***5 E Learning Cycle Model***, as publicized through its use in the BSCS (Biological Sciences Curriculum Study) science program, incorporates five phases of learning: engagement, exploration, explanation, elaboration, and evaluation. The lessons in this curriculum follow the 5 E Model, guiding students through this powerful cycle of learning. In the descriptions of the lesson plans provided below, notes indicate which stage of the 5 E Learning Cycle Model aligns with each lesson plan.

Lesson One: Introduction to Animal Research

"Engage"
Lesson One is made up of two activities. In the first activity, students begin a unit-long written conversation (Chalk Talk) in which they explore and share their thoughts and ideas about animal research by silently responding to statements, pictures, and questions posted on the classroom walls. The posters remain on the classroom walls throughout the unit and are revisited by students in Lessons 1, 3, and 5 of the unit. This provides teachers with a formative assessment of students' understandings about animal research and humans' uses of animals.

In the second activity, students explore a number of human activities which result in animal deaths: raising animals for food, hunting, abandoning animals in shelters (which results in euthanasia), using animals in scientific research, driving on U.S. roads and highways. Students predict the number of animals impacted by each activity and then compare their predictions to actual numbers. In addition, students take a closer look at animals used only for scientific research and make predictions about what types and how many animals are used for this purpose. Lastly, students consider any possible benefits and supervision for each category.

Lesson Two: Why Use Animals in Research?

"Explore & Explain"
Students begin this lesson by watching video vignettes exploring the "3 Rs" (*Replacement*, *Reduction*, and *Refinement*) that guide scientists in conducting humane research with animals. Student groups are then introduced to several types of models, including model organisms, which scientists may use to answer different types of research questions. Using a set of Research Model Cards, students explore research questions and evaluate possible methods to determine the most appropriate model for answering the research questions.

Lesson Three: History of Animal Research

"Explain"
Students are introduced to a brief history of animal research through a timeline mapping activity. Students are asked to order the events in the timeline and highlight the occurrence of significant events. A discussion about significant events and trends helps students understand the impacts of history on today's regulations, governing bodies, and uses of animals in research. An extension to this lesson explores the meaning of the phrase *Not Tested on Animals*.

Lesson Four: Exploring Ethical Viewpoints

"Explore & Explain"
In this lesson, students are introduced to duties-based and outcomes-based ethical theories through a series of actual quotes from people who hold different views on animal research. Students then role-play the stakeholder positions. First students identify their stakeholder's stance as coming from a primarily duties-based or outcomes-based ethical perspective, when possible, and then students align themselves around the room based on their stakeholder's assumed support of or opposition to the use of animals in research. While standing with other student stakeholders holding similar views, students record their group's top three supporting arguments. Groups with different perspectives then join together for a Structured Academic Controversy to present and listen to alternative viewpoints. Lastly, students drop their stakeholder roles and further define and justify their individual position on the issue.

Lesson Five: Case Study Decisions

"Elaborate"
In this lesson, students read one of three case studies involving animals in research. Students work through a Decision-Making Framework in small groups, in which they identify the ethical question, determine which facts are known or unknown, consider the values of different stakeholder groups, generate possible solutions, and then make and justify a decision about the case. This is a jigsaw exercise, in which students first meet in "like" stakeholder groups to become experts on the values and concerns of that group. Teams are then rearranged so that each new group has students from different stakeholder viewpoints. After sharing the views and values of each stakeholder group with their peers, groups work together to generate options for solutions to the case study. Lastly, students come to individual decisions about the case and write a thorough justification. [**Note:** Some field test teachers suggest transitioning from *Lesson Four* directly to the *Assessment* and using this lesson as a reflective tool for re-visiting the topic at a later date].

Assessment

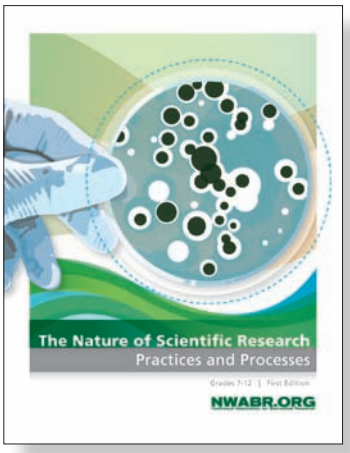
"Evaluate"
At the beginning of *Lesson One*, students engaged in a silent Chalk Talk regarding their personal understandings and beliefs about animal research. By beginning successive lessons with students adding to these conversations, students are able to observe how these understandings and beliefs change and/or grow through the unit as they add to the "conversation."

At the culmination of the daily lessons, students engage in a whole class discussion about what they observed and how their understandings and beliefs about animal research have or have not changed over the course of the activities. This provides teachers with a formative assessment of students' understandings about animal research and the use of animals in and by society.

As a summative assessment, students will create an Action Plan of how they will exercise their personal position on the use of animals in and by society based on background information and ethical principles.

Research Ethics Series

The Science and Ethics of Animal Research is part of the following curricular set:



The Social Nature of Scientific Research

- How is scientific research different from other ways of discovery and learning about the world?
- How does the ethical conduct of scientific research lead to a process that promotes accountability, integrity, and intellectual honesty?
- How are scientific research, society, and culture shaped and influenced by each other?
- How does scientific research develop and change in response to new evidence, knowledge, and the application of new tools?
- What is my role and responsibility in being a scientific literate citizen?

The Science and Ethics of Animal Research

- Why do scientists use animals?
- How does the history of animal research influence current views and policies?
- How do ethical considerations influence the use of animals in research?
- How can my actions reflect my position on the use of animals in research?

A poster that details the 3 Rs of animal research: Replacement, Reduction and Refinement is also available.

The Science and Ethics of Humans in Research

- How does the history of research with humans influence attitudes, policies, and current practices?
- Why do scientists involve humans in research? How do scientists recruit, engage, and partner with participants?
- What is the process used to make decisions regarding humans in research, and how are costs and benefits evaluated?
- How does the process of carrying out ethics trials involving humans influence the time needed to develop new cures and treatments?
- How can my actions reflect my position on research involving humans?

Each unit is designed to be used independently or as part of a larger curricular set.
All three units are available from http://www.nwabr.org.

Correlation to National and Washington State Science Standards

National Standards Alignment: Science (Grades 5-12)

	Lesson One: Introduction to Animal Research	Lesson Two: Why Use Animals in Research?	Lesson Three: History of Animal Research	Lesson Four: Exploring Ethical Viewpoints	Lesson Five: Case Study Decisions	Assessment
Unifying Concepts and Processes						
Systems, order, and organization.		X				X
Evidence, models, and explanation.		X				

National Research Council. (1995). *National Science Education Standards.* Washington DC: National Academies Press.

National Standards Alignment: Science (Grades 5-8)

	Lesson One: Introduction to Animal Research	Lesson Two: Why Use Animals in Research?	Lesson Three: History of Animal Research	Lesson Four: Exploring Ethical Viewpoints	Lesson Five: Case Study Decisions	Assessment
E. Science and Technology						
Abilities of technological design.		X				
Understandings about science and technology.		X	X			
F. Science in Personal and Social Perspectives						
Risks and benefits.		X				
Science and technology in society.			X	X		
G. History & Nature of Science						
Science as a human endeavor.			X			
Nature of science.				X		
History of science.			X			

National Research Council. (1995). *National Science Education Standards.* Washington DC: National Academies Press.

National Standards Alignment: Science (Grades 9-12)

	Lesson One: Introduction to Animal Research	**Lesson Two:** Why Use Animals in Research?	**Lesson Three:** History of Animal Research	**Lesson Four:** Exploring Ethical Viewpoints	**Lesson Five:** Case Study Decisions	**Assessment**
E. Science and Technology						
Abilities of technological design.		X				
Understandings about science and technology.		X	X			
F. Science in Personal and Social Perspectives						
Science and technology in local, national, and global challenges.	X	X	X	X	X	X
G. History & Nature of Science						
Science as a human endeavor.			X	X	X	
Historical perspectives.			X			

National Research Council. (1995). *National Science Education Standards.* Washington DC: National Academies Press.

Washington State Standards: Science (Grades 6-10)

	Lesson One: Introduction to Animal Research	**Lesson Two:** Why Use Animals in Research?	**Lesson Three:** History of Animal Research	**Lesson Four:** Exploring Ethical Viewpoints	**Lesson Five:** Case Study Decisions	**Assessment**
Inquiry						
2.1.4 Investigating Systems: Modeling. Analyze how physical, conceptual, and mathematical models represent and are used to investigate objects, events, systems, and processes.		X				
2.2.5 Nature of Science: Evolution of Scientific Ideas. Understand how scientific knowledge evolves.			X			
Application						
3.2.1 Science, Technology, and Society: All People Contribute to Science and Technology. Analyze how scientific knowledge and technological advances discovered and developed by individuals and communities in all cultures of the world contribute to changes in societies.			X			
3.2.1 Science, Technology, and Society: Relationship of Science and Technology. Analyze how the scientific enterprise and technological advances influence and are influenced by human activity.	X	X	X	X	X	X

Washington State Office of the Superintendent of Public Instruction. (2005). *Science—K-10 Grade Level Expectations: A New Level of Specificity.* Washington: Office of the Superintendent of Public Instruction.

LESSON 1:
Introduction to Animal Research

INTRODUCTION

Lesson One is made up of two activities. In the first activity, students begin a unit-long written conversation (Chalk Talk) in which they explore and share their thoughts and ideas about animal research by silently responding to statements, pictures, and questions posted on the classroom walls. The posters remain on the classroom walls throughout the unit and are revisited by students in Lessons 1, 3, and 5 of the unit. This provides teachers with a formative assessment of students' understandings about animal research and humans' uses of animals.

In the second activity, students explore a number of human activities which result in animal deaths: raising animals for food, hunting, abandoning animals in shelters (which results in euthanasia), using animals in scientific research, driving on U.S. roads and highways. Students predict the number of animals impacted by each activity and then compare their predictions to actual numbers. In addition, students take a closer look at animals used only for scientific research and make predictions about what types and how many animals are used for this purpose. Lastly, students consider any possible benefits and supervision for each category.

KEY CONCEPTS

- It is important that students' perceptions about the use of animals in research be aired in a respectful manner.
- Human activities impact the lives of animals in many ways.
- The number of animals euthanized in the course of scientific research each year is a very small fraction of the number of animals killed each year by humans for various other reasons.
- The ways in which lives of animals are impacted by humans vary in their level of benefit to humans, and are subject to various types and levels of supervision and regulation.

LEARNING OBJECTIVES

Students will know:

- The number of animals used in research in comparison with other uses.

Students will be able to:

- Discuss the relationship between humans and other animals across a spectrum.
- Address their preconceptions about the use of animals in biomedical research.
- Consider the differing amounts of benefits and regulations pertaining to the many ways humans use animals.

CLASS TIME

One to two class periods of 50 minutes each and one night homework time.

COMMON MISCONCEPTIONS ABOUT ANIMAL RESEARCH

- Dogs, cats, and monkeys are the most commonly used animals.
- Research animals are often kept in a state of suffering and pain.

Vocabulary words used in each lesson are in bold. Definitions can be found at the end of each lesson and in a Master Glossary found in the Appendix.

MATERIALS

Materials	Quantity
Activity One: Silent Chalk Talk	
Teacher Resource 1.1—*Silent Chalk Talk Posters*	1
Teacher Resource 1.2—*Silent Chalk Talk Rules of Participation*	1
Large pieces of butcher paper or easel pad paper	6
Activity Two: Animal Use Activity	
Scissors	1 per student
Glue sticks, rubber cement, or tape	1 per student
Student Handout 1.1—*Predicting the Numbers: All Animal Uses*	1 per student
Student Handout 1.2—*Predicting the Numbers: Scientific Research*	1 per student
Student Handout 1.3—*Animal Research: The Need for Middle Ground*	1 per student
Teacher Resource 1.3—*Predicting the Numbers*	1

An accompanying PowerPoint presentation can be found at http://nwabr.org. The slides contain graphics used to represent the proportion of animals killed by human activities. This information can also be found in Teacher Resource 1.3—*Predicting the Numbers*.

NOTE TO THE TEACHER

It is especially important to foster a safe classroom atmosphere when discussing issues about which students may have differing views and strong feelings. The ethical issues that arise may involve conflicting moral choices. Please review or create classroom discussion ground rules ('norms') before proceeding. Instructions for doing this can be found in the *Appendix*.

FRAMING THE LESSON

Research using animals is not done in a vacuum—it is one piece of a larger process that includes basic science research involving chemistry and biology, cell and tissue cultures, computer imaging, human clinical trials, safety testing, and more. If teachers would like a resource to show how research with animals fits into the larger picture, a good online activity can be found at the website listed below. Of the ten steps listed in this game, *Lesson One* focuses only on the animal research step.

Understanding Animal Research: The Shuffle
http://www.understandinganimalresearch.org.uk/learning_centre/interactives/the_shuffle

TEACHER PREPARATION

- Create the six posters shown in Teacher Resource 1.1—*Silent Chalk Talk Posters* using large sheets of butcher paper or easel pads. Be sure to leave enough space for students to add their comments over a number of days.
- Place the posters around the room, leaving space for students to congregate and write on the posters.
- Make copies of Student Handouts. Student Handout 1.1 and Student Handout 1.2 should be copied single-sided so that students can cut out the Animal Uses Cards.

PROCEDURE

ACTIVITY ONE: SILENT CHALK TALK

Teacher Background:

In this activity, students explore and share their thoughts and ideas about animal research by silently responding in writing to statements, questions, and pictures posted on the classroom walls. Because the conversation is in written (silent) form, conversation cannot deteriorate into shouting matches, all students are given an equal voice, and students feel safe to express their true thoughts and feelings.

The posters can remain up around the room for the duration of the unit, or teachers may choose to roll them out when needed for each class. Some subsequent lessons will begin by allowing time for students to record their personal thoughts and ideas as well as discuss the more sensitive nature of the topic in a safe manner.

This activity allows for evolution of thought and can be used as a formative assessment for the unit.

Instructions:

1. Tell students that the class is beginning a unit of study about the science and ethics of animal research. To begin, students will be able to share their preliminary ideas and thoughts through silent discussion. Students will then consider the many ways in which the lives of animals are impacted by humans.

2. Place the *Silent Chalk Talk Posters* around the room. Before letting the students respond, read through each poster with students and ask for clarifying questions. Be careful to not discuss any opinion or give any information that may change students' responses; merely ensure that they understand what the questions or statement is addressing. It is important to leave this as vague as possible to allow for students to identify their own preconceived notions and/or misconceptions and to allow for evolution of thought throughout the lessons.

3. Post and review rules of participation from Teacher Resource 1.2—*Silent Chalk Talk Rules of Participation*.

4. Provide the same color marker for each poster so that responses are as anonymous as possible. If possible, use the same color marker on each day, and then change the color of marker on subsequent days. This will allow teachers and students to see an evolution of thought over time.

5. Give students ten to fifteen minutes to contribute to each poster a minimum of two times. Encourage students to respond at least one time to the primary comment on the poster, but if they have trouble doing so they may only respond to other students comments.

6. Explain to students that they will be using these posters to continue a conversation over the next few days (Days 1, 3, and 5 of the unit) but are not to discuss it outside of class.

7. Assure students they will be having a culminating conversation on the last day of the unit and it is important that they do not engage in talking about the posters before then to allow for the richest conversation possible.

ACTIVITY TWO: ANIMAL USE ACTIVITY

Teacher Background:

Many resources that educate about the need for animals in **biomedical research** focus on the many benefits that this research has provided over time—vaccines for polio, smallpox, measles, and mumps; surgical techniques; treatments for leukemia and other cancers; development of antibiotics, insulin, and much more. Many students, however, are ultimately—rightly so—concerned about the wellbeing of the animals involved. For this reason, the first lesson confronts the many human actions that result in animal deaths. Some discussion of benefits to humans as a result of the animal deaths is involved, as well as a direct look into the amount of pain and suffering an animal might experience as well as any regulations that might affect animal welfare.

Part I: How Do Humans Use Animals?

8. Explore the many relationships students have with other animals through a short discussion. Discuss ways humans use animals as a food, clothing, and labor resource along with their use as pets, as entertainment, recreation, and scientific research.

9. Explain to students that the following activity looks directly at actions that may make students uncomfortable—ways in which human activities lead to animal deaths.

10. Have students consider for a short moment some of the human activities that lead to animal deaths.

11. Make a list on the board. The list should include:

    - Animals hunted for food/sport/wildlife management.
    - Animals euthanized in shelters.
    - Animals raised for food.
    - Animals killed by motorists on the roads.
    - Animals used in medical research.

12. Students will likely have differing views on whether humans ***should*** or ***should not*** engage in activities that result in animal deaths.

13. The field of **ethics** helps us to work through difficult questions in a systematic, rational way. Ethical questions around the use of animals include:

    - Does the benefit of using an animal in any way outweigh the moral cost of taking an animal's life?
    - How shall we treat each other and other living things?
    - Is bringing about the greatest good for the greatest number the right thing to do?
    - What are our duties towards other living things?
    - What are our duties to people with cancer? Spinal cord injury? Diabetes?
    - Should animal interests be considered equal to those of humans? Does this pertain to all animals?

14. Tell students that the field of ethics helps us, as a society, to determine the best course of action in the face of conflicting choices. Throughout this unit, students will learn more about ethical perspectives in animal research as well as rules and regulations applying to the **humane treatment** of animals.

Part II: Predicting the Numbers

15. The activity continues by addressing possible student misconceptions concerning the number of animals killed and used in scientific research compared to other ways animal deaths are caused by humans. In addition, the misconception of how many **non-human primates** are used relative to other research animals is also explored. The goal is to put the numbers in perspective so students have an informed view of the impact of several types of human activity on the lives of other animals.

16. Pass out Student Handout 1.1—*Predicting the Numbers: All Animal Uses*. Students may work in pairs. Follow the directions on the Student Handout

17. When all students have completed their predictions, conduct a discussion about their answers and why they chose them. Poll each group about their predictions and ask student groups with the highest and lowest predicted numbers to explain how and why they chose those numbers. This will build interest in the actual numbers given to students in the next step.

18. Show students the actual data using overhead or PowerPoint slides. Students should record the actual data in the appropriate column on their handouts. The data can also be found on Teacher Resource 1.3—*Predicting the Numbers*, and below:

Hunting:	2%
Dogs and cats euthanized at shelters:	0.1%
Livestock and poultry killed for food:	94%
Animals killed by motorists:	4%
Animals euthanized for scientific research	0.3%

If students ask, explain that the total does not exactly equal 100% because the larger numbers have been rounded to the nearest whole number. For example, actual numbers for livestock and poultry killed for food is slightly under 94% but has been rounded up for ease of use.

19. As you go through each category, ask students to share their reactions to the data and their role in contributing to the numbers presented. End the discussion by focusing on the number of animals killed by scientific research compared to the number euthanized at animal shelters. Connect to the idea that although these numbers are small in comparison to the others, the lives of all of these animals are important and need to be treated with respect.

20. Pass out Student Handout 1.2—*Predicting the Numbers: Scientific Research*. Students may work in pairs. Follow the directions on the Student Handout.

21. Again, after students have completed their predictions, conduct a discussion about students' answers and why they chose them. Have a few students justify their predictions.

22. Show students the actual data using overhead or PowerPoint slides. Students should record the actual data in the appropriate column on their handouts. The data can also be found on Teacher Resource 1.3—*Predicting the Numbers*, and below:

Mice and rats:	90% euthanized
Non-human primates:	0.25% used and euthanized
Other **vertebrate** species:	10% euthanized

23. As you go through each category, ask students to share their reactions to the data and their role in contributing to the numbers presented. Emphasize that because of their lifespan and importance to research, **primates** may not be killed at the end of a study, but are used for multiple studies. Therefore the number given on the graph represents the number of non-human primates both used and killed during an average year. After euthanasia, most primate bodies are also used for further research using cells, tissues, and organs.

Part III: Benefits and Regulations

24. Refer students to Student Handout 1.1—*Predicting the Numbers: All Animal Uses* and ask if the activities listed seem equally worthy of the animal's life. Do some lead to a greater benefit than others? Why?

25. Ask students to brainstorm any **regulatory oversight** (supervision, laws, or rules) that influences how much pain or suffering an animal might experience before or at the time of death. Again, are all activities equally regulated?

    For example, ***animals killed on the roadways*** in the U.S. benefit humans only by allowing us to drive on long stretches of open road. There are few rules and regulations pertaining to animals killed or injured on the road, although construction engineers may consider the migration patterns of animals when constructing certain roads. After being hit, animals may suffer before dying.

    Animals used for food are of great benefit to humans, supplying a substantial amount of caloric and protein intake for the majority of Americans. This is an arguable position, however, from the **vegetarian** or **vegan** viewpoint. The care and use of food animals is regulated by the Humane Slaughter Act. In most states, animals must be "rendered insensible to pain" in the slaughter process.

    Animal research has benefitted humans tremendously through medical advances such as the elimination of smallpox, rabies, polio, measles, the advancement of surgical procedures, and treatments for heart disease, cancer, diabetes, leukemia, and other diseases. Animal research and resulting euthanization is conducted under stringent regulations. Animals also benefit from veterinarian vaccines and treatments made available through animal research.

Ninety-three percent of animals used in research either do not experience pain or are given drugs to relieve pain during research.

Hunting. Hunting can benefit humans by providing food and animal products to people. Hunting is also used to thin overpopulated species and manage wildlife. The number and species of animals, hunting season and equipment type is controlled through the sale of hunting licenses, which is regulated by each state's department of fish and game. Regulations vary from state to state, and many states require hunter education classes that emphasize safety and may teach about humane hunting practices.

Animal shelters. Euthanizing excess dogs and cats in shelters is of questionable benefit, except perhaps for dogs found to be dangerous. Regulation of animal shelters varies from state to state; most states require pets to be licensed, which can aid in the return of an animal picked up or turned in to animal control officials. Most shelters follow the American Veterinary Medical Association's guidelines on humane euthanasia. The number of animals euthanized in shelters has been substantially reduced over the past decades due to successful spay and neuter campaigns.

26. Draw a large graph on the board with four quadrants. Label the x-axis "Benefits to Humans." Label the y-axis "Rules and Regulations." Tell students that the purpose of this exercise is to ***map out general trends***, not graph distinct data points. Students may have differing views on the benefits of each category and may not be overly familiar with the rules and regulations for each category. As such, challenge students to help you plot the general quadrant for each of the following categories on the graph:

    - Animals killed by hunting.
    - Animals euthanized at shelters.
    - Animals killed by motorists.
    - Animals killed for food.
    - Animals euthanized for scientific research.

27. Discuss the graph that the class completed together. Which animal uses are highly beneficial to humans? Which animal uses have few regulations associated with them?

28. Tell students that if they were graphing the relative percentages for each animal use and used one inch to represent the number of animals used in medical research, the line representing animals killed for food would be over two stories high.

CLOSURE

29. Teachers should emphasize that the goal of this lesson is not to downplay the importance of animals, especially primates, used in research just because the numbers are so small in proportion of the total number of animals killed each year due to human activity. Each animal is valuable and worthy of respect; high ethical standards about their use and care need to be, and are, applied. Also point out that the numbers used for these uses are estimates that vary slightly year to year.

30. Let students know that, as part of the unit assessment, they will be asked to identify their own personal involvement and choices they make pertaining to animal research and other uses of animals. In looking at the graph, ask students to think about where their interest in animal welfare might lie.

HOMEWORK

- In the next lesson, students will be asked to consider three principles that guide the humane use of animals in research. Known as the "3 Rs," students will see how methods that use **Replacement**, **Reduction**, and **Refinement** are widely used in animal research.
- Distribute copies of Student Handout 1.1—*Animal Research: The Need for Middle Ground* for students to read as homework. This is an adapted version of an editorial by Richard Smith of the British Medical Journal.
- Some students may have difficulty with the reading level of the editorial. Support these students by using a guided reading strategy such as Think/Share/Advise/Revise (TSAR).
  a. **Think**: First, have students individually read each paragraph. Ask students to make a T-Chart in their journal or on a separate piece of paper, recording in the left-hand column "Ideas from Text" and the right-hand column "Questions I have about Ideas."
  b. **Share:** Have students find a partner and share their thinking by reading aloud each column of their T-Charts.
  c. **Advise:** After each pair has shared their T-Charts with each other, allow time for them to provide alternative explanations or suggestions about the questions they had about the text.
  d. **Revise:** Challenge each pair to work together to agree on a common understanding of the reading and to record this new understanding in their journal or on a piece of paper. If they are still confused or unclear about some portions of the reading, encourage students to seek clarification from another pair, or from the teacher.
- As an alternative to reading Student Handout 1.1—*Animal Research: The Need for Middle Ground*, students can find information on the 3 Rs at the following websites:

  Understanding Animal Research
  http://www.understandinganimalresearch.org.uk/page/download_document/?document_id=4

  Animal Ethics Infolink: 3 Rs
  http://www.animalethics.org.au/three-rs

  NC3Rs: What are the 3 Rs?
  http://www.nc3rs.org.uk/page.asp?id=7

EXTENSION

- Have students graph the actual data rather than showing them the graphs. Compare their work to their predictions.

GLOSSARY

Bioethics: A subfield of ethics applied to the life sciences. It helps us, as a society, make decisions about how to best gain and use scientific knowledge in the fields of biology, biotechnology and medicine.

Biomedical Research: Research that supports the field of medicine, including clinical trials with animals and humans to study the safety and efficacy of new drugs, treatments, techniques, or devices.

Ethics: A field of study that looks at the moral basis of human behavior and attempts to determine the best course of action in the face of conflicting choices.

Euthanasia: The practice of ending an animal's life while minimizing pain, distress and anxiety prior to loss of consciousness. Most often accomplished through the administration of drugs.

Humane treatment: Treating animals with a high degree of respect and care.

Non-human primate: Members of the order Primates, not including humans.

Primate: Members of the order Primates, which includes anthropoids (monkeys and apes—which includes humans) and prosimians (galagos, lemurs, lorises, and tarsiers).

Regulatory oversight: The amount of supervision given by an authoritative body over an activity (i.e. the existence of laws, rules or regulations imposed by governments or institutions).

Reduction: One of the 3 Rs of animal research proposed by Russell and Burch. Reduction means using the fewest number of animals possible in a research project to gain statistically significant results.

Refinement: One of the 3 Rs of animal research proposed by Russell and Burch. Refinement means using any technique or procedure that decreases the suffering, or enriches the life of, an animal used in research.

Replacement: One of the 3 Rs of animal research proposed by Russell and Burch. Replacement means replacing conscious, living vertebrates with cell or tissue cultures, computer models, and/or less developed animal species.

Vegetarian: A diet that avoids the consumption of animal meat, such as red meat, poultry, fin fish, and shellfish.

Vegan: A diet that avoids the consumption of all animal products, including milk, eggs, and honey. A vegan lifestyle may also include avoiding the purchase of products made from animals, including leather and wool.

Vertebrate: An animal with a vertebral column (backbone).

NOTES ON DATA SOURCES

Hunting: Statistics include birds, small mammals, and large game. No fish are included. Compiled from: the Fund for Animals, U.S. Fish and Wildlife Service, state wildlife agencies, and In Defense of Animals.

Research: Accounts for vertebrates used in research, including mice and rats. Compiled from Speaking of Research and Alternatives to Animal Use in Research, Testing, and Education.

Food: Livestock and poultry only. Compiled from National Agricultural Statistics Service, United Poultry Concerns/ USDA's National Agricultural Statistics Service, and Speaking of Research.

Euthanized: The number of dogs and cats euthanized in shelters is difficult to ascertain, as shelters are only now being asked to track and report this data. Numbers compiled from *Use of Dogs and Cats in Research*, National Academies Press.

Motorist-Killed: Number from an article in the *Wall Street Journal* in 2002 (see source information, below).

SOURCES

American Veterinary Medical Association
http://www.avma.org/issues/animal_welfare/euthanasia.pdf

In Defense of Animals
http://www.idausa.org/facts/hunting.html.

Humane Society of the United States
http://www.humanesociety.org/animal_community/resources/qa/common_questions_on_shelters.html.

"In the Headlights: As Man and Beast Clash on Highways, Both Sides Lose."
Wall Street Journal, August 1, 2002. Page A1.

National Agricultural Statistics Service
http://www.nass.usda.gov/.

National Research Council Committee on Scientific and Humane Issues in the Use of Random Source Dogs and Cats in Research. *Use of Dogs and Cats in Research: Public Perception and Evolution of Laws and Guidelines*. Washington DC: National Academies Press, 2009.
http://www.ncbi.nlm.nih.gov/books/NBK32668/.

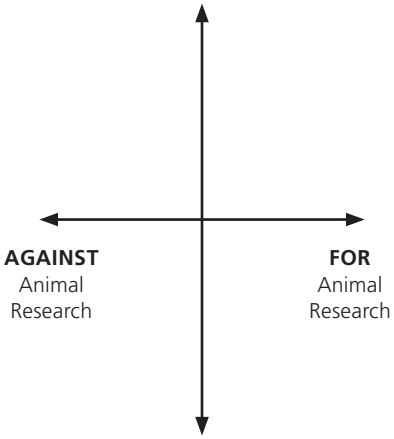
Speaking of Research
http://speakingofresearch.com/facts/statistics/.

United Poultry Concerns/USDA's National Agricultural Statistics Service
http://www.upc-online.org/slaughter/2000slaughter_stats.html.

U.S. Congress, Office of Technology Assessment. *Alternatives to Animal Use in Research, Testing, and Education*. Washington DC: U.S. Government Printing Office, OTA-BA-273, February 1986.
http://govinfo.library.unt.edu/ota/Ota_3/DATA/1986/8601.PDF.

TEACHER RESOURCE 1.1
Silent Chalk Talk Posters

These posters should be re-created on large pieces of butcher paper to allow ample room for student discussion and thought development. If possible, use a different color marker for each day.

<table>
<tr>
<td>A person who conducts animal research is...</td>
<td>What is animal research?</td>
<td>How are a person's views of animals influenced by his/her upbringing, religion, and culture?</td>
</tr>
<tr>
<td>What should the rules be for conducting research with animals?</td>
<td> 
What does this image say to you?
(See Appendix for larger image)</td>
<td>I know A LOT about this topic
 

I know a LITTLE about this topic

(Have students plot their own position/knowledge point using a different class color each day).</td>
</tr>
</table>

RESOURCE

RESOURCE

TEACHER RESOURCE 1.2

Silent Chalk Talk Rules of Participation

1. Respond to the main comment anywhere on the poster you would like.

2. Respond to others by drawing an arrow from their comment to yours.

3. Keep all responses respectful and school-appropriate.

4. If you agree with a comment add an exclamation point (!) or star (*).

5. If you disagree with something that someone said, explain why you disagree, using appropriate language.

6. Do not cross out or write over anyone else's comments.

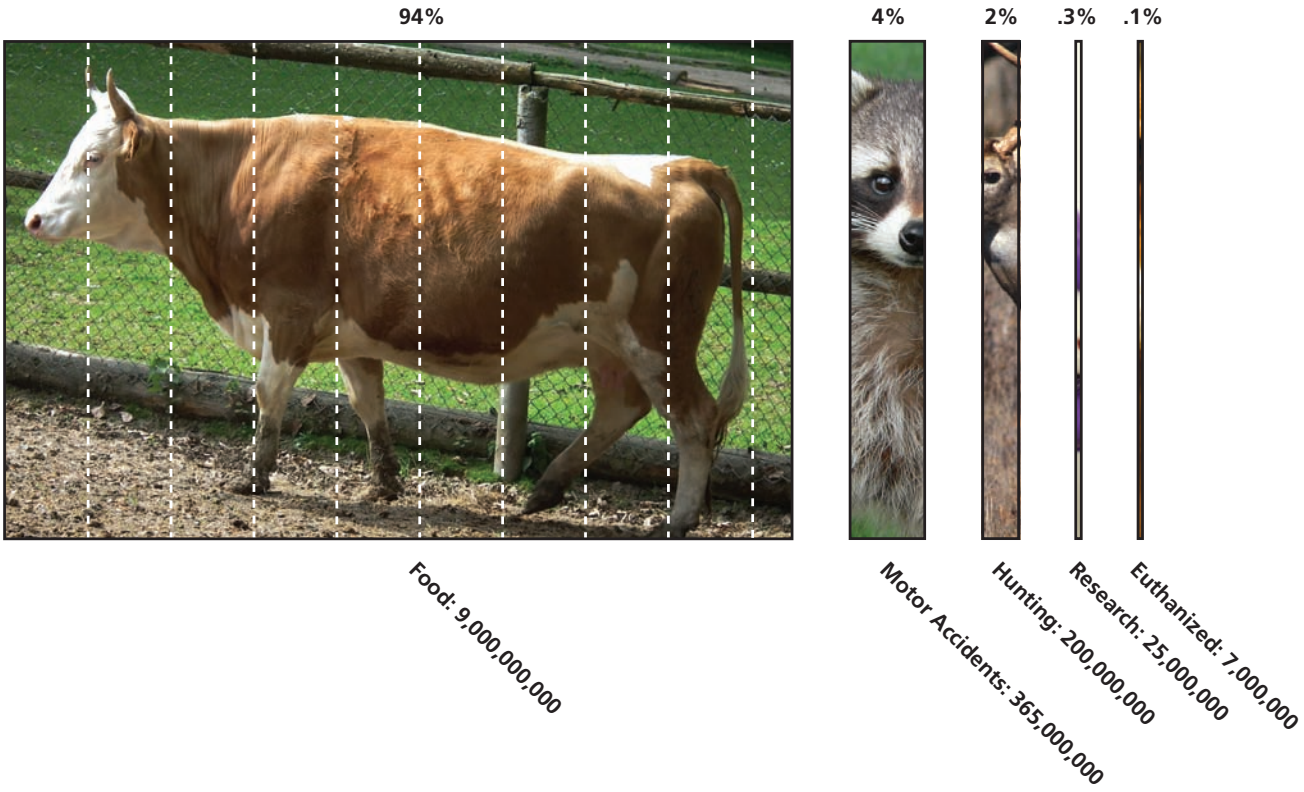
7. Pictures are completely permissible; just keep them appropriate.

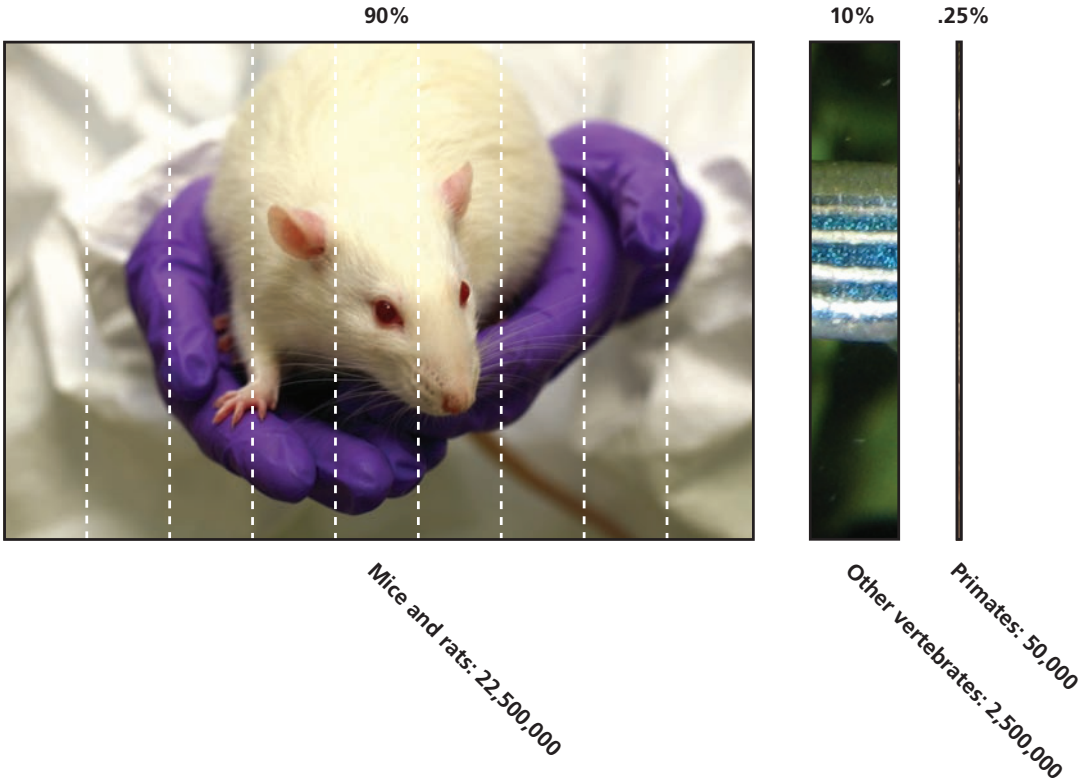
8. NO TALKING!

RESOURCE

TEACHER RESOURCE 1.3

Predicting the Numbers





Cow – Credit: Wikimedia, http://commons.wikimedia.org/wiki/File:Tierpark_Bretten_Hinterw%C3%A4lder_Rind.JPG

White Rat – Credit: Understanding Animal Research, http://www.understandinganimalresearch.org.uk/resources/images_library/details/226/white_rat_on_purple_gloved_hands_3/

RESOURCE

STUDENT HANDOUT 1.1

Predicting the Numbers: All Animal Uses

Name_____ Date_____ Period_____

1. Cut out the 3 x 5 inch animal cards on the next few pages. Each card represents a group of animals killed annually by humans in the United States for a certain purpose or in a certain way.
2. Put the cards in order, going from the card you think represents the ***most*** number of animals killed to the card you think represents the ***least*** number of animals killed.
3. Predict the ***percentage*** (out of 100) that you think accounts for each use. For example, what percentage of the total number of animals do you think are killed due to food production? 50%? 80%? 99%? Write your predictions in the Prediction column in the following table.

Animal Uses	Prediction (%)	Actual (%)
Hunting		
Dogs and cats euthanized or abandoned at animal shelters		
Livestock and poultry used for food		
Animals killed by motorists		
Animals used for scientific research		
Total	**100%**	**100%**

4. In two or three sentences, justify your predictions. Why did you choose these percentages? What evidence do you have to support your predictions?

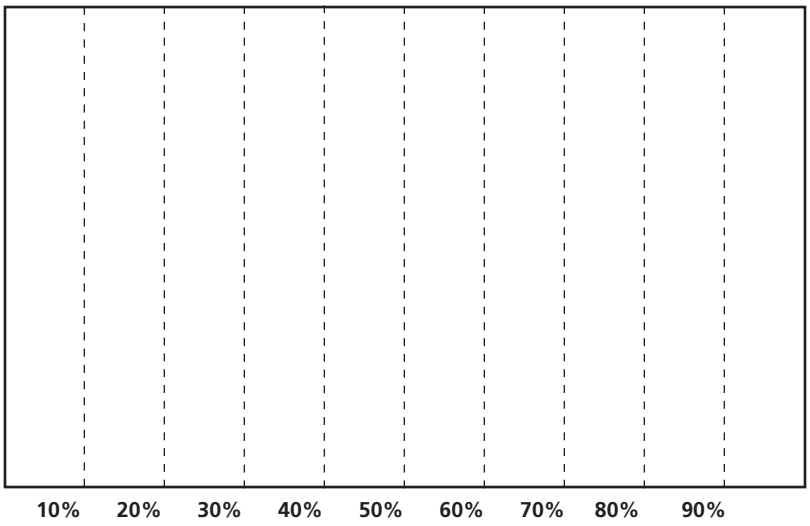
HANDOUT

5. The Set 1 box below represents 100% of the animals killed annually by humans in the United States. Each dotted line represents an increment of 10%.
6. According to your above predictions, cut that percentage from each animal card. The animal cards have lines representing 10% increments to guide you. (You do not have to use 10% increments, you may use smaller percentages.)
7. Glue your predicted percentages to the card. When you are done, the whole card should be covered, representing 100%.
8. When finished mapping your predictions, write down the actual percentages given to you by your teacher.

9. What surprised you about the actual percentages? In two or three sentences, reflect on the differences between your predictions and the actual percentages.

HANDOUT

Set 1: Animals Killed Each Year Due to Human Activity



HUNTING

White-tailed deer. Credit: Scott Bauer, USDA. Wikimedia, http://commons.wikimedia.org/wiki/File:White-tailed_deer.jpg

DOGS & CATS EUTHANIZED

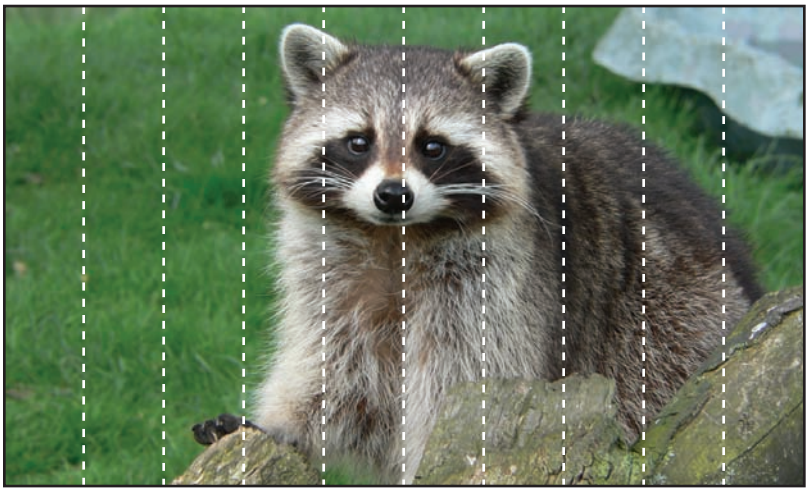
Credit: Wikimedia, http://upload.wikimedia.org/wikipedia/commons/3/3e/Street_dog_-yellow.jpg

LIVESTOCK & POULTRY KILLED FOR FOOD

Credit: Wikimedia, http://commons.wikimedia.org/wiki/File:Tierpark_Bretten_Hinterw%C3%A4lder_Rind.JPG

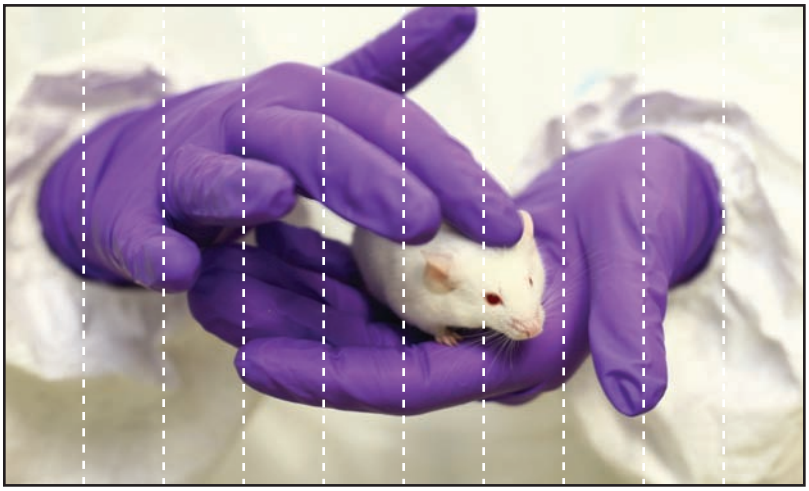
HANDOUT

ANIMALS KILLED BY MOTORISTS



Credit: Harlequeen, Wikimedia, http://commons.wikimedia.org/wiki/File:Raccoon_Cute_Pose.jpg

ANIMALS USED FOR RESEARCH



(all vertebrate species combined)

Credit: Understanding Animal Research, http://www.understandinganimalresearch.org.uk/resources/images_library/details/198/white_mouse_in_purple_gloved_hands/

HANDOUT

STUDENT HANDOUT 1.2

Predicting the Numbers: Scientific Research

Name_____ Date_____ Period_____

1. Cut out the 3 x 5 inch animal cards on the next few pages. Each card represents a group of animals killed or used annually by humans in the United States for ***scientific research only***.
2. Put the cards in order, going from the card you think represents the ***largest*** number of animals used or killed to the card you think represents the ***smallest*** number of animals used or killed.
3. Predict the ***percentage*** (out of 100) that you think accounts for each use. For example, what percentage of the total number of animals used in scientific research is mice and rats? What percentage is primates? Write your predictions in the Prediction column in the following table.

Animal Used in Scientific Research	Prediction (%)	Actual (%)
Mice and rats		
Non-human primates		
Other vertebrate species		
Total	**100%**	**100%**

4. In two or three sentences, justify your predictions. Why did you choose these percentages? What evidence do you have to support your predictions?

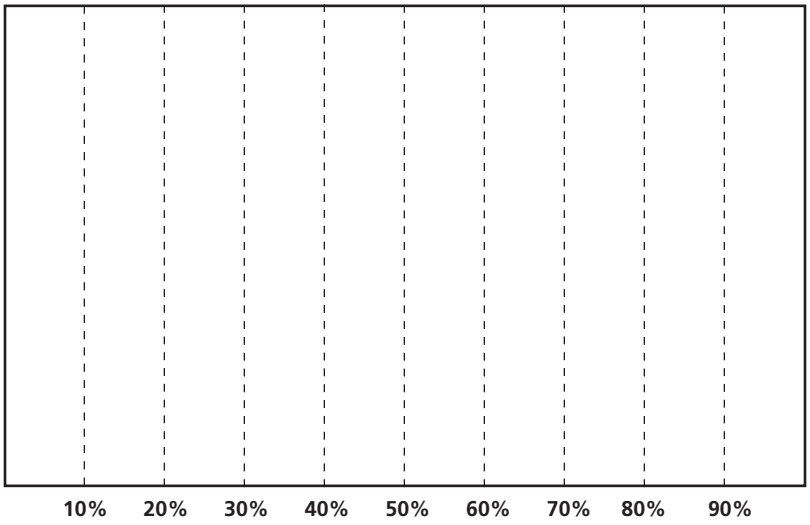
HANDOUT

5. The Set 2 box below represents 100% of the animals killed or used annually by humans in the U.S. for scientific research. Each dotted line represents an increment of 10%.
6. According to your above predictions, cut that percentage from each animal card. The animal cards have lines representing 10% increments to guide you. (You do not have to use 10% increments, you may use smaller percentages.)
7. Glue your predicted percentages to the card. When you are done, the whole card should be covered, representing 100%.
8. When you finish graphing your predictions, write down the actual percentages given to you by your teacher.

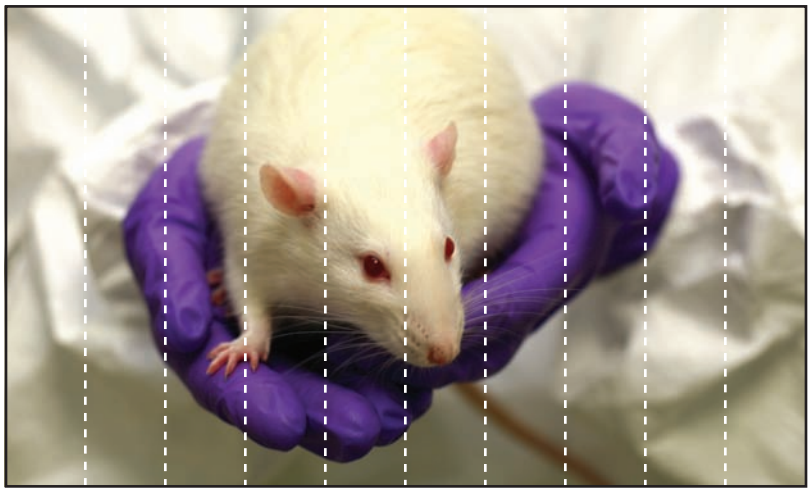
9. What surprised you about the actual percentages? In two or three sentences, reflect on the differences between your predictions and the actual percentages.

HANDOUT

Set 2: Animals Used/Killed in Scientific Research

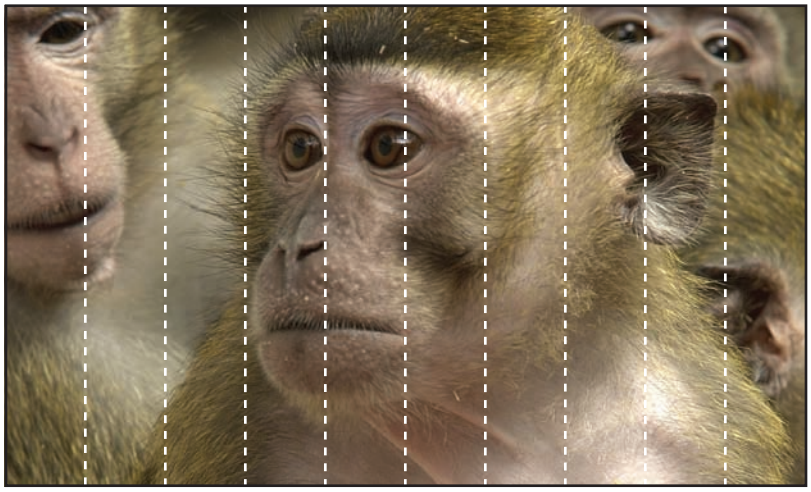


MICE & RATS



Credit: Understanding Animal Research, http://www.understandinganimalresearch.org.uk/resources/images_library/details/226/white_rat_on_purple_gloved_hands_3/

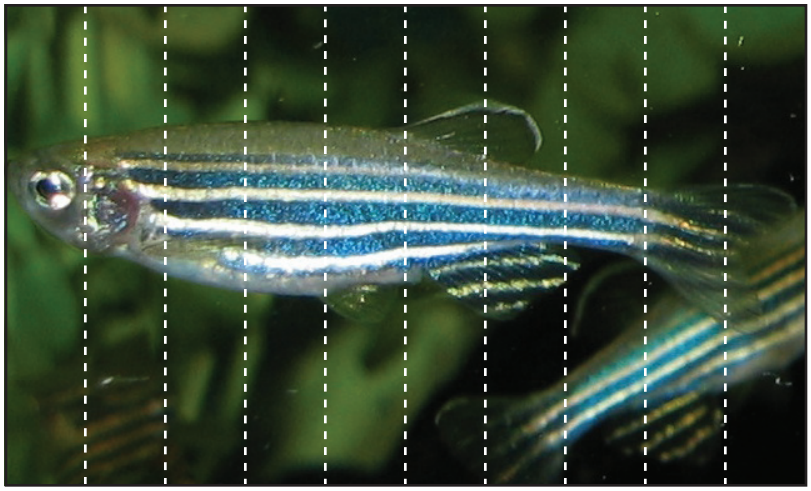
NON-HUMAN PRIMATES



(For non-human primates, consider both use and death during research since they are long-lived and death is often not the end-point of the research).

Credit: Understanding Animal Research, http://www.understandinganimalresearch.org.uk/resources/images_library/details/65/macaque_trio_close_up/

OTHER VERTEBRATE SPECIES



Credit: Wikimedia, http://commons.wikimedia.org/wiki/File:Zebrafisch.jpg

HANDOUT

HANDOUT

STUDENT HANDOUT 1.3

Animal Research: The Need for a Middle Ground

Abridged from an article written by Richard Smith,
Editor of the *British Medical Journal*.

Let's promote the 3 Rs of animal research: replacement, reduction, and refinement.

Many countries suffer from oversimplified debates on important issues like drugs, crime and punishment, genetically modified foods, and animal research. Are you for or against? Sign here. Yet none of these issues is moved forward by such "for-or-against" arguments. The debate on animal research currently features, on one side, people in masks using every tactic (including illegal and violent ones) to close down animal research institutes pitted against the other side of intimidated scientists arguing that no progress can be made in treating serious human diseases without animal research. We need more understanding of the complexities of animal research and a greater concentration on where we agree.

Can any of us imagine a world where animals were not used for food, clothing, or transport, where we had no pets, where rats and other vermin were not controlled, and where an ape, or even a fly, was regarded as the moral equal of the Archbishop of Canterbury? Most of us can't, and many people accept the need for some animal research. Yet most of us would not tolerate a world where animals had no rights and could be exploited for whatever cause. We thus have to find some middle ground in our relationship with animals, and a world that tries to afford more rights to men and women will probably also try to give more to animals.

The arguments over animal research are so polarized because the two sides have completely different ways of thinking. Opponents of research are concerned primarily with the ***rights and suffering of animals***, whereas supporters are interested in ***preventing and treating disease***. We need ways to promote agreement rather than disagreement, and the 3 Rs of animal research—replacement, reduction, and refinement—can do just that. They were first proposed by scientists William Russell and Rex Burch in 1959. The 3 Rs are:

- **Replacement:** Replacing conscious, living vertebrates with cell or tissue cultures, computer models, and/or less-developed animal species.
- **Reduction:** Using the fewest number of animals possible in a research project to gain statistically significant results.
- **Refinement:** Using any technique or procedure that decreases the suffering, or enriches the life of, an animal used in research.

Most animal research policy and practices are based on the 3 Rs. They start with the assumption that there will be animal research but are open to the possibility that science might advance to a point where it would no longer be necessary. The beauty of the 3 Rs is that they provide a way for all parties to work together to advance the cause of both animals and humans. Nothing will be gained by forcing laboratories to close or by oversimplifying the debate.

Adapted from: Richard Smith. "Animal Research: The Need for Middle Ground." British Medical Journal BMJ. 2001 February 3; 322(7281): 248–249. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1119509/.

HANDOUT

HANDOUT

LESSON 2:
Why Use Animals in Research?

INTRODUCTION

Students begin this lesson by watching video vignettes exploring the "3 Rs" (*Replacement*, *Reduction*, and *Refinement*), which guide scientists in conducting humane research with animals. Student groups are then introduced to several types of models, including **model organisms**, which scientists may use to answer different types of research questions. Using a set of Research Model Cards, students explore research questions and evaluate possible methods to determine the most appropriate **model** for answering the research questions.

KEY CONCEPTS

- The 3 Rs (*Replacement*, *Reduction*, and *Refinement*) guide scientists in conducting humane research with animals.
- Our views on the use of animal models in research can be informed by understanding the purpose of the research, the different methods available for testing research questions, and the importance of using the appropriate model for collecting the strongest evidence.
- Some models are more appropriate than others for answering research questions. Many questions cannot be satisfactorily answered without the use of whole organisms.
- Scientific research is conducted for a variety of reasons, such as:

  a) to increase scientific understanding (basic research).

  b) to develop treatments for medical conditions.

  c) to evaluate the toxicity of different compounds that humans use (medicinally or cosmetically).

LEARNING OBJECTIVES

Students will know:

- The definitions of the 3 Rs (*Replacement*, *Reduction*, and *Refinement*).

Students will be able to:

- Apply the 3 Rs to scientific research.
- Identify the purpose and importance of various scientific questions.
- Identify the appropriate models needed for answering various scientific questions.
- Understand the importance of using animal models to answer various scientific questions.

CLASS TIME

Two to three class periods of 50 minutes each.

MATERIALS

Materials	Quantity
Student Handout 2.1—*Research Model Cards Summary Table*	1 per student
Student Handout 2.2—*Research Topics*	1 per group or used as a class overhead
Student Handout 2.3—*Alzheimer's Disease*	Enough for each student in each group to get one (i.e. for a class of 30 split into 5 groups, 6 copies of each handout would be needed).
Student Handout 2.4—*Type II Diabetes*	
Student Handout 2.5—*Male Pattern Baldness*	
Student Handout 2.6—*Antibacterial Soap*	
Student Handout 2.7—*Spinal Cord Injury*	
Teacher Resource 2.1—*Answer Key for Research Model Cards Summary Table*	1
Teacher Resource 2.2—*Questions for Use with Research Model Cards*	1
Teacher Resource 2.3—*Possible Answers for Research Questions*	1
Teacher Resource 2.4—*Master Copy for Research Model Cards*. Each group will need a complete set of cards (copy these back-to-back).	1 set per group

FRAMING THE LESSON

While Lesson Two focuses on the use of appropriate animal models to answer specific research questions, it may be helpful for students to know that biomedical research depends on animal models in four general categories:

1. **To advance scientific understanding:** Scientists need a fundamental understanding of the body in both health and illness before new drugs and therapies can be applied to human disease. Basic research done today may be the foundation of treatments in the future. Transgenic organisms, especially mice, have been useful in both basic research and as disease models.

2. **Models to study disease:** Some animals have naturally-occurring diseases that also affect humans (cats get diabetes, for example) and some animals are purpose-bred to have specific diseases or conditions (i.e. mice induced to have cystic fibrosis). Both types can be used as animal models in order to study how disease affects the body.

3. **Models for new medical treatments, devices and techniques:** Once scientists have an idea about how to best treat a disease or improve a condition, the concept is tested on animals before being tested in humans. This applies to new medications, medical devices such as a new heart valves or knee replacements, and new surgical procedures.

4. **Safety testing:** The Food and Drug Administration (FDA) requires that new medicines be tested for safety and effectiveness in two species before they are tested in humans. Researchers must account for how the drug is absorbed, distributed, metabolized, and excreted (referred to as ADME testing) in a living system. More information about alternatives to using animals in safety testing can be found as an extension to this lesson.

TEACHER PREPARATION

- Make copies of Student Handouts.
- Make a set of Research Model Cards for each student group. Using Teacher Resource 2.3—*Master Copy for Research Model Cards*, copy the cards back-to-back and then cut them to create separate cards.

PROCEDURE

ACTIVITY ONE: WHAT ARE THE 3 Rs?

1. Tell students that the aim of this lesson is to a) have them become more familiar with the 3Rs that guide scientists in conducting humane research with animals, and b) learn about how animal models are used in research.

2. Review with students the 3 Rs, introduced in Student Homework 1.1—*Animal Research: The Need for a Middle Ground*. Make sure students have an understanding of what each "R" stands for and how it can be applied. Below are some questions that pertain to each "R:"

   - **Replacement**

     a) Can the animal model be replaced by another type of model, such as a cell culture, **computer model**, or tissue culture?

     b) Can a lower organism be used to replace a higher one? For example, can zebrafish or fruit flies be used instead of rodents to study the effects of genetic mutation?

   - **Reduction**

     a) What is the fewest number of animals that can be used in a research project and still gain statistically significant results (to demonstrate that the results of the research are from a direct cause and not just by chance)?

     b) How can researchers get the same amount of data from fewer animals?

   - **Refinement**

     a) How can techniques and procedures be refined so as to avoid animal suffering? For example, what is the best type of pain relief medication to give a rodent after surgery?

     b) How can the lives of research animals be enhanced through shared housing, social enrichment, or diet?

3. Go to the Understanding Animal Research website to access the interactive "What R You Watching?" video set.

   Understanding Animal Research: What R You Watching? Videos
   http://www.understandinganimalresearch.org.uk/schoolzone/rights_and_wrongs/

4. Choose one or more of the six short videos (each is less than three minutes long) to show students. Each researcher-narrated vignette illustrates one of the 3 Rs. A one-question quiz is built into the website. Have students guess which "R" is applied in each case before revealing the answer.

ACTIVITY TWO: INTRODUCING THE RESEARCH MODEL CARDS

5. Introduce the concept of a "model" to students. Ask students, "When I say the word ***model***, what do you think of?" In some cases, students may think models represent the ideal, such as fashion models, or model students.

6. Explain that there are different types of models, including physical models, mental models, and conceptual models—which includes mathematical and computer models. Discuss models that are actual physical constructions. Have students point out science models in the classroom (i.e. a model of DNA, the solar system, or human body systems), if available. Ask students about the strengths and weaknesses of using these different models. Point out that each model represents the "real thing" when working directly with the object is not feasible (i.e. DNA is too small, the solar system is too large, and using a human body to study human body systems is not practical or ethical.)

7. Point out that scientists involved in biomedical research use models too—they could be computer models, animal models, cell or tissue cultures, or other types of models. Models are used to help scientists understand how the "real thing" works. With the goal of much biomedical research being to find cures and treatments for human disease, the "real thing" is usually a human being. The use of models adds to the understanding of how human systems work.

8. Tell students that all model organisms, including animal models, are used, on some level, ***to study human disease and function when using humans is not feasible.*** However, in the case of medications, medical devices, or medical treatments, final testing will be conducted on humans after safety and efficacy has been demonstrated on animal models. Most model organisms have traits in common. A useful model organism tends to be:

- Small.
- Able to reproduce rapidly with many offspring.
- Inexpensive to house and maintain.
- Able to be manipulated genetically on the molecular level.
- Well-studied by other scientists.

9. Point out to students that many model organisms have had their genomes completely sequenced, meaning scientists have determined the exact order of the base pairs (A, T, C, G) in the genome from a representative of that species. This, in turn, gives scientists information about the genes found in that species and allows them to ***compare gene sequences*** between species. This work involves a high level of collaboration between scientists.

10. Divide the class into groups. Ideally, you will have five student groups. Give each group a set of the *Research Model Cards*.

11. Explore the cards with students to identify words they do not understand or unclear concepts such as **transgenic organisms** or **sequenced genome**. Use the parenthetical definitions on the cards, as well as the ***Glossary*** section in this lesson plan, to help students understand new terms and concepts.

12. Give the groups about three to five minutes to look through the cards.

13. Have students examine the photographs of the animals on the cards. For pictures of all the vertebrate animals, tell students that these are pictures of actual research animals in a laboratory situation. They are not "pets" or living in their natural habitat.

14. Introduce students to the types and uses of organisms on the Research Model Cards by asking them questions using Teacher Resource 2.2—Questions for Use with Research Model Cards. Since students are already in groups, the questions could be the basis for a team game if desired. After the teacher poses a question, the first team to write down and share the correct answer wins a point. If no teams give the correct answer, the teacher may read the included hint. The team with the most points at the end of the game may get first choice of which research topic they want to pursue in *Activity Three*. Encourage thoughtful guesses, since this will most likely be new information for students.

The use of the words "lower" and "higher" when describing types of living organisms reflects an obvious bias which should be acknowledged. Even a single yeast cell shows amazing complexity and shares many cellular processes with humans. However, the concerns about killing yeast when baking bread, for example, do not trigger the same level of ethical concern as the harming of higher animals that are more neurologically developed.

15. Challenge each group to sort their Research Model Cards so that they are roughly in order from **lower organisms** or models to **higher organisms** or models. "Lower" organisms are those for which there is less ethical concern about their use due to their level of neurological development or complexity (There might be several cards on the same level of complexity.) In working to *Replace* higher organisms with lower organisms (one of the principles of the 3 Rs), scientists are moving towards using lower organisms such as zebrafish and *C.elegans* worms to replace research with rodents when possible.

16. Distribute copies of Student Handout 2.1—*Research Model Cards Summary Table*, one per group. Challenge each group to work as a team to complete the table by placing a check mark in the column that best represents a potential use for that organism. This summary table will be a helpful tool for students to use when completing the next activity.

ACTIVITY THREE: CHOOSING THE RIGHT MODEL FOR THE RIGHT RESEARCH QUESTION

17. Discuss the "Your Reaction to its Use" section of the table. Students may want to acknowledge a unique understanding or familiarity with different animals in the model card set. For example, a student who has had frogs as pets may react differently than a student without much experience with frogs. Generally, student reactions will change based on the complexity of an organism as well as that student's familiarity with an organism.

    If a student's reaction is to state, for example, "Dogs should never be used in research" then ask the student to explain his or her reasoning in writing on the handout. Additional points can be found on Teacher Resource 2.1.

18. Distribute one copy of Student Handout 2.2—*Research Topics* to each student group, or create one overhead for the class to use as a group. Ask the students to cooperatively read the background information and research goals for each of the five topics presented on the Student Handout (**Alzheimer's Disease**, **Type II Diabetes**, **Male Pattern Baldness**, **Antibacterial Soap**, and **Spinal Cord Injury**).

19. Ask students, ***"Are all of these research goals equally beneficial?"*** If the funding agency has a limited amount of funds, should each study be funded? If only three could be funded, which would they be? If more money became available, what would the fourth study be? Consider that even a study that might seem low priority (i.e. male pattern baldness) could have unforeseen benefits in other areas, such as the treatment of other genetic skin conditions, or helping patients grow hair lost through chemotherapy treatments.

20. Tell students that an overarching Research Question ("How can we cure Alzheimer's?") is really answered by asking many smaller questions, such as, "How do **neurons** work?" or "Which parts of our brain work to give us memory?" Different research models may be used to answer different types of questions at various points in the research process. It may take years of **basic research** ("How do neurons work?" or "How do neurons communicate?") before an idea for a drug or treatment is ready to test in a living organism. This basic research may (or may not) benefit Alzheimer's patients and people with other types of neurological conditions in years to come.

21. Explain to students that researchers must carefully choose their models in order to collect reliable, accurate results and that they are required to follow regulations about the care and use of their animal subjects.

22. Distribute one copy of Student Handouts 2.3 - 2.7 to each student group, so that each group is given a different research topic (Alzheimer's Disease, Type II Diabetes, Male Pattern Baldness, Antibacterial Soap, and Spinal Cord Injury). If the class has fewer than five groups, only hand out the topics the class decided were the most important. If the class has more than five groups, make additional copies of one or more of the handouts.

23. Once the student groups receive the Student Handout featuring their research topic, they should:

- Put aside any of the Research Model Cards that will not be useful to them in answering the questions.
- Choose which models they think can best help answer the Research Questions.
- Of the models they have chosen, put the cards in order from lowest organism or model to highest organism or model (some cards might be at the same level).
- Answer the questions on the Student Handout.

[***Note:*** Each of the three questions on the Student Handouts 2.3 – 2.7 generally corresponds to a different point in the research process. Further notes are available on Teacher Resource 2.3—*Possible Answers to Research Questions*.]

24. Tell students that many different models may work to answer the same question—there is no one right answer. Groups should be prepared to explain why they thought one model would be better than another model.

25. During group work time, the teacher should move from group to group monitoring the discussions, reminding students of the 3 Rs, and making sure the subjects they choose are appropriate.

26. Students should then select a speaker to summarize their findings in a whole class discussion.

ACTIVITY FOUR: DEBRIEFING THE RESEARCH QUESTIONS

27. Provide time for each group to present their Research Question and their chosen model(s).

28. Ask the class, "Did any group use plants for their model organism?" Students should notice that plants will not work for any of the research questions. The teacher can emphasize that compounds often originate from plant sources but need to be tested on animals if they are to become a treatment. Otherwise plants are used mainly for agricultural studies.

29. Ask students, "Which of the 3 Rs were you using when ordering the cards? Why does this matter?" Students were using *Replace*, hopefully replacing animals such as primates or dogs with the lowest species available, or with a computer or cell culture model system.

30. Survey students again to see if all of the research questions seem equally important to them. Have students vote informally for what they think is the most important and the least important research question. Would any groups choose not to pursue the research?

CLOSURE

31. Check students' comprehension to be sure they realize that research using animals is not a "free for all" in which scientists randomly choose an animal subject. Instead, specific animals or models are chosen to answer specific questions asked at different times in the research process. The large research questions (i.e., "How do we cure Alzheimer's?" or "How do we cure diabetes?") are being asked collaboratively by thousands of scientists worldwide. Each scientist, however, may be working to answer a very small part of the larger question.

32. Review the 3 Rs (*Replacement*, *Reduction*, and *Refinement*) and ask students for examples of how each might be used.

33. Let students know that the use of the 3 Rs is a place of "common ground" between research scientists and animal rights activists.

HOMEWORK

- Students can explore the following website to learn more about model organisms.

WWW Virtual Library: Model Organisms
http://www.ceolas.org/VL/mo/

ADAPTATION

- Student groups could work with a number of different Research Questions by rotating each question to a new group every few minutes. Students could check the previous group's work, and add or change information as they proceed.

EXTENSION

What are the alternatives to using animals in safety testing?

The use of animals in safety and toxicity testing, specifically for chemicals used in cosmetics, has lead to vigorous public debate since the 1970s. While safety testing in animals is not required by law for cosmetics as it is for drugs, research organizations and drug companies have sought out alternative toxicity testing methods as guided by the 3Rs. Creating, verifying and incorporating alternative methods can take many years, as the alternatives need to be formally validated as being as accurate, or better than, the animal procedures they are replacing. The U.S. federal government supports the development of alternatives to animals through the Interagency Coordinating Committee on the Validation of Alternative Methods, or ICCVAM.

Some examples of alternative methods are:

- EPISKIN is a three-dimensional human skin model that can be used to assess topical applications. This model was developed by a company now owned by L'Oreal, the cosmetics corporation.
- Medical devices and injected compounds that come into contact with blood or cerebral spinal fluid must be tested to find out if they cause fever in humans. This test used to be done in rabbits by injecting the compound in question into the rabbit and seeing if a fever developed within twenty four hours. Now, researchers can use the "blood cells" (hemolymph) of a horseshoe crab to test for fever-inducing compounds, since the horseshoe crab blood reacts to the compounds that cause inflammation (and fever) in humans.
- Skin penetration or absorption tests that used to rely on living animals can now be done using a "Franz Cell." This is a vertical diffusion tube with an upper and a lower chamber. Skin left over from elective surgeries or donated through cadavers can be placed in the upper chamber and used to determine the rate and extent of penetration of a test compound.

Students can research alternative methods at the following websites:

ICCVAM: http://iccvam.niehs.nih.gov/about/ni_QA.htm

John Hopkins Center for Alternatives to Animal Testing: http://caat.jhsph.edu/

Non-Animal Methods for Toxicity Testing: http://www.AltTox.org

Additional information about alternatives to safety testing can be found at the end of Lesson 3 in the **Consumer Awareness** curriculum found at:

http://www.nwabr.org.

GLOSSARY

Alzheimer's Disease: A form of dementia, or loss of brain function, that gradually worsens over time and affects behavior, thinking, and memory.

Anti-inflammatory Drugs: Drugs used to treat inflammation. These drugs counteract the reactions caused by damaged cells, which release chemicals that stimulate the immune system, leading to swelling, and increase flow of cells to the damaged site.

Bacteria: Tiny, single-celled organisms. These prokaryote organisms lack a nucleus and organelles within the membrane of the cell. Bacteria can form an association with other organisms that cause them to become pathogens, which can cause human disease and death from infections such as cholera, diphtheria, tuberculosis, and tetanus.

Basic Research: Fundamental questions that are asked in order to enhance the knowledge base of a subject, rather than to cure a specific disease or condition.

Blood Glucose: Also called blood sugar, glucose is a simple sugar that is the basic fuel used by cells in the body. The blood glucose level is a measurement of glucose in blood.

Computer Model: A computer program which attempts to simulate the behavior of a system, generally through the use of a mathematical model.

Diabetes: A disease characterized by a person having a high blood glucose level and treated with injections of insulin and other medications. There are three main types of diabetes: Type I, Type II, and gestational diabetes, the latter of which only occurs in pregnant women.

Differentiation: The process by which a less specialized cell transforms into a more specialized type of cell.

Dosage: A prescribed amount of a medication.

Embryo: An organism at its earliest stages of development, after fertilization of the egg and first cell division. In humans, an embryo is the first eight weeks after fertilization, after which the developing organism is called a fetus.

Eukaryote: Any organism that has a nucleus and specialized organelles within its cell(s). All of the living Research Models are eukaryotes, except bacteria.

Genome: An organism's entire genetic information, encoded in either DNA or RNA (for many viruses). Scientists have been able to sequence the genome of some organisms.

Hair Transplant: A surgical treatment for male pattern baldness that involves taking hair follicles from a donor part of the body and transplanting it into a recipient part of the body (usually the scalp). The donor site is chosen based on the hair follicles' genetic resistance to balding.

Hereditary Condition: Also called a genetic disorder, a hereditary condition is a condition or illness caused by abnormalities in genes or chromosomes. The genetic defect can be inherited from an individual's parents and/or passed down to his or her children.

Informed Consent: In a research study with human volunteers, each research subject must be capable of understanding the facts and risks of the study, and the researchers must clearly relay this information. Informed consent is this exchange of information, followed by the volunteer providing their consent to participate in the study.

Insulin: A hormone that causes cells in the body to take glucose from the blood into the cells where it can be used.

Insulin Receptors: A receptor in the body that is activated by the presence of insulin, which causes uptake of glucose.

Lower/Higher Organisms: "Lower" organisms are those for which there is less ethical concern about their use due to their level of neurological development or complexity. "Higher" organisms are those for which there is more significant ethical concern about their use in research.

Male Pattern Baldness: A genetic condition that causes hair loss in a predictable pattern along the temples and crown of the head.

Microbe: Also called a microorganism, a microbe is one of a group of microscopic organisms that includes bacteria, fungi, archaea, protists, green algae, plankton, and planaria.

Model: A representation of a phenomenon, object, or idea. A model can be developed to represent a phenomenon, object, or idea using a more familiar one (like using an analogy).

Model Organism: An organism that is used in research because it is easier to study a particular aspect in that organism, rather than in humans and higher organisms. Model organisms tend to be small, able to reproduce rapidly with many offspring, inexpensive to house and maintain, able to be manipulated genetically on the molecular level, and well-studied by other scientists. Major model organisms include E. coli bacteria, yeasts, slime molds, fruit flies, zebrafish, and mice.

Neuron: Also called a nerve cell, a neuron is a specialized cell in the nervous system (brain, spinal cord, and nerves) that processes and communicates information through electrical and chemical signals.

Prokaryote: Any organism that does not have a nucleus or membrane-bound organelles, such as bacteria.

Quadriplegia: The result of a paralyzing injury that causes partial or total loss of the use of arms, legs, and torso, as well as the loss of sensory functions in these areas.

Reduction: One of the 3 Rs of animal research proposed by Russell and Burch. Reduction means using the fewest number of animals possible in a research project to gain statistically significant results.

Refinement: One of the 3 Rs of animal research proposed by Russell and Burch. Refinement means using any technique or procedure that decreases the suffering, or enriches the life of, an animal used in research.

Regenerate: The process of growth and renewal that allows cells, organs, and organisms to be resilient to damaging events. For example, a sea star is capable of regenerating an arm that has been damaged by a predator.

Replacement: One of the 3 Rs of animal research proposed by Russell and Burch. Replacement means replacing conscious, living vertebrates with cell or tissue cultures, computer models, and/or less developed animal species.

Sequenced Genome: A laboratory process that results in the cataloging of an organism's entire genetic information, encoded in either DNA or RNA (for many viruses).

Spinal Cord Injury: An injury to the spinal cord as a result of trauma (not disease). An example of the result of a spinal cord injury is quadriplegia.

Toxicity: The degree to which a substance can cause damage to an organism. A toxic substance is one that may be damaging or poisonous.

Transgenic Organism: A living organism in which genes, or gene regulatory regions, have been added, removed, or modified. The change in DNA will cause the organism to exhibit a new property (immune system change, genetic disorder, etc.) which can be passed to its offspring.

Type II Diabetes: One of the three types of diabetes. Also called Diabetes Mellitus Type II or Adult-onset Diabetes. The disease is characterized by high blood glucose levels due to insulin resistance and insulin deficiency.

Virus: A tiny organism that can transmit infections and disease, such as influenza and HIV.

RESOURCES

Understanding Animal Research
http://www.understandinganimalresearch.org.uk/homepage

Animal Research.info
http://www.animalresearch.info/en/home

"Models in Science Education: Application of Models in Learning and Teaching Science." Funda Omek. International Journal of Environmental & Science Education, 2008, 3 (2), 35-45. http://www.ijese.com/V3_N2_Ornek.pdf

STUDENT HANDOUT 2.1

Research Model Cards Summary Table

Name_____ Date_____ Period_____

First, sort your Research Model Cards from lower organisms to higher organisms. Then, provide a summary of the information on each card in the table below by marking an "x" in the column(s) the best represent the use of that model. Please note that the uses listed on each model card are not comprehensive. Be sure to record the reactions of your group members' to the use of this model in scientific research.

Level of Complexity	Name of Research Model	Cell biology/function	Toxicity	Drug and product development/safety	Behavioral	Embryonic development	Transplantation/prosthetic	Brain/nervous system	Heart/cardiovascular	Respiratory system	Surgical technique	Gene-environment	Specific disease/disorder:	Other:
Lower organisms														
Higher organisms														

HANDOUT

Your Reaction to its Use	Name of Research Model

HANDOUT

STUDENT HANDOUT 2.2
Research Topics

Name_____ Date_____ Period_____

Your student group will be investigating one of the following five research topics. First, review the background and research questions for all five topics. Then, your teacher will provide you with detailed information about one of the topics.

ALZHEIMER'S DISEASE

Misplacing car keys. Not remembering a familiar name. Some people become more forgetful as they get older. That's a normal part of aging. ***Alzheimer's disease*** *is not.*

Alzheimer's disease affects over five million people in the U.S. and is in the top ten leading causes of death. Over time, Alzheimer's disease gradually destroys a person's memory and ability to learn and carry out daily activities such as talking, eating, and going to the bathroom. As the disease progresses, individuals may also experience changes in personality and behavior. Unfortunately, there are no cures for Alzheimer's disease and there is no way to predict how fast someone will progress through the stages of the disease.

http://www.namenda.com/sections/about-alzheimers-disease

RESEARCH GOAL:

You are a research team trying to develop a cure for Alzheimer's disease. The team knows the brain is made up of **neurons**, and these die as the disease progresses. Alzheimer's can be studied in all animals with brains.

TYPE II DIABETES

At first the symptoms seemed so harmless, they were easy to ignore. The thirst, frequent trips to the bathroom, feeling tired and irritable all the time. Is blurred vision normal? Could this be serious for a teenager?

Diabetes affects over 23 million children and adults in the U.S. and is among the top ten causes of death. People with diabetes have high ***blood glucose*** *levels because their body no longer produces enough insulin (Type I) or their cells ignore the insulin that is produced (Type II). Glucose is a basic fuel used by cells in the body; insulin takes glucose from the blood into the cells where it can be used.*

http://www.diabetes.org

RESEARCH GOAL:

Your research team wants to better understand why some teens develop **Type II Diabetes**. In the future this knowledge could lead to drugs that reduce the risk in young adults. Insulin and **insulin receptors** have been found in all animals including worms.

HANDOUT

MALE PATTERN BALDNESS

"At the age of eighteen, I noticed an abundance of short dark hairs at my hairline and didn't know what to make of it. Then, not too long after that I noticed the crown receding and the temples cutting back sharply. Then the sickening realization that the hair on the entire top of my head was getting thinner…and all I could think about was my hair."

***Male pattern baldness** is a common, **hereditary condition** that affects roughly 40 million men in the U.S. and accounts for about 90% of all hair loss cases in men. Hair loss can affect self-esteem and standing within society, and many men are willing to buy expensive products that might prevent or decrease hair loss. About 25% of men who have male pattern baldness begin losing their hair before the age of 21.*

David M. Hatch,
http://www.malepatternbaldness.net/
http://www.WebMD.com

RESEARCH GOAL:

You and your research team are working on the production of a new drug for male pattern baldness.

ANTIBACTERIAL SOAP

*Antibacterial soap has become tremendously popular over the last number of years as a way of killing **bacteria** and **microbes** when used with water in a traditional hand washing manner. Antibacterial soaps are not the same thing as hand sanitizers, which use alcohol to kill bacteria when water may not be available. Most antibacterial soaps use the chemical Triclosan as the antibacterial agent. Antibacterial soap cannot kill **viruses**, and the chemicals do not distinguish between helpful and harmful bacteria when killing them on skin. Some concerns exist about the effects of Triclosan in the environment, and the potential rise of Triclosan-resistant bacteria that become very difficult to kill.*

RESEARCH GOAL:

Your research team has found a new antibacterial agent to replace Triclosan, and wants to use it in a new soap. If the soap can effectively kill the bacteria and viruses that cause disease without causing side effects, the researcher could prevent illness in a large population.

SPINAL CORD INJURIES

"Four days before heading back to school for the fall term a very close friend, Ray, had invited me to the Allegheny River for a canoe trip. We paddled down the river a few miles and someone had set up a rope swing. Ray grabbed the rope, climbed to the top, and swung away. As soon as the rope retreated back to the bank, I threw it up behind the platform, climbed to the top, and kicked off. It was an incredible rush. Ray went up another time and launched himself way out in the water. I had noticed another canoe coming down the river. As cool as it was to be doing what we were doing, it's always better to be showing off while doing it! I gripped the rope tight and kicked my legs straight out and gained a lot of air fast. Tucking my knees up in my chest to spin into a few flips, something wasn't right. I lost my bearings and landed head first. That's the last I remembered."

-Mark with a 6th cervical vertebra (C6) complete compression fracture causing **quadriplegia**,
http://www.dreamblvr.com/history.htm

RESEARCH GOAL:

A researcher is working to identify better methods to treat **spinal cord injuries**. Up to 12,000 people annually suffer from spinal cord injury. Treatments for spinal cord injury are limited and often do not restore lost function. Spinal cord injury models can be developed in any animal model with a spine.

HANDOUT

STUDENT HANDOUT 2.3

Alzheimer's Disease

Name_____ Date_____ Period_____

Misplacing car keys. Not remembering a familiar name. Some people become more forgetful as they get older. That's a normal part of aging. Alzheimer's disease is not.

Alzheimer's disease affects over five million people in the U.S. and is in the top ten leading causes of death. Over time, Alzheimer's disease gradually destroys a person's memory and ability to learn and carry out daily activities such as talking, eating, and going to the bathroom. As the disease progresses, individuals may also experience changes in personality and behavior. Unfortunately, there are no cures for Alzheimer's disease and there is no way to predict how fast someone will progress through the stages of the disease.

http://www.namenda.com/sections/about-alzheimers-disease

RESEARCH GOAL:

You are a research team trying to develop a cure for **Alzheimer's disease**. The team knows the brain is made up of neurons, and these die as the disease progresses. Alzheimer's can be studied in all animals with brains. To begin:

- Put aside any of the Research Model Cards that will not be useful in answering the questions.
- Put the remaining cards in order from lowest organism or model to highest organism or model (some cards might be at the same level).
- Using the Research Model Cards, answer the following questions with your group:

Alzheimer's Disease: A form of dementia, or loss of brain function, that gradually worsens over time and affects behavior, thinking, and memory.

Neuron: Also called a nerve cell, a neuron is a specialized cell in the nervous system (brain, spinal cord, and nerves) that processes and communicates information through electrical and chemical signals.

Research Questions:

1. Which models would you use to determine how **neurons** communicate with each other?

2. Which models would you use to determine how drugs change the effects of Alzheimer's on neurons?

3. Which models are particularly well-suited to the study of Alzheimer's disease in a whole organism? (i.e. disease models of that animal exist, or that organism naturally develops the disease.)

As you discuss the answers, consider:

- The benefits and limitations of each subject on the cards.
- How best to replace, reduce, and refine so the optimal number of organisms is used with the most humane methods.
- The ethical issues involved in your choices for research subjects.

HANDOUT

HANDOUT

STUDENT HANDOUT 2.4
Type II Diabetes

Name_____ Date_____ Period_____

At first the symptoms seemed so harmless, they were easy to ignore. The thirst, frequent trips to the bathroom, feeling tired and irritable all the time. Is blurred vision normal? Could this be serious for a teenager?

Diabetes affects over 23 million children and adults in the U.S. and is among the top 10 causes of death. People with diabetes have high ***blood glucose*** *levels because their body no longer produces enough* ***insulin*** *(Type I) or their cells ignore the insulin that is produced (Type II). Glucose is a basic fuel used by cells in the body; insulin takes glucose from the blood into the cells where it can be used.*

http://www.diabetes.org

RESEARCH GOAL:

Your research team wants to better understand why some teens develop **Type II Diabetes**. In the future this knowledge could lead to treatments that reduce the risk in young adults. Insulin and **insulin receptors** have been found in all animals including worms. To begin:

- Put aside any of the Research Model Cards that will not be useful in answering the questions.
- Put the remaining cards in order from lowest organism or model to highest organism or model (some cards might be at the same level).
- Using the Research Model Cards, answer the following questions with your group:

Blood Glucose: Also called blood sugar, glucose is a simple sugar that is the basic fuel used by cells in the body. The blood glucose level is a measurement of glucose in blood.

Insulin Receptors: A receptor in the body that is activated by the presence of insulin, which causes uptake of glucose.

Type II Diabetes: One of the three types of diabetes. Also called Diabetes Mellitus Type II or Adult-onset Diabetes. The disease is characterized by high blood glucose levels due to insulin resistance and insulin deficiency.

Research Questions:

1. Which models would you use to determine how cells with insulin receptors are affected by changes in insulin levels?

2. Which models would you use to determine if there are genetic factors that can influence the development of Type II Diabetes?

3. Which models could be studied to determine how diets or environmental factors contribute to the probability of getting the disease?

As you discuss the answers, consider:

- The benefits and limitations of each subject on the cards.
- How best to replace, reduce, and refine so the optimal number of organisms are used with the most humane methods.
- The ethical issues involved in your choices for research subjects.

HANDOUT

HANDOUT

STUDENT HANDOUT 2.5
Male Pattern Baldness

Name_____ Date_____ Period_____

"At the age of eighteen, I noticed an abundance of short dark hairs at my hairline and didn't know what to make of it. Then, not too long after that I noticed the crown receding and the temples cutting back sharply. Then the sickening realization that the hair on the entire top of my head was getting thinner…and all I could think about was my hair."

David M. Hatch, http://www.malepatternbaldness.net/

Male pattern baldness *is a common,* ***hereditary condition*** *that affects roughly 40 million men in the U.S. and accounts for about 90% of all hair loss cases in men. Hair loss can affect self-esteem and standing within society, and many men are willing to buy expensive products that might prevent or decrease hair loss. About 25% of men who have male pattern baldness begin losing their hair before the age of 21.*

http://www.WebMD.com

RESEARCH GOAL:

You and your research team are working on the production of a new drug for male pattern baldness. To begin:

- Put aside any of the Research Model Cards that will not be useful in answering the questions.
- Put the remaining cards in order from lowest organism or model to highest organism or model (some cards might be at the same level).
- Using the Research Model Cards, answer the following questions with your group:

Research Questions:

1. Which models would you use to determine how hair-producing cells communicate with each other?

2. Which models would you use to determine if the identified drugs have effects on any other cells in the animal?

3. Which models would you use to determine if **hair transplants** work?

As you discuss the answers consider:

- The benefits and limitations of each subject on the cards.
- How best to replace, reduce, and refine so the optimal number of organisms are used with the most humane methods.
- The ethical issues involved in your choices for research subjects.

HANDOUT

Hair Transplant: A surgical treatment for male pattern baldness that involves taking hair follicles from a donor part of the body and transplanting it into a recipient part of the body (usually the scalp). The donor site is chosen based on the hair follicles' genetic resistance to balding.

Hereditary Condition: Also called a genetic disorder, a hereditary condition is a condition or illness caused by abnormalities in genes or chromosomes. The genetic defect can be inherited from an individual's parents and/or passed down to his or her children.

Male Pattern Baldness: A genetic condition that causes hair loss in a predictable pattern along the temples and crown of the head.

HANDOUT

STUDENT HANDOUT 2.6
Antibacterial Soap

Name_____ Date_____ Period_____

*Antibacterial soap has become tremendously popular over the last number of years as a way of killing **bacteria** and **microbes** when used with water in a traditional hand washing manner. Antibacterial soaps are not the same thing as hand sanitizers, which use alcohol to kill bacteria when water may not be available. Most antibacterial soaps use the chemical Triclosan as the antibacterial agent. Antibacterial soap cannot kill **viruses**, and the chemicals do not distinguish between helpful and harmful bacteria when killing them on skin. Some concerns exist about the effects of Triclosan in the environment, and the potential rise of Triclosan-resistant bacteria that become very difficult to kill.*

RESEARCH GOAL:

Your research team has found a new antibacterial agent to replace Triclosan, and wants to use it in a new soap. If the soap can effectively kill the bacteria and viruses that cause disease without causing side effects, the researcher could prevent illness in a large population. To begin:

- Put aside any of the Research Model Cards that will not be useful in answering the questions.
- Put the remaining cards in order from lowest organism or model to highest organism or model (some cards might be at the same level).
- Using the Research Model Cards, answer the following questions with your group:

Bacteria: Tiny, single-celled organisms. These prokaryote organisms lack a nucleus and organelles within the membrane of the cell. Bacteria can form an association with other organisms that cause them to become pathogens, which can cause human disease and death from infections such as cholera, diphtheria, tuberculosis, and tetanus.

Microbe: Also called a microorganism, a microbe is one of a group of microscopic organisms that includes bacteria, fungi, archaea, protists, green algae, plankton, and planaria.

Virus: A tiny organism that can transmit infections and disease, such as influenza and HIV.

Research Questions:

1. Which models would you use to determine what agents can kill bacteria?

2. Which models would you use to determine if applying the chemical onto the skin in the form of a soap has any effects on skin?

3. Which models would you use to determine if overuse or misuse of your product can lead to antibiotic-resistant bacteria over time?

As you discuss the answers, consider:

- The benefits and limitations of each subject on the cards.
- How best to replace, reduce, and refine so the optimal number of organisms are used with the most humane methods.
- The ethical issues involved in your choices for research subjects.

HANDOUT

HANDOUT

STUDENT HANDOUT 2.7
Spinal Cord Injury

Name_____ Date_____ Period_____

"Four days before heading back to school for the fall term a very close friend, Ray, had invited me to the Allegheny River for a canoe trip. We paddled down the river a few miles and someone had set up a rope swing. Ray grabbed the rope, climbed to the top, and swung away. As soon as the rope retreated back to the bank, I threw it up behind the platform, climbed to the top, and kicked off. It was an incredible rush. Ray went up another time and launched himself way out in the water. I had noticed another canoe coming down the river. As cool as it was to be doing what we were doing, it's always better to be showing off while doing it! I gripped the rope tight and kicked my legs straight out and gained a lot of air fast. Tucking my knees up in my chest to spin into a few flips, something wasn't right. I lost my bearings and landed head first. That's the last I remembered."

*-Mark with a 6th cervical vertebra (C6) complete compression fracture causing **quadriplegia**,* http://www.dreamblvr.com/history.htm

Anti-inflammatory Drugs: Drugs used to treat inflammation. These drugs counteract the reactions caused by damaged cells, which release chemicals that stimulate the immune system, leading to swelling, and increase flow of cells to the damaged site.

Neuron: Also called a nerve cell, a neuron is a specialized cell in the nervous system (brain, spinal cord, and nerves) that processes and communicates information through electrical and chemical signals.

Quadriplegia: The result of a paralyzing injury that causes partial or total loss of the use of arms, legs, and torso, as well as the loss of sensory functions in these areas.

Regenerate: The process of growth and renewal that allows cells, organs, and organisms to be resilient to damaging events. For example, a sea star is capable of regenerating an arm that has been damaged by a predator.

Spinal Cord Injury: An injury to the spinal cord as a result of trauma (not disease). An example of the result of a spinal cord injury is quadriplegia.

RESEARCH GOAL:

A researcher is working to identify better methods to treat spinal cord injuries. Up to 12,000 people annually suffer from **spinal cord injury**. Treatments for spinal cord injury are limited and often do not restore lost function. Spinal cord injury models can be developed in any animal model with a spine. To begin:

- Put aside any of the Research Model Cards that will not be useful in answering the questions.
- Put the remaining cards in order from lowest organism or model to highest organism or model (some cards might be at the same level).
- Using the Research Model Cards, answer the following questions with your group:

Research Questions:

1. Which models would you use to determine how **neurons** communicate with each other?

2. Which models would you use to determine the effects of **anti-inflammatory drugs** administered immediately after the injury?

3. Which models would you use to determine if human patients could **regenerate** nerves after a spinal cord injury?

As you discuss the answers, consider:

- The benefits and limitations of each subject on the cards.
- How best to replace, reduce, and refine so the optimal number of organisms are used with the most humane methods.
- The ethical issues involved in your choices for research subjects.

HANDOUT

HANDOUT

TEACHER RESOURCE 2.1

Answer Key for Research Model Summary Table

Use this Answer Key to assess student performance on Student Handout 2.1—*Research Model Cards Summary Table*. This summary table is a tool to help students prepare for answering the Research Questions (as provided on Student Handout 2.2—*Research Topics*. NOTE: This chart does not reflect the comprehensive use of each model. It contains only the uses listed on the Research Model Cards.

Level of Complexity	Name of Research Model	Cell biology/function	Toxicity	Drug and product development/safety	Behavioral	Embryonic development	Transplantation/prosthetic	Brain/nervous system	Heart/cardiovascular	Respiratory system	Surgical technique	Gene-environment	Specific disesase/disorder:	Other:
This provides the "simplest" choice	Computer-based Modeling			X										
Simple	Cell Culture Systems	X	X					X	X			X		
"Lower organisms" Prokaryotes Single celled	Bacteria	X	X	X										Viral infection
Eukaryotes Single celled	Yeast	X		X										Viral infection
	Plants			X								X	Plant pathogens	Transgenic
	Worms	X						X						
	Fruit Flies			X		X							Alzheimer's	Genetic
	Zebrafish					X			X			X	Alzheimer's, diabetes	Regeneration
	Frogs	X				X								
	Chickens		X			X		X				X		
These rodents are on a similar order	Mice		X	X	X		X		X		X	X	Spinal injury, stroke, diabetes, autoimmune, cancer, bone, psychiatric	
	Rabbits			X			X			X			Asthma, Cystic fibrosis	Antibody production, respiratory system

RESOURCE

Level of Complexity	Name of Research Model	Cell biology/function	Toxicity	Drug and product development/safety	Behavioral	Embryonic development	Transplantation/prosthetic	Brain/nervous system	Heart/cardiovascular	Respiratory system	Surgical technique	Gene-environment	Specific disease/disorder:	Other:
Pigs and dogs are on a similar order	Pigs		X				X	X			X		Alzheimer's	
	Dogs				X		X		X		X			
	Macaques			X	X			X			X		HIV	Vaccine and infectious diseases
"Higher" organism	Humans			X										

YOUR REACTION TO ITS USE

Students may want to acknowledge a unique understanding or familiarity with different animals in the model card set. For example, a student who has had frogs as pets may react differently than a student without much experience with frogs. Generally, student reactions will change based on the complexity of an organism as well as that student's familiarity with an organism.

If a student states that a certain animal or group of animals should not be used in research under any circumstances, ask the student to address how ***not*** using this animal would impact research. It may also be helpful to ask, "What laws or regulations should be in place for this animal to be considered as a research subject?"

Try not to engage in debate at this point of the curriculum. The following lessons in this unit will help students better support their reasoning and justification for their answers.

Further points for consideration include:

- Many research studies investigating ***how cells work*** can be answered using cell and tissue cultures. For example, neurons and cells of the pancreas can be grown in culture. Preliminary research may not require a whole organism system.
- Many ***toxicity*** and/or ***drug studies*** can be started in cell and tissue cultures. Additional studies would eventually require whole animals. All drugs on the market must be tested on humans, too.
- Studies involving ***genetics*** would likely use a model organism that reproduces quickly and has genes that can be manipulated on the molecular level. Zebrafish are becoming the model of choice for this type of research.
- Research involving ***side effects*** of drugs or how a treatment affects a system require a whole animal system in order to see interactions between parts of the system.

RESOURCE

TEACHER RESOURCE 2.2

Questions for Use with Research Model Cards

These questions can be used to introduce students to the types and uses of organisms on the Research Model Cards through a team game. The teacher should pose a question (but not the included hint) and allow teams time to decide on an answer and write it down. The teacher then checks written answers and awards a point to each team with a correct answer. If no team gives the correct answer, the teacher may read the included hint and allow teams to try again. Encourage thoughtful guesses, since this will most likely be new information for students.

1. **Which organism has been engineered to have a clear skin, allowing scientists to more easily study the progress of cancer and the aging of internal organs? Hint: it is an amphibian.**

   Frog.

2. **Which organism has helped scientists identify genes responsible for the development of tumors that grow in the brain, lung, kidney, skin, and other organs? Hint: most of these have red eyes and are about 1/8" in length.**

   Fruit fly.

3. **Which organism played an essential role in the creation of cardiac pacemakers, heart transplant surgery and the canine distemper vaccine, helping save the lives of millions of human beings and animals? Hint: the canine distemper vaccine benefits its own kind.**

   Dog.

4. **Which small budding organism has led to the understanding of basic cellular processes, such as respiration and cell division? Hint: it is also important in the beer, bread, wine and pharmaceutical industries.**

   Yeast.

5. **Which organism helped scientists identify how to prolong the storage of donated blood, making blood transfusions a widely available life-saving procedure?**

   Rabbit.

6. **Which small mammal was responsible for the development of penicillin, an antibiotic used to treat infections? Today penicillin is the most widely used antibiotic, saving thousands of lives every day. Hint: it is the most widely used animal model.**

   Mouse.

7. **This organism has been a classical model for genetic studies for decades. It is also used extensively in pharmaceutical production. Hint: it is the major cash crop in the United States.**

   Corn.

8. **Which organism has transparent embryos, giving scientists a clear window to study genetically related diseases and the effects medical treatments have on development? Hint: this is quickly becoming one of the most-used model organisms.**

   Zebrafish.

9. **Which organism's heart valves have been used to replace damaged heart valves in human beings? Hint: the physical structure of their organs is very similar to that of human beings.**

   Pig.

10. **Which organisms have had their genomes sequenced?**

    All of them. Most are completely sequenced, and a few are still in the post-sequencing assembly stage.

Questions courtesy of *Americans for Medical Progress*, http://www.amprogress.org.

RESOURCE

TEACHER RESOURCE 2.3

Possible Answers for Research Questions

Each of the three questions on Student Handouts 2.3 – 2.7 generally corresponds to a different point in the research process. ***Note:*** A number of research models could be used to answer each question.

- ***Question #1*** focuses on ***basic research***, such as learning how cells work together and communicate. These questions can often be answered using cell or tissue cultures and may not require a whole organism system.
- ***Question #2*** focuses on ***toxicity*** and/or ***drug studies***. These represent an increased level of complexity allowing for interactions between cell types within a system. Though drug/toxicity studies may be started in cell and tissue cultures, they eventually require a living organism, usually the lowest practical model to start. Successful studies on lower organisms may lead to studies in higher model organisms. The FDA requires toxicity testing on two animal species before human trials can begin. All drugs intended for human use must be tested on humans before reaching the market.

  Question #2 may also involve studies of ***genetics***. This would likely use a model organism that reproduces quickly and has genes that can be manipulated on the molecular level. Zebrafish are becoming the model of choice for this type of research.
- ***Question #3*** looks at issues that involve animal models purpose-bred to model the disease, populations or environmental factors. Information from these types of research questions *may* have a clinical application to humans. Consenting humans are also often part of these types of studies.

ALZHEIMER'S DISEASE

1. Cell culture systems (animal models including worms and fruit flies would also work, but would be more difficult to study).
2. Mice are the most likely, but all animal models will work. Animals with a short lifespan can be advantageous for this research. Mice and rats live about two and a half years.
3. Fruit flies, zebrafish, pigs.

TYPE II DIABETES

1. Cell culture systems (animal models would also work, but would be more difficult to study).
2. Zebrafish and mice (possibly humans if there are families that have a higher incidence).
3. All animal models including humans.

MALE PATTERN BALDNESS

1. Cell culture systems (animal models would also work but would be more difficult to study).
2. Mice. Possibly rabbits, dogs, or pigs. Macaques and humans are unlikely.
3. Mice and rabbits (as well as other mammalian models).

ANTIBACTERIAL SOAP

1. Bacteria.
2. Cell culture systems (skin models exist for penetration and irritation). Mice and rabbits, as well as other mammalian models.
3. Bacteria cultures, as well as public health studies in humans.

SPINAL CORD INJURIES

1. Cell culture systems, vertebrate models.
2. Cell culture systems to study inflammation due to immunce cell response. Mice (as well as other mammalian models).
3. Zebrafish and mice (and other mammalian models), or recently-injured consenting humans.

RESOURCE

TEACHER RESOURCE 2.4
Master Copy for Research Model Cards

Copy these pages back-to-back and then cut out each card. Each student group will need one complete set of cards.

Computer-Based Modeling

Uses: For predicting the best dosage (a prescribed amount of a drug), potential toxicity (from damaging and poisonous substances), and side effects from drugs.

Advantages: No animals needed; can be used to refine animal studies.

Disadvantages: Only able to make predictions which must then be tested on animals.

Ethical Considerations: Animal studies are still needed to validate results (to be sure that the results of the modeling are accurate).

Cell Culture Systems

Uses: For basic cell biology research to determine how cells work and respond to changes in their environment. Used to measure toxic (damaging or poisonous) effects on specific cell types and to encourage cell growth and specialization. Cell culture lines exist for prostate and breast cancers, neural tissue, heart tissue, bone marrow, skin and many other cell types.

Advantages: Can be strictly controlled. Cells are easy to work with and provide results quickly.

Disadvantages: Cells are grown in artificial environments (grown in culture, such as a Petri dish, instead of inside an organism). Cells maintained for a long time in culture are different than those growing naturally inside an organism.

Ethical Considerations: Cells must be obtained from animals or humans.

Humans

Homo sapiens (animal, mammal)

Uses: For studying the safety and effectiveness of drugs and other treatments that are at the final stages of development (before they are allowed to be manufactured and sold).

Advantages: Results are strongest, since the testing is done on actual humans.

Disadvantages: Low participation by human volunteers. Costly and takes time. Ethical considerations limit most studies.

Ethical Considerations: Researchers must obtain informed consent from volunteers (volunteer must be capable of understanding the facts and risks of the study). Researchers must protect vulnerable populations (such as children, pregnant women, prisoners, and others). The study must maximize benefits and reduce harm for the volunteers.

Macaques

Macaca mulatta (animal, mammal, non-human primate)

Uses: For behavioral studies, brain function and development studies, surgical development, vaccine and infectious disease studies, and drug safety studies. HIV research relies on primates such as macaques.

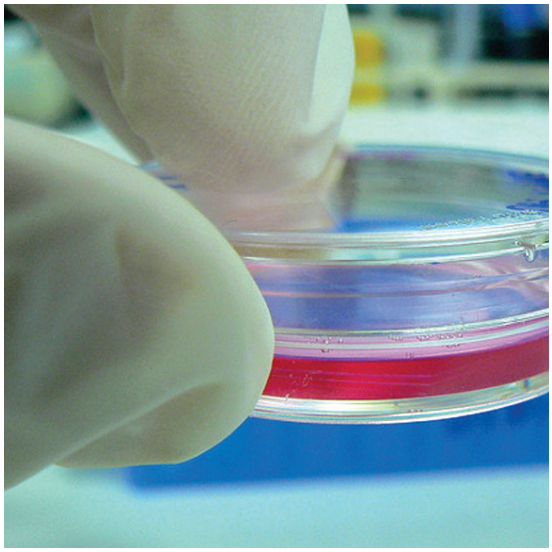
Advantages: Primates are humans' closest relatives. They provide a strong model for both behavioral (study of behavior) and physiological (study of organisms, organs, and cells) studies.

Disadvantages: Primates are expensive to house and feed, slow to breed, useful only for a limited number of studies, and genetically diverse.

Ethical Considerations: Because of their intelligence and social nature, macques require intensive care and social interaction to maintain their health.

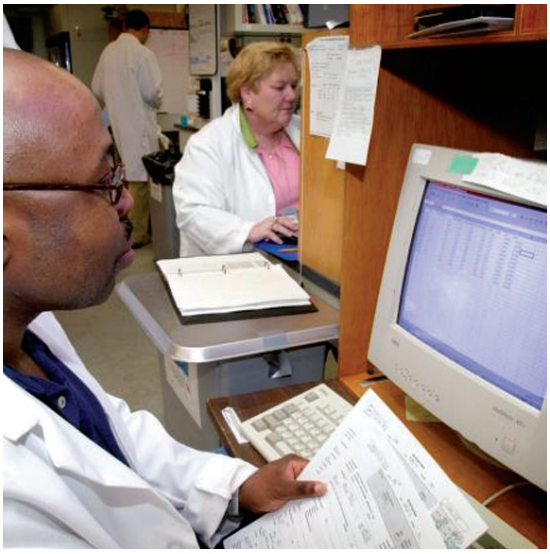
RESOURCE

Cell Culture Systems



Credit: Wikimedia, 2008. Umberto Salvagnin, http://www.flickr.com/photos/kaibara/3075268200/.

Computer-Based Modeling



Credit: Centers for Disease Control and Prevention/James Gathany, 2003.

Macaques

Macaca mulatta (animal, mammal, non-human primate)

Credit: Copyright 2007 Understanding Animal Research.

Humans

Homo sapiens (animal, mammal)

Credit: Centers for Disease Control and Prevention/James Gathany, 2006.

RESOURCE

Pigs

Sus scrofa (animal, mammal)

Uses: For transplantation, cardiac, skin and prosthetic device studies, surgical technique studies, gene-environment interaction studies, and studies of brain disorders like Alzheimer's disease.

Advantages: Mammals. Pigs have large organ systems that are similar to humans.

Disadvantages: Pigs are large, expensive to house and feed, and genetically diverse.

Ethical Considerations: Because of their intelligence and social nature, pigs require some social interaction to keep them healthy.

Dogs

Canis lupus familiaris (animal, mammal)

Uses: For behavioral studies and the development of surgical techniques for both veterinary and human applications. Dogs are also important for heart research, as well as transplantation and prosthetic device studies.

Advantages: Mammals. Dogs have large organ systems that are similar to humans. They are able to interact with researchers. Research on dogs benefits veterinary practice as well as humans.

Disadvantages: Dogs are expensive to house and feed as compared to smaller mammals.

Ethical Considerations: Because of their intelligence and social nature, dogs require some social interaction to keep them healthy. Historically, there has been public concern about the use of dogs in research.

Rabbits

Oryctolagus cuniculus (animal, mammal)

Uses: For antibody (an immune system protein) production studies, product safety testing, gene-environment interaction studies, transplantation and prosthetic device studies, surgical technique studies, and studies of respiratory diseases such as asthma and cystic fibrosis.

Advantages: Small mammals. Easy to breed and inexpensive to house and feed. Can be bred specifically for research to obtain genetically similar animals.

Disadvantages: Rabbits are larger and more expensive to house and feed than mice or rats.

Ethical Considerations: Historically, there has been public concern about the use of rabbits in research, especially the use of the Draize test on rabbits. In this test for cosmetics safety, substances are applied to the eyes or skin of conscious rabbits.

Mice

Mus musculus (animal, mammal)

Uses: For surgical technique studies, transplantation studies, drug safety studies, toxicity studies, behavioral studies, gene-environment interaction studies, and the study of diseases and disorders, including: cardiovascular disease, psychiatric disorders (mental illness), spinal injuries, stroke, diabetes, autoimmune disorders, Alzheimer's disease, cancer, bone healing, and many more.

Advantages: Small mammals. Easy to breed and inexpensive to house and feed. 80% of human genes are the same as in mice, allowing for the study of human genetic disorders and diseases. Genes can be added or removed in embryos to produce transgenic mice (where a gene has been added into a living organism) with genes that are similiar to human disorders. Currently, most animal research is conducted on mice and rats.

Disadvantages: Mice are different from humans, so not all results transfer directly to human responses.

Ethical Considerations: The creation of transgenic mice is controversial and might ultimately increase the number of animals used in research because many mice must be bred in order to produce a few with the genes of interest.

Dogs

Canis lupus familiaris (animal, mammal)

Credit: Copyright 2007 Understanding Animal Research.

Pigs

Sus scrofa (animal, mammal)

Credit: Copyright 2000 Understanding Animal Research/Wellcome Images.

Mice

Mus musculus (animal, mammal)

Credit: Copyright 2007 Understanding Animal Research.

Rabbits

Oryctolagus cuniculus (animal, mammal)

Credit: Copyright 2000 Understanding Animal Research/Wellcome Images.

Zebrafish

Danio rerio (animal, fish)

Uses: For regeneration studies (processes of renewal and growth of cells and organs), the study of embryonic development and gene-environment interaction studies. Also used for research on developmental defects in adult diseases and age-related abnormalities, such as cardiovascular disease, Alzeheimer's disease, and diabetes.

Advantages: Vertebrates. Easy and inexpensive to maintain and breed. Sequenced genome. Some transgenic zebrafish (where a gene has been added into a living organism) are available. Embryos (fertilized eggs) are transparent and develop outside of the parent's body, allowing for observation of the developing embryo.

Disadvantages: Zebrafish have many differences from humans, including many organ systems. Any drug studies on zebrafish need additional testing on mammals before human use.

Ethical Considerations: The creation of transgenic zebrafish is controversial.

Chickens

Gallus gallus (animal, bird)

Uses: For embryonic development studies (after an egg is fertilized). In particular, this includes craniofacial development studies (face and skull development), brain development studies, environmental factors studies, and toxicity (damaging or poisonous substances) studies.

Advantages: Vertebrates. Warm blooded. Easy and inexpensive to maintain and breed. Embryos (fertilized eggs) develop outside of the parent's body, allowing for observation of the developing embryo.

Disadvantages: Chickens have many differences from humans. Any drug studied on chickens needs additional testing on mammals before human use.

Ethical Considerations: The creation of transgenic chickens (where a gene has been added into a living organism) is controversial.

Frogs

Xenopus tropicalis (animal, amphibian)

Uses: For embryonic development studies (after an egg is fertilized). In cell biology and biochemistry studies, frogs are used for studying chromosome replication, control of the cell cycle, and various signaling pathways between cells.

Advantages: Vertebrates. Easy and inexpensive to maintain and breed. Large, transparent embryos (fertilized eggs) develop outside of the parent's body, allowing for observation of the developing embryo. Organ systems are complex. Genetic material can be easily manipulated to produce genetically similar organisms.

Disadvantages: The frog life cycle is very different from that of mammals.

Ethical Considerations: The creation of transgenic frogs (where a gene has been added into a living organism) is controversial. Ethical issues with frogs may differ from those with "higher" organisms like mammals.

Fruit Flies

Drosophila melanogaster (animal, insect)

Uses: Essential for research of genetics, developmental biology, and drug development. Also used for research on the effects of drugs on the progression of Alzheimer's disease. Although flies have very simple brains, they have highly developed muscles and nerves.

Advantages: Easy and inexpensive to maintain and breed. Easy to observe embryonic development (fertilized eggs). Large chromosomes. Can easily produce mutants.

Disadvantages: Invertebrates. Flies are very different from humans. Any drug studied on flies needs additional testing on mammals before human use.

Ethical Considerations: Ethical issues with flies may differ from those with "higher" organisms like mammals.

Chickens

Gallus gallus (animal, bird)

Credit: Copyright 2007 Understanding Animal Research.

Zebrafish

Danio rerio (animal, fish)

Credit: Wikimedia, 2007.
http://commons.wikimedia.org/wiki/File:Danio_rerio_port.jpg.

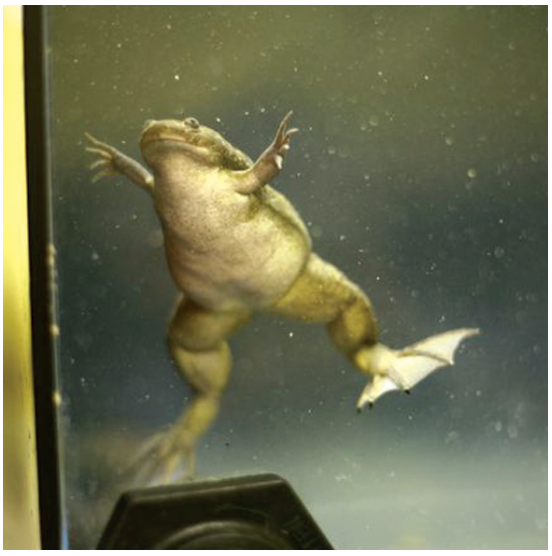
Fruit Flies

Drosophila melanogaster (animal, insect)

Credit: Wikimedia, Mr. Checker, 2009.
http://commons.wikimedia.org/wiki/File:Drosophila_melanogaster.jpg.

Frogs

Xenopus tropicalis (animal, amphibian)



Credit: Copyright 2007 Understanding Animal Research.

RESOURCE

Worms

Caenorhabditis elegans (animal, roundworm)

Uses: For research on the development of nerve cells and genetic screening. Worms are used as models of basic cellular communication.

Advantages: Instead of a brain, worms have a primitive nerve ring, making them ideal for studying the development of nerve cells. Easy and inexpensive to maintain and breed in large numbers. Sequenced genome.

Disadvantages: Invertebrates. Limited in scope. Worms are very different from humans. Any drug studied on worms needs additional testing on mammals before human use.

Ethical Considerations: Ethical issues with worms may differ from those with "higher" organisms like mammals.

Plants

Zea mays (land plant, corn)

Uses: For studies of plant diseases that affect crop production. Compounds found in plants can be used for drug development. Also used for genetic studies of transgenic organisms (where a gene has been added into a living organism), and gene-environment studies.

Advantages: Easy and inexpensive to maintain and breed. Less concern over care and welfare than animals.

Disadvantages: Plant. Require room to grow. Much of the cellular processes in plants are different than those in animals.

Ethical Considerations: Ethical issues surrounding genetic modification and the loss of genetic diversity in crop species.

Yeast

Saccaromyces cerevisiae (fungi, ascomycetes, Baker's yeast)

Uses: For studies of basic cell biology, drug development, and the effects of virus infection on cell function.

Advantages: Yeasts have similar basic cellular functions as humans. Easy to grow and maintain on a large scale.

Disadvantages: Yeasts are different from multicellular organisms.

Ethical Considerations: Less concern over care and welfare.

Bacteria

Escherichia coli (bacteria, gammaproteobacteria)

Uses: For studies of basic cell biology, drug development, and the effects of virus infection on cell function. Also used for studying how toxins (damaging or poisonous substances) affect cell growth and function.

Advantages: Bacteria can be used to synthesize medical compounds.

Disadvantages: Bacteria are very different from eukaryotic cells (cells that have a nucleus contained inside a membrane).

Ethical Considerations: Less concern over care and welfare. Much concern over the development of "super bugs" that are resistant to antibiotics.

Plants

Zea mays (land plant, corn)

Credit: Wikimedia, 2009, Ashlyak at ml.wikipedia.
http://commons.wikimedia.org/wiki/File:Corn_01.JPG.

Worms

Caenorhabditis elegans (animal, roundworm)

Credit: Centers for Disease Control and Prevention/Dr. Mae Melvin, 1974.

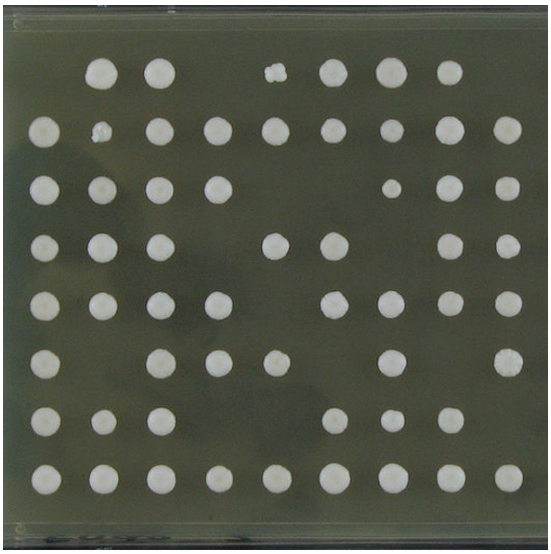
Bacteria

Escherichia coli (bacteria, gammaproteobacteria)

Credit: Centers for Disease Control and Prevention/Pete Seidel, 2010.

Yeast

Saccaromyces cerevisiae (fungi, ascomycetes, Baker's yeast)



Credit: Wikimedia, 2009, Masur.
http://commons.wikimedia.org/wiki/File:Yeast_colonies_array_96_format.jpg.

RESOURCE

LESSON 3:
History of Animals Research

INTRODUCTION

Students are introduced to a brief history of animal research through a timeline mapping activity. Students are asked to order the events in the timeline and highlight the occurrence of significant events. A discussion about significant events and trends helps students understand the impacts of history on today's regulations, governing bodies, and uses of animals in research. An extension to this lesson explores the meaning of the phrase *Not Tested on Animals*.

KEY CONCEPTS

- There are regulations and guidelines governing use of animals in research. Various government and organizational bodies oversee the adherence to these standards.
- The prevalent use of animals in research developed in response to human diseases, endangerment of human health, and unethical human research.
- Regulations and policies evolve for several reasons:
  - a) Scientific advancements allow for alternatives to animals.
  - b) There is a greater scientific understanding of proper and **humane treatment**, anesthesia, and **euthanasia** of animals.
  - c) The climate in the research community shifts.
  - d) Public voice and action calls for change.
- There is a delicate balance between the need for new discoveries, the need to uphold current regulations, and the need to hold people and organizations accountable when in violation of the regulations.

LEARNING OBJECTIVES

Students will know:

- There are regulations and regulatory bodies overseeing animal research.
- Regulations overseeing research on animals and humans evolve as knowledge and understanding grows.

Students will be able to:

- Identify some significant moments in the history of animal research and human research.
- Examine the role of people in the evolution of regulations and guidelines surrounding animal research.

CLASS TIME

Two class periods of 50 minutes each.

MATERIALS

Materials	Quantity
Chalk Talk Posters from *Lesson One*	6
Marking pens (all the same color)	As needed
Student Handout 3.1—*Historical Events in Animal Research*	1 per student
Teacher Answer Key 3.1—*Historical Events in Animal Research*	1
Teacher Resource 3.2—*Timeline Event Cards*	1 full set of cards

FRAMING THE LESSON

During *Lessons One* and *Two*, students began examining the various questions that scientists ask to determine whether animal subjects are necessary for research, including: for what purpose, which animal, how many, the 3 Rs, etc. In *Lesson Three*, students will examine how the use of animals became prevalent in human history.

Inform students that they are about to learn about many significant events in the history of animal research; some are steps ahead, and some are backward steps. Some of the events will describe atrocious breaches of rights and abuses of dignity for both humans and animals. What is important is not to vilify groups of people or stereotype research, but rather to understand that sometimes it takes horrific lessons for people to move toward positive action. It is critical to understand history so that we will not repeat the mistakes of the past. It is also critical to understand the history of positive change so that we can create preventative measures and action steps that lead to further positive change.

A vast majority of scientists agree that animals should not suffer as a result of research and that animal lives should not be wasted unnecessarily. A vast majority of the general public supports ethical conduct of animal research for medical and biomedical purposes. Unfortunately, the few extreme scientists who have mistreated animals and conducted unethical research and the few extreme animal rights activists who have destroyed property and threatened human lives have made the most memorable marks in animal research history. Again, it is important to examine the timeline with a critical eye so as not to generalize ***all*** scientists or ***all*** **animal welfare** or **animal rights activists**.

The history of animal research timeline is divided into three time periods:

- ***Time Period I*** details details events occurring from the third century B.C.E. (Before the Common Era) through the 1930s. .
- ***Time Period II*** details events occurring between the late 1930s and mid 1970s.
- ***Time Period III*** details events occurring between the late 1970s and into the future.

TEACHER PREPARATION

- Make copies of Student Handouts.
- Make a set of Timeline Event Cards. Using Teacher Resource 3.2—*Timeline Event Cards*, copy the pages single-sided and then cut them to create separate cards.

PROCEDURE

WARM-UP

1. As students enter the room, have them add to the Chalk Talk posters that were posted around the room during *Lesson One*. Provide a different colored marker than you did during *Lesson One* (but be sure you have the same color available for all students) to help distinguish the evolution of thought from day to day.

ACTIVITY ONE: HISTORY OF RESEARCH TIMELINE

2. Tell students that they will be learning about significant moments in history that shaped human research and animal research.

3. Define the term "vivisection." Explain that the term will be used on the timeline cards and is often used in animal advocacy language. **Vivisection**—from Latin *vivus* ("alive") and *sectio* ("cutting")—is defined as surgery conducted for experimental purposes on a living organism to view living internal structure. The term is sometimes more broadly defined as ***any*** experimentation on live animals. The term is often used by organizations opposed to animal experimentation, but is no longer used by practicing scientists.

4. Explain to students that they will work together as a class to complete a timeline that covers the third century B.C.E. to the present. Because the time span is so great, the class will work together on one ***portion*** of the timeline (either ***Time Period I***, ***Time Period II***, or ***Time Period III***) before moving on to the next portion of the timeline. Point out to students that the time periods are not divided equally and that ***Time Period I*** covers most of the actual time that has passed. Provide an overview of the three time periods:

   - ***Time Period I*** **(the third century B.C.E. through the 1930s):**
     In the early years, few (if any) known rules or regulations protected animals or humans used in research. In fact, the philosophy of this time held that animals were not even capable of feeling pain. Although this view was later disputed, many of the very early scientific advancements used animals (or humans) in ways that would be considered abusive today. Toward the end of this time period, great strides were made in the treatment or control of malaria, diphtheria, diabetes, and other diseases.

   - ***Time Period II*** **(late 1930s to mid 1970s):**
     Nazi atrocities in WWII led to requirements for animal testing. Biomedical research as a field became recognized, supported and funded, creating a demand for research animals. Using what they knew from the past, many scientists used dogs in their research. This demand led to a number of abuses in the acquisition, housing, and transporting of animals, especially dogs. Public outcry resulted in new laws and regulations. It also resulted in use of a new model—mice—which would eventually replace dogs and cats in most research. During this time, a Thalidomide disaster was averted in the U.S., and new treatments or vaccines for polio, leukemia, and smallpox greatly reduced the effects of those diseases.

   - ***Time Period III*** **(late 1970s and into the future):**
     Animal activism became increasingly organized and violent. At the beginning of this time period, the activist focus was on the use of animals for cosmetics testing. Later, much of the protest centered on the use of non-human primates in research, though there were other targets. Regulations for research institutions using animals continued to be strengthened. There was push from both outside and inside the research community to use "lower" animals like zebrafish as research models, and to find alternative testing methods. During this time, contributions to health included advancements in *in vitro* fertilization, treatment for HIV/AIDS and more.

5. Tell students that each card details an event from history. Students first need to decide in which category the event best fits. Go over the categories with students and check for understanding. The categories are:

   - **Views of Animals:** Philosophical views on the nature and value of animals (the "moral status" of animals), and humankind's relationship with animals.
   - **Contributions to Health:** Benefits of scientific research that advance health and wellbeing for humans and animals.
   - **Mistreatment:** Actions that would be considered abusive to humans or animals.
   - **Laws and Regulations:** Rules declared by a regulating body that guide or specify practices.
   - **Protest:** Actions by groups of people that object to a certain practice.

6. Choose a card from the timeline to read to the class, and decide as a group which category the card best fits. Some cards may fit best in ***more than one*** category.

7. Explain to students that they will have to use their best judgment to decide in which category a card best fits. For example, early views about animals may seem outdated or abusive to us today. Point out that views on important issues change over time and not every historical event will fit neatly into a category.

8. Begin with ***Time Period I***. Hand out one card from ***Time Period I*** to each student (The *Timeline Event Cards* are found in Teacher Resource 3.2). For small classes, you may hand out more than one card to each student, as long as the cards given to a student are next to each other chronologically. For large classes, you may have students pair up and share one card. There are sixteen event cards for each of the three time periods.

9. Ask students to circle the category on their card(s) into which the event best fits.

10. Tell students that they will be asked to share with the class the event on their card(s). Students should give a brief narrative about the event in their own words, rather than read the card itself. Provide a few minutes for students to review their cards. Students may turn to a neighbor to check for understanding and to practice explaining the events on their cards to each other.

11. Next, ask the students to work together to form a living timeline. Designate one end of the classroom to represent the earliest date in ***Time Period I*** and the other end to represent the latest date in ***Time Period I***. Challenge students to work together—checking the dates on each other's cards—to line up chronologically.

12. Review the events in the living timeline, moving from the earliest event to the latest event. Each student should share the story of the event featured on their card(s).

13. Lead a class discussion about the events featured in the timeline. Options may include:

    - Discuss the timeline by focusing on each of the five categories (**Views of Animals**, **Contributions to Health**, **Mistreatment**, **Laws and Regulations**, and **Protest**). Which events fell into each of the categories? Discuss any trends that the students notice within and among the categories.
    - Highlight the cards with an asterisk (*). These are key events in the time period.
    - Discuss any trends in thoughts or practices over time. How are events interrelated? Do some past events impact future events? Is "cause and effect" in play?

14. Instruct students to leave their cards in chronological order and post them where the entire class can access them (i.e., taped to a wall or placed on a long counter). Students may then sit down.

15. Pass out Student Handout 3.1—*Historical Events in Animal Research*. Encourage students to re-read the event cards as needed and work cooperatively to complete the questions related to ***Time Period I***.

16. Follow Steps #5-15 for ***Time Period II*** and ***Time Period III***.

ACTIVITY TWO: THE EVOLUTION OF HUMAN AND ANIMAL RESEARCH

17. **Addressing stereotypes:** There are stereotypes about research scientists, and there are stereotypes about people concerned with animals' welfare or rights. These stereotypes are based on the actions of a few very visible members of each group. Discuss this concept with students by asking the following questions: Is this similar to stereotypes about teenagers? What does it feel like to have these stereotypes placed on you? How does this understanding inform our views of stereotypes about people for and against animal research?

18. **Trends:** Talk about the ***trends*** students saw over time related to each of the five categories.

    - **Views of Animals:** Our philosophical views of animals have changed markedly over time. It is difficult to understand early notions that animals could not feel pain. The role of some animals, especially cats and dogs, has changed from workers to members of the family. Point out that in ***Time Period I***, both humans and animals were used in research. ***Time Period II*** brought a push to test on animals before humans. Dogs were often research subjects, though they began to be replaced in many cases with mice and rats. In ***Time Period III***, mice account for almost 90% of research animals, and scientists are actively exploring the use of "lower" animals such as zebrafish.
    - **Contributions to Health:** During all three time periods, scientists have pushed to understand physiology, cure diseases, and lessen human suffering.
    - **Mistreatment:** Some advancements to health came at the expense of both humans and animals through actions that would not be considered ethical or

humane by today's standards. Thanks to enforcement of laws and regulations, the care of research animals continues to improve.

- **Laws and Regulations:** ***Time Period I*** had few laws and regulations. Many new forms of regulations were introduced during ***Time Period II***, and these same regulations continue to be both strengthened and challenged during ***Time Period III***.
- **Protest:** Protesters have been active in all three time periods. The nature of the protests has become increasingly violent in ***Time Period III***.

CLOSURE

19. Tell students that this timeline exercise has been a skewed presentation; not all discoveries, not all groups, not all advancements in animal welfare, and not all examples of unethical behavior are included in the timeline. At the same time, the proportions of unethical and ethical research have shifted over time, especially with the onset of laws and regulations.
20. Share with students that there is constant need to balance the potential benefits and harms to both humans and animals. This tension requires constant case-by-case analysis as well as examination of overall policies.
21. Methods of educating the public about these issues include the news media, reports from organizations, schools, and propaganda. Ask students to briefly share with the class examples of public education about animal research that they may have seen and how they were influenced by these examples.
22. Tell students that these are real-world, complex, and engaging ethical questions. The information we receive is sometimes very biased toward one end of the spectrum or the other. By learning how to ***recognize*** the issues, ***listen critically*** to different viewpoints, and make a ***reasoned judgment*** about a course of action, students gain experience in critical thinking and grow in their understanding and respect for other points of view. Animal research is a heated ethical topic in science; an understanding of bioethics and decision-making will help students make well-reasoned and informed choices.

HOMEWORK

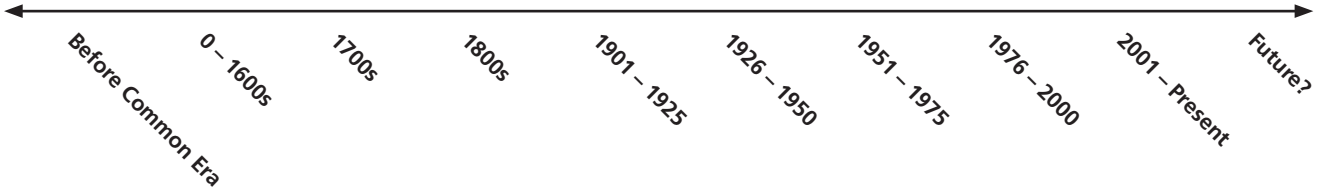
- Have students read the "Regulation of Animal Research" section (pages 29-36) of the book *Science, Medicine, and Animals*. The book and an accompanying teacher's guide can be downloaded for free as a PDF.

  Science, Medicine, and Animals
  http://www.nap.edu/catalog/10733.html

ADAPTATION

- When working with middle school students or those with lower reading levels, you may choose to use just the cards within each time period that have an asterisk (*). These cards are most representative of the time period and are simpler to read.
- Students can also approach the activity as an interactive timeline. Cut the date off the Timeline Event Cards and put the date portion inside an envelope. Attach the event description to the outside of the envelope. Working as a class, place each envelope along a timeline in the room, as below:

When students have agreed on the order for the timeline as a group, they may open the envelopes and see the actual time for that event. Students should rearrange the envelopes accordingly.



EXTENSION

"Not tested on animals"

Ask students to bring in personal care products such as shampoo, deodorant, soap, or face cream. Ask students if their personal shopping habits are influenced by the "not tested on animals" label. Why or why not?

Examine the labels of the personal care products carefully to determine if the product is a cosmetic or a drug. **Cosmetics and drugs are regulated differently** by the Food and Drug Administration (FDA). Products that contain drugs are required to identify themselves by listing the Drug Facts (active ingredient) on the label. By law, **all drugs** must go through animal safety/toxicology testing before human clinical trials and marketing to the public.

The FDA does not specifically require animal testing of cosmetics before human testing or marketing. The FDA requires that cosmetics be safe and properly labeled. It is up to the cosmetics manufacturer to decide which safety tests are necessary since the FDA does not tell them which tests to conduct, nor does FDA review the safety test results before products go on the market.

In the United States, what does "*Not Tested on Animals*" mean? This claim by cosmetics companies can have multiple meanings:

- The final product was not tested on animals, but the individual ingredients were.
- The manufacturer/distributor did not test on animals, but someone else did.
- The animal tests were done more than five years ago so the manufacturer can claim that the product was "not tested on animals." This is called the "rolling circle rule."
- There are no new ingredients in the product so the manufacturer can assemble safety information from the literature that shows previous safety testing and/or a history of safe use for the ingredients in the quantities used. In this case, no additional animal safety tests would be needed.
- The product conforms to European Union laws which banned cosmetic testing on animals in 2009, to take effect by 2013. In this case, the ingredients and final product really were not tested on animals.

More information can be found in Lesson 1 of the ***Consumer Awareness*** curriculum available at http://www.nwabr.org.

GLOSSARY

Animal Rights Activist: A person who believes that animals should be given similar considerations as human beings, should not be considered as property, and should be awarded basic rights.

Animal Welfare Activist: A person who believes that it is morally acceptable to use animals for human purposes, as long as the animal's welfare (physical and psychological well-being) is protected.

Dissection: Surgery conducted for educational or experimental purposes on a non-living organism to view internal structures.

Euthanasia: The practice of ending an animal's life while minimizing pain, distress, and anxiety prior to loss of consciousness. Most often accomplished through the administration of drugs.

Humane treatment: Treating animals with a high degree of respect and care.

Model Organism: An organism that is used in research because it is easier to study a particular aspect in that organism, rather than in humans and higher organisms. Model organisms tend to be small, able to reproduce rapidly with many offspring, inexpensive to house and maintain, able to be manipulated genetically on the molecular level, and well-studied by other scientists. Major model organisms include E. coli bacteria, yeasts, slime molds, fruit flies, zebrafish, and mice.

Transgenic Organism: A living organism in which genes, or gene regulatory regions, have been added, removed, or modified. The change in DNA will cause the organism to exhibit a new property (immune system change, genetic disorder, etc.) which can be passed to its offspring.

Vivisection: Surgery conducted for experimental purposes on a living organism to view living internal structures. The term is sometimes more broadly defined as any experimentation on live animals. The term is often used by organizations opposed to animal experimentation and is no longer used by practicing scientists.

RESOURCES

All About Diabetes
http://www.medicalnewstoday.com/info/diabetes/discoveryofinsulin.php

Animal Welfare Act Information Center
http://awic.nal.usda.gov/

Association for Assessment and Accreditation of Laboratory Animal Care International
http://www.aaalac.org/

Clinical Diabetes Mellitus: A Problem-Oriented Approach. John Davidson. Thieme, 2000, p. 6-8.

Edward Jenner and the History of Smallpox and Vaccination
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1200696/

Guide for the Care and Use of Laboratory Animals. Institute for Laboratory Animal Research. National Academies Press, 2010.
www.nap.edu/catalog.php?record_id=12910

History of AIDS up to 1986
http://www.avert.org/aids-history-86.htm

History of Medical Advances Timeline
http://www.animalresearch.info/en/medical/timeline

Profiles in Science: The Mary Lasker Papers & the National Institutes of Health
http://profiles.nlm.nih.gov/TL/Views/Exhibit/narrative/nih.html

Pro-Test Blog: Standing Up for Science
http://www.pro-test.org.uk/b2evo/index.php?m=201010

"Regulation of Animal Research." Institute for Laboratory Animal Research. *Science, Medicine, and Animals*. National Research Council of the National Academies, 2004.
http://www.nap.edu/catalog/10733.html

Research Animals: History
http://www.libraryindex.com/pages/2180/Research-Animals-HISTORY.html

Scientific and Humane Issues in the Use of Random Source Dogs and Cats in Research. National Research Council Committee on Scientific and Humane Issues in the Use of Random Source Dogs and Cats in Research. National Academies Press, 2009.
http://www.ncbi.nlm.nih.gov/books/NBK32665/

Silver Springs Monkey Case. "Renewal of Brain is Found in Disputed Monkey Tests." Leary, Warren E. *The New York Times*, June 28, 1991.
http://www.nytimes.com/1991/06/28/us/renewal-of-brain-is-found-in-disputed-monkey-tests.html

Thalidomide & FDA Medical Reviewer Frances Oldham Kelsey
http://permanent.access.gpo.gov/lps1609/www.fda.gov/fdac/features/2001/201_kelsey.html

The Rights of Animals. Tamara Roleff and Jennifer Hurley (editors). Cengage Gale, 1999.

Timeline: Chronology of Landmarks in Animal Based Research and the Key Moral Statements
http://www.ccac.ca/Documents/Education/timeline_tiled.pdf

US Food and Drug Administration History
http://www.fda.gov/AboutFDA/WhatWeDo/History/default.htm

STUDENT HANDOUT 3.1
Historical Events in Animal Research

Name_____ Date_____ Period_____

Summary Message for Time Period I (The third century B.C.E through the 1930s):

In the early years, few (if any) known rules or regulations protected animals or humans used in research. In fact, the philosophy of this time held that animals were not even capable of feeling pain. Although this view was later disputed, many of the very early scientific advancements used animals (or humans) in ways that would be considered abusive today. Toward the end of this time period, great strides were made in the treatment or control of malaria, diphtheria, diabetes, and more.

QUESTIONS FOR TIME PERIOD I:

1. Did anything surprise you?

2. What are some laws, regulations, or guidelines for animal research?

3. Why or how do laws, regulations, or guidelines change?

4. What types of animals were used for research? How were they treated?

HANDOUT

Summary Message for Time Period II (late 1930s through mid 1970s):

Nazi atrocities in WWII led to requirements for animals testing. Biomedical research as a field became recognized, supported, and funded, creating a demand for research animals. Using what they knew from the past, many scientists used dogs in their research. This demand led to a number of abuses in the acquisition, housing, and transporting of animals, especially dogs. Public outcry resulted in new laws and regulations. It also resulted in use of a new model—mice—which would eventually replace dogs and cats in most research. During this time a Thalidomide disaster was averted in the U.S., and new treatments or vaccines for polio, leukemia, and smallpox greatly reduced the effects of those diseases.

QUESTIONS FOR TIME PERIOD II:

5. Did anything surprise you?

6. What are some laws, regulations, or guidelines for animal research?

7. In what way(s) does public opinion influence changes to laws, regulations, or guidelines?

HANDOUT

Summary message for Time Period III (late 1970s and into the future):

Animal activism became increasingly organized and violent. At the beginning of this time period, the activist focus was on the use of animals for cosmetics testing. Later, much of the protest centered on the use of non-human primates in research, though there were other targets. Regulations for research institutions using animals continued to be strengthened. There was push from both outside and inside the research community to use "lower" animals such as zebrafish as research models, and to find alternative testing methods. During this time, contributions to health included advancements in *in vitro* fertilization, treatment for HIV/AIDS and more.

QUESTIONS FOR TIME PERIOD III:

8. Did anything surprise you?

9. What are some laws, regulations, or guidelines for animal research?

10. Do you think the situation surrounding animal research changed for the better? Why or why not?

11. What future steps are required to create further positive change?

12. **Looking forward:** Who are the people involved in animal research today? What are their perspectives? Where do we go from here?

HANDOUT

HANDOUT

TEACHER ANSWER KEY 3.1
Historical Events in Animal Research

QUESTIONS FOR TIME PERIOD I:

1. Did anything surprise you?

*Students will provide an example of something that surprised them from **Time Period I**.*
Possible answers may include:

- *Live criminals were used for vivisection.*
- *Philosophers believed that animals were incapable of feeling pain.*
- *Laws against animal abuse existed before laws against child abuse.*
- *The idea that disease is caused by germs is relatively new (1881).*
- *Deaths were caused by the use of eyelash and eyebrow dye before safety testing.*

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Provides three or more examples of things that were surprising.	Provides two examples of things that were surprising.	Provides one example of something that was surprising.	Does not provide a response

2. What are some laws, regulations, or guidelines for animal research?

*Student responses should include laws, regulations, or guidelines featured in the cards from **Time Period I**.*
Possible answers include:

- *1860s: U.S. law to prevent the beating of horses.*
- *1890s: U.S. legislation to outlaw repetition of painful animal experiments.*
- *1906: Pure Food and Drug Act (PFDA) passed by U.S. Congress.*

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Provides three or more examples of laws, regulations, or guidelines used for animal research.	Provides two examples of laws, regulations, or guidelines used for animal research.	Provides one example of laws, regulations, or guidelines used for animal research.	Does not provide any examples of laws, regulations, or guidelines used for animal research.

3. What types of animals were used for research?

*Students should provide the names of animals used in research during **Time Period I**.*
Student responses should also include a brief description of how the animals were treated.
Possible answers include:

- *Ancient Egypt: Animals were vivisected.*
- *150-200: Greek physician Galen vivisected goats, pigs, monkeys, oxen, and dogs.*
- *1500s: Vesalius practiced vivisection on animals without anesthesia.*
- *1881: Pasteur develops germ therapy by conducting research on silkworms and sheep.*
- *1906: Ross conducts malaria research on birds.*
- *1913: Von Behring injected diphtheria toxin into rats, mice, rabbits, guinea pigs, monkeys, and donkeys.*
- *1922: Dog studies provided information on the role of the pancreas in producing insulin.*
- *1922: Banting extracted insulin from beef pancreases.*

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Provides five or more examples of the types of animals used in research.	Provides three or four examples of the types of animals used in research.	Provides one or two examples of the types of animals used in research.	Does not provide any examples of the types of animals used in research.

RESOURCE

QUESTIONS FOR TIME PERIOD II:

4. Did anything surprise you?

   *Students will provide an example of something that surprised them from **Time Period II**.*
   Possible answers may include:

   - *There were no requirements to test medicines for toxicity; people died from unsafe medicines.*
   - *Animal research is a requirement of the Nuremburg Code (in response to WWII atrocities).*
   - *A dog was stolen from a family's yard to be used for research.*
   - *The movie 101 Dalmatians reflects cultural fears of the time.*
   - *Smallpox has been eradicated from the planet.*

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Provides three or more examples of things that were surprising.	Provides two examples of things that were surprising.	Provides one example of something that was surprising.	Does not provide a response.

5. What are some laws, regulations, or guidelines for animal research?
   *Student responses should include laws, regulations, or guidelines featured in the cards from **Time Period II**.*
   Possible answers include:

   - *1938: Food, Drug, and Cosmetics Act (FDC Act) passed by U.S. Congress.*
   - *1947: Nuremburg Code drafted.*
   - *1959: 3 Rs published.*
   - *1960s: As a result of the Thalidomide disaster, new guidelines for testing the effects of drugs on animal reproduction and fetus development were incorporated by the FDA.*
   - *1962: The FDC Act was amended to require that all products be effective as well as safe.*
   - *1963: Publication of The Guide for the Care and Use of Laboratory Animals.*
   - *1965: Formation of the Association for the Assessment and Accreditation of Laboratory Animal Care (AAALAC) which provided guidelines and accreditation.*
   - *1966: U.S. Congress passes the Animal Welfare Act (AWA).*

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Provides five or more examples of laws, regulations, or guidelines used for animal research.	Provides three or four examples of laws, regulations, or guidelines used for animal research.	Provides one or two examples of laws, regulations, or guidelines used for animal research.	Does not provide any examples of laws, regulations, or guidelines used for animal research.

6. In what way(s) does public opinion influence changes to laws, regulations, or guidelines?
*Student responses should include examples of how public opinion influenced changes, as featured in the cards from **Time Period II**. Possible answers include:*
   - *1938: Public outrage concerning Elixir of Sulfanilmide causes the U.S. Congress to pass the Food, Drug, and Cosmetics Act (FDC Act).*
   - *1947: Outrage within the scientific community at the atrocities of Nazi doctors inspires the drafting of the Nuremburg Code.*
   - *1961-65: In fear of having their pet dogs stolen for use in biomedical research (due to 101 Dalmatians, the story of Pepper the dog, and the Life magazine article), the public demanded more accountability in animal research using dogs. The Animal Welfare Act (AWA) was passed in 1966.*
   - *Public outrage at the use of dogs and cats in research influenced researchers to use other organisms, including mice, rats, and zebrafish.*

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Provides three or more examples of how public opinion influenced laws, regulations, or guidelines used for animal research.	Provides two examples of how public opinion influenced laws, regulations, or guidelines used for animal research.	Provides one example of how public opinion influenced laws, regulations, or guidelines used for animal research.	Does not provide any examples of laws, regulations, or guidelines used for animal research.

QUESTIONS FOR TIME PERIOD III:

7. Did anything surprise you?
*Students will provide an example of something that surprised them from **Time Period III**.*
Possible answers may include:
   - *Some mice have human genes.*
   - *People working in research organizations have been harassed and assaulted, and their property has been firebombed and vandalized.*
   - *Zebrafish are becoming a popular research model organism.*

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Provides three or more examples of things that were surprising.	Provides two examples of things that were surprising.	Provides one example of something that was surprising.	Does not provide a response.

8. What are some laws, regulations, or guidelines for animal research?
Student responses should include laws, regulations, or guidelines featured in the cards from ***Time Period III****.*
Possible answers include:
   - *1979: Research institutions that receive federal money are required to have an Institutional Animal Care and Use Committee (IACUC) to oversee the use of all vertebrates.*
   - *1985: The U.S. Congress amends the Animal Welfare Act (AWA) to require that researchers minimize animal pain and distress through the use of anesthesia, analgesics, and humane euthanasia.*
   - *1992: Animal Enterprise Protection Act is passed to protect against acts of "animal enterprise terrorism."*
   - *1994: The U.S. Congress passes a law to allow veterinarians to treat animals with drugs approved for humans or other species.*

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Provides three or more examples of laws, regulations, or guidelines used for animal research.	Provides two examples of laws, regulations, or guidelines used for animal research.	Provides one example of laws, regulations, or guidelines used for animal research.	Does not provide any examples of laws, regulations, or guidelines used for animal research.

9. Do you think the situation surrounding animal research changed for the better? Why or why not?
Student responses should provide a position on whether animal research has changed for the better and include an explanation for their thoughts. Exemplary answers will cite multiple examples from the timeline.

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Student states a clear position on whether animal research has changed for the better . -AND- Student response includes an explanation for the position. -AND- Cites one or more examples from the timeline.	Student states a position on whether animal research has changed for the better. -AND- Student response includes an explanation for the position.	Student states a position on whether animal research has changed for the better.	Student does not state a position on whether animal research has changed for the better.

RESOURCE

10. What future steps are required to create further positive change?

Answers will vary, but should show connections to the events featured on the timeline cards.

Possible answers may include:

- *Using the 3 Rs to guide research will continue to reduce and replace animals used in research:*
  - *Non-animal models and other alternatives will continue to be developed and relied upon.*
  - *Higher animals will be replaced with lower animals as model organisms.*
- *As the health and well-being of research animals affects the quality of scientific results, scientists will be proponents of animal welfare.*
- *The enforcement of laws and regulations will continue to improve the care of research animals.*
- *Public outcry over inhumane treatment has changed/created regulations in the past, and will continue to do so in the future.*

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Provides three or more examples of possible future steps.	Provides two examples of possible future steps.	Provides one example of a possible future step.	Does not provide any possible future steps.

11. **Looking forward:** Who are the people involved in animal research today? What are their perspectives? Where do we go from here?

Answers will vary, but should show connections to the events featured on the timeline cards.

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Provides an adequate response to all three questions.	Provides an adequate response to two of the three questions.	Provides an adequate response to one of the three questions.	Does not provide an adequate response to any of the three questions.

RESOURCE

TEACHER RESOURCE 3.2
Timeline Event Cards

TIME PERIOD I

TIME PERIOD I
Third and second centuries B.C.E.

At the medical school in Alexandria, Egypt, humans and animals were vivisected. Vivisection is surgery conducted for experimental purposes on a living organism to view living internal structures.

Historians believe that more than **600 criminals were subjected to vivisection while they were alive**. Human dissection and vivisection were generally forbidden throughout the rest of Egypt and in the Roman Empire due to moral concerns.

Views of Animals • Contributions to Health
Mistreatment • Laws & Regulations • Protest

TIME PERIOD I
150 – 200

The Greek physician Galen frequently practiced vivisection on animals. Vivisection is surgery conducted for experimental purposes on a living organism to view living internal structures. In particular, Galen vivisected goats, pigs, monkeys, oxen, and dogs.

Galen made some **important anatomical discoveries about the internal structures of animals**, such as the importance of the brain and the presence of blood inside arteries. Galen's writings and teachings formed the basis of Western medical science well into the Middle Ages.

Views of Animals • Contributions to Health
Mistreatment • Laws & Regulations • Protest

TIME PERIOD I
1500s

Belgian doctor Andreas Vesalius studied blood circulation by **performing autopsies** (dissections on non-living organisms) **on human corpses**. He also **practiced vivisection on animals** without using any sort of anesthesia. Vivisection is surgery conducted for experimental purposes on a living organism to view living internal structures. Vesalius wrote about the importance of autopsies and vivisection in the study of **anatomy** (internal structures and systems).

British physician and anatomist William Harvey performed animal vivisection and dissected the corpses of executed criminals. He discovered the true role of the heart in pumping blood throughout the body.

Views of Animals • Contributions to Health
Mistreatment • Laws & Regulations • Protest

* TIME PERIOD I
1596 – 1650

French **philosopher** René Descartes and his followers believed that animals were unthinking, unfeeling machines. This allowed researchers to perform all manner of experiments on live animals without any moral concerns.

Views of Animals • Contributions to Health
Mistreatment • Laws & Regulations • Protest

RESOURCE

* TIME PERIOD I
1764

French **philosopher** François-Marie Arouet de Voltaire noted that vivisection uncovered organs of feeling in animals, proving that animals were not machines, but feeling beings. Vivisection is surgery conducted for experimental purposes on a living organism to view living internal structures.

Later in the century, British **philosopher** Jeremy Bentham summarized his thoughts on the subject: "The question is not, can they reason? Nor, can they talk? but, can they suffer?"

Views of Animals • Contributions to Health
Mistreatment • Laws & Regulations • Protest

* TIME PERIOD I
1866

The **American Society for the Prevention of Cruelty to Animals (ASPCA)** was the **first humane society** to be established in North America. Humane treatment means treating animals with respect and care.

A law to prevent the beating of horses came about through early action from ASPCA. Later, this law was used to prosecute a parent who was beating her child, as there were no laws at the time preventing the abuse of children. Nine years later the **American Society for the Prevention of Cruelty to Children** was founded.

Views of Animals • Contributions to Health
Mistreatment • Laws & Regulations • Protest

TIME PERIOD I
1871

Harvard University founded one of the first vivisection laboratories in the country, despite opposition from the **Massachusetts Society for the Prevention of Cruelty to Animals (MSPCA)**. Vivisection is surgery conducted for experimental purposes on a living organism to view living internal structures.

Various **anti-vivisection groups were founded**, including the **American Anti-Vivisection Society (AAVS)** and the **New England Anti-Vivisection Society (NEAVS)**. The new anti-vivisection groups tried, unsuccessfully, to outlaw the practice of vivisection.

Views of Animals • Contributions to Health
Mistreatment • Laws & Regulations • Protest

TIME PERIOD I
1881

French scientist Louis Pasteur proved the controversial theory that diseases were caused by microscopic organisms ("germs"). Using yeast, silkworms, and sheep, Pasteur found that microbes could travel through the air and that the **spread of disease could be controlled by sterilization**, which includes the use of heat, chemicals, pressure, irradiation, or filtration to remove or kill microbes. This discovery had wide application to surgical techniques and medicine.

Views of Animals • Contributions to Health
Mistreatment • Laws & Regulations • Protest

RESOURCE

TIME PERIOD I
1890s

Legislation was passed in the United States that **outlawed** repetition of painful animal experiments for the purpose of teaching or demonstrating well-known and accepted facts.

Views of Animals • Contributions to Health
Mistreatment • Laws & Regulations • Protest

TIME PERIOD I
1903

Writer Mark Twain (1835–1910) published a short story called "A Dog's Tale" in Harper's Magazine. The story was written to **protest cruelty to animals** and their use in research. It is told from the viewpoint of a dog that lives with the family of a scientist. The dog saves the family's baby from a nursery fire but later sees her own puppy blinded and killed during an experiment performed by the scientist to impress his friends. Critics condemned the work as overly sentimental, but animal welfarists were pleased that it brought public attention to the issue of animal experimentation.

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TIME PERIOD I
1906

Controlling **malaria** was vital to the building of the Panama Canal. Malaria is an infectious disease caused by a parasite that is transmitted through the bite of an infected mosquito. Of the 26,000 people working on this strategic project, over 21,000 were hospitalized for malaria some time during their work.

Biologist Ronald Ross tested the theory that malaria might be caused by mosquito bites by studying the avian (bird) form of malaria in the crow. Work with crows, sparrows, pigeons, weaver birds, and larks led Ross to believe that the parasite accumulated in the salivary gland of the mosquito. This led to a mosquito control program which greatly reduced the incidence of malaria in Panama and elsewhere. Ross was awarded the Nobel Prize in medicine for his discoveries.

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* TIME PERIOD I
1906

The U.S. Congress passed the **Pure Food and Drug Act (PFDA)** which made it against the law to use false or misleading claims about a food or drug. As it applied to "man and other animals," it also covered animal feed and veterinary drugs. The act did not, however, require any type of testing to ensure that a product was safe or effective.

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RESOURCE

TIME PERIOD I
1907

The **American Medical Association** started to advocate for the benefits of research with animals and developed **regulations for the humane treatment** of animals used in medical schools. Humane treatment means treating animals with respect and care.

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TIME PERIOD I
1913

Once known as the "strangling angel of children," **diphtheria** is a highly contagious childhood illness caused by a bacteria. The dreaded disease would begin with cold-like symptoms and lead to death in as little as a week. Death rates for diphtheria were high, and the need for a vaccine was clear.

German scientist Emil von Behring found that low doses of modified toxin (a damaging substance naturally produced by diphtheria bacteria) injected into rats, mice, or rabbits appeared to protect them from the illness. After more than 15 years of research, von Behring produced long-lasting immunity in guinea pigs, monkeys, and donkeys. This research was used in the first vaccination studies on humans.

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* TIME PERIOD I
1920s and 1930s

A cosmetics company introduced a brand of eyelash and eyebrow dye called Lash-Lure. The dye contained chemicals (aniline compounds) that were well-known to be **harmful to the eyes**. Doctors reported thousands of eye injuries and even deaths after patients suffered serious infections. Other popular cosmetic products of the time contained **high concentrations of toxic (damaging or poisonous) chemicals** such as silver, lead acetate, or rat poison. Doctors lobbied the U.S. Congress to crack down on dangerous drugs and personal products sold to Americans, but they were opposed by powerful marketing groups. Injuries also prompted calls for products to be tested on animals before being put on the market for human use.

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* TIME PERIOD I
1922

For 150 years, doctors had been researching ways to treat **diabetes**, a disease in which a person has high blood sugar levels. Juvenile diabetics would usually fall into a coma and die a year or two after symptoms of the disease first appeared. Through studies with dogs, it was known that the pancreas produced an important substance ("insulin") that regulated blood sugar.

Canadian doctor Frederick Banting extracted insulin from beef pancreases and used it to successfully treat a 14-year old boy dying of diabetes, who at the time weighed only 65 pounds. Families with diabetic children rushed to Toronto for treatment. The Toronto Star called the extract "one of the greatest achievements in modern medicine." Banting and colleagues won the Nobel Prize for their work.

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RESOURCE

TIME PERIOD II
1937-1938

Nearly 100 people (mostly children) died after drinking a raspberry-flavored product used to treat sore throats called Elixir of Sulfanilamide. The medicine contained drugs dissolved in the same toxic (poisonous) chemical found in antifreeze. It had been tested for flavor, appearance, and fragrance, but not for toxicity—the degree to which it was poisonous or damaging to health. At the time, there were no requirements for safety testing. The product had also not been tested on animals. The public was outraged and pressured the U.S. Congress to strengthen the original **Food and Drug Act** and include cosmetics. The federal **Food, Drug, and Cosmetic Act (FDC Act)** was passed, containing a **requirement for animal testing** for drugs.

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* TIME PERIOD II
1947

During World War II, German Nazi doctors performed gruesome **experiments on prisoners** who were Jewish, homosexual, mentally disabled, physically disabled, or children. These prisoners were forced into being test subjects. Several tens of thousands of people died in these experiments, and many of those who survived were disfigured.

In response, the "Nuremberg Code" was developed to describe ethical conduct in human research. The Code was widely adopted in scientific research communities. One of the ten points of the code stated a **requirement for animal research** before human research to minimize the harm to humans.

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TIME PERIOD II
1950s

During the 1950s, many children were not allowed to go to swimming pools, movie theaters, amusement parks, beaches, and other public places as **fear of the polio virus** grew. This crippling disease involved the spinal cord and brain. Some people who were affected with it could not breathe without a ventilator or "iron lung."

Scientists grew and extracted the virus from cell and tissue cultures. Because the virus was too small to be seen with available technology, the fluid extracted from the cultures was injected into mice and monkeys in order to check that scientists were actually working with the polio virus. These techniques allowed viruses to be isolated and, eventually, a vaccine to be developed.

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TIME PERIOD II
1959

Members of the research community published The Principles of Humane Experimental Technique. One of its core messages, the **3 Rs** (Replacement, Reduction, and Refinement), became widely accepted by scientific communities. In many countries, the 3 Rs are the principles currently guiding the use of animals in research.

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TIME PERIOD II
1960s

Francis Oldham Kelsey was a new employee at the **Food and Drug Administration** in 1960 when she was asked to evaluate a drug, **Thalidomide**. At the time, Thalidomide was already in widespread use in Canada and Europe to treat nausea in pregnant women. Her previous work with drug metabolism in pregnant rabbits made her cautious, so she held back Thalidomide's approval for use in the U.S.

The use of this drug elsewhere resulted in more than 10,000 deformed babies, many born without arms or legs. Although the drug had been extensively tested on animals, it had not been tested on pregnant animals. **As a result, new guidelines** for testing the effects of drugs on animal reproduction and fetal development were incorporated.

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* TIME PERIOD II
1961

After World War II, the Federal government began supporting biomedical research in ways it never had before, **increasing the budget** of the National Institutes of Health (NIH) 150-fold between 1945 and 1961. Additional research money created a demand for more research animals.

Dogs, which had played a large part in animal research in the past, were especially sought after. People's fears of dog-napping are reflected in the 1961 Disney movie ***101 Dalmatians***, which tells the story of pet dogs stolen by a cruel villain.

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TIME PERIOD II
1962

The federal **Food, Drug, and Cosmetic Act (FDC Act)** was amended to require that all drugs not only be safe but **effective**. This amendment did not distinguish between medicines for humans and animals. Regulations for animal drugs, medicated feed, and veterinary food additives were strengthened.

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TIME PERIOD II
1963

A group of veterinarians formed the **Animal Care Panel** and soon published the first edition of ***The Guide for the Care and Use of Laboratory Animals***. Currently, the Guide informs scientists on the proper housing of various animals, good practices of veterinary care, training requirements of caretakers, and more.

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RESOURCE

* TIME PERIOD II
1965

Pepper, a Dalmatian dog, disappeared from her family's backyard in Pennsylvania. The family tracked the dog to an animal dealer who had sold her to a hospital in New York City that conducted a pace-maker experiment on her heart, which she did not survive. Pepper's story was widely publicized and an **outraged public** demanded more accountability in animal research, especially research using dogs.

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TIME PERIOD II
1965

A group of scientists and veterinarians form the **Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC)**, a nonprofit organization working to increase the standards of care in research institutions. If institutions demonstrated a willingness to go above and beyond the minimums required by law, they received an accreditation or "seal of approval" from AAALAC. Accreditation assured the public that the institution was committed to the **responsible use and treatment of animals** in science.

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* TIME PERIOD II
1966

Life magazine ran an article called "Concentration Camps for Dogs," describing a police raid on a dog dealer's facility. With increased public pressure after the article's publication, the U.S. Congress passed what would become the **Animal Welfare Act (AWA)**. It called for humane care and treatment of animals in research facilities and regulated the "transportation, purchase, sale, housing, care, handling, and treatment" of such animals by the USDA. Animal dealers and laboratories had to be **licensed and inspected**. The act applied to dogs, cats, primates, guinea pigs, hamsters, rabbits, and several other warm-blooded animals, though it did not include rats, mice, and birds.

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* TIME PERIOD II
1966 on

The demand for dogs and cats as research subjects begins to decline due to public opinion, research trends, institutional policies, and the increased use of other animal models, such as mice. The number of dogs and cats used in research will continue to fall significantly in the next 30 years.

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RESOURCE

* TIME PERIOD II
1973

Leukemia is a cancer of the blood or bone marrow. At this time, nine out of ten children with the most common form of leukemia (acute lymphocytic leukemia) died from the disease.

Scientists working with a leukemia mouse model named Skipper discovered the importance of killing every single malignant (cancerous) cell in a patient's body, as just one cell can divide and eventually kill the patient. This and other discoveries were crucial to advancements in cancer chemotherapy, a combination of drugs that kills cells that divide rapidly, including cancer cells.

Today, about three out of ten children die from this form of leukemia.

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TIME PERIOD II
1975

Australian **philosopher** Peter Singer's book *Animal Liberation* brought more coverage to the use of animals in scientific research. The book included disturbing photographs and descriptions of animals being subjected to all sorts of painful procedures for questionable purposes. Singer argued that the pain and suffering inflicted on the animals was **too high a moral price** to pay for scientific research.

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TIME PERIOD II
1977

Smallpox is an infectious disease caused by a virus. It causes rashes, fluid-filled bumps on the skin, blindness, and death. Smallpox had been a scourge since ancient times and large-scale epidemics are thought to have affected the course of history. The most virulent (strongest) strain would kill 20-60% of those infected; of those who survived, most were left with disfiguring scars and one-third of survivors were blinded.

A vaccine was developed through over 250 years of research that, at various times, used cows, prisoners, children, and orphans as test subjects. The last case of naturally-acquired smallpox is treated in Somalia. After a ten-year vaccination campaign by the **World Health Organization**, the disease is considered **eradicated from the planet**.

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TIME PERIOD II
1977

Animal Liberation Front (ALF) is founded. ALF is an animal rights group that believed in militant and **extreme means** to end the use of animals on all fronts. ALF members were involved in various acts, including slashing tires and breaking windows of hunters' cars, setting fire to animal research facilities, raiding chicken breeders and gun shops, releasing or taking animals from fur farms, and verbally harassing employees of such institutions. Spin-off groups of the ALF also sent letter bombs to various companies and placed firebombs under the cars of researchers.

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RESOURCE

* TIME PERIOD III
1977

Animal activists brought awareness to the **testing of cosmetics** on animals, particularly the Draize test, in which chemicals were put into the eyes of rabbits. In full-page advertisements in major newspapers, major cosmetics companies were accused of being **cruel to animals**. Public response was immediate. Several companies, including Revlon and Avon, announced their intention to cease animal testing.

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TIME PERIOD III
1977

Lesley and John Brown, a young English couple, had been unable to conceive a child for nine years. Lesley Brown had blocked fallopian tubes. Having gone from doctor to doctor for help to no avail, she was referred to Dr. Patrick Steptoe. In 1977, Lesley Brown underwent the very experimental *in vitro* ("in glass") fertilization procedure in which an egg was extracted from one of her ovaries and fertilized outside her body with John's sperm. The two-day-old embryo was placed back into Lesley's uterus and the pregnancy resulted in the first successful "**test tube baby**." This work was made possible by decades of research with mice, rabbits, and hamsters. Dr. Steptoe's colleague won the Nobel Prize.

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* TIME PERIOD III
1979

Each research institution that uses animals and receives federal money is required to have an **Institutional Animal Care and Use Committee (IACUC)** to oversee the use of all vertebrates—animals with backbones (including rats, mice, fish and birds). The IACUC has to include five members with expertise to regulate animal welfare at that institution—at least one scientist familiar with animal research, at least one veterinarian, and at least one community member not associated with the institution or animal research. Though not required of private companies not funded by the federal government, many private facilities adopt these practices and seek AAALAC accreditation.

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* TIME PERIOD III
1980

The first transgenic mouse is created. A transgenic organism is a living organism in which genes, or gene regulatory regions, have been added, removed, or modified. The change in DNA will cause the organism to exhibit a new property (immune system change, genetic disorder, etc.) which can be passed to its offspring.

Scientists create mice with human genes. To more effectively study human diseases and cures, these **transgenic** mice become the research subject of choice. Currently, **more than 90%** of animals used in research are mice.

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TIME PERIOD III
1981

The national **Cosmetics, Toiletries, and Fragrance Association** funded the founding of the **Center for Alternatives to Animal Testing (CAAT)** at Johns Hopkins University. CAAT promotes humane science by supporting the development and use of alternatives to animals in research, product safety testing, and education. They work with scientists to find new ways to ***replace*** animals with non-animal methods, ***reduce*** the numbers of animals used in research, or ***refine*** methods to make them less painful or stressful to the animals involved

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TIME PERIOD III
1981

A little-known organization called **People for the Ethical Treatment of Animals (PETA)** gained national prominence with an exposé on research that involved depriving monkeys of sensory input into their spinal cords to give them numbed arms. The monkeys gnawed and licked their arms, producing wounds. A co-founder of PETA worked as a laboratory assistant, photographed the monkeys, then reported the lab to authorities. A subsequent raid led to the filing of **animal cruelty charges**, loss of funding, and the end of the research. The incident came to be known as the **Silver Springs Monkey Case**.

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* TIME PERIOD III
1985

Congress amended the Animal Welfare Act to require that researchers **minimize animal pain and distress** whenever possible through use of anesthesia (numbing drugs), analgesics (painkilling drugs), and humane euthanasia (drugs that cause death). New requirements were added regarding the physical and psychological well-being of dogs and primates used in research work. The act also addressed employee training and searching for ways to reduce or replace animal use.

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* TIME PERIOD III
1986

Research on rats, mice, dogs and primates led to the development of **Azido-thymidine (AZT)**. AZT became the first approved drug **treatment for HIV and AIDS**, which affected about 10,000 people worldwide at this time. Originally developed in the 1960s as an anti-cancer agent but never licensed, AZT slowed the progress of HIV in humans. Six months into a human clinical trial, only one member of the group receiving AZT died, compared to 19 deaths in the placebo group (the people enrolled in the study for comparison purposes who did not receive AZT). Since the results were positive, the trial was stopped early so that AZT could be given to the placebo group, giving them a better chance of survival.

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RESOURCE

TIME PERIOD III
1990

All charges against the researcher involved in the **Silver Springs Monkey Case** (inhumane treatment of monkeys in a research lab) were overturned by 1983. The researcher contended his work was scientifically valid and the monkeys were neglected while he was on vacation and the care of the animals fell to the lab assistant who took the exposé photos. After almost a decade of custody battles in the courts for the monkeys, the monkeys that had not been disabled were given to a zoo. The research monkeys were euthanized and autopsied. Analysis showed a remarkable degree of brain restructuring ("neuroplasticity") that was previously thought to be unlikely. The knowledge gained from this research is now used widely with stroke patients.

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TIME PERIOD III
1992

In response to **destruction and damage** caused by animal activists, the **Animal Enterprise Protection Act** was enacted against "animal enterprise terrorism." The law prohibits "causing physical disruption to the functioning of an animal enterprise." Animal enterprises included food and fiber production, research, testing, zoos, aquaria, circuses, rodeos, fairs, and others.

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* TIME PERIOD III
1995

Scientists search for a vertebrate (having a backbone) **animal that could function as a model organism** because it is easier to study rather than humans and higher organisms, making it a **more ethical research subject**. A model organism tends to be small, able to reproduce rapidly with many offspring, inexpensive to house and maintain, able to be manipulated genetically on the molecular level, and well-studied by other scientists.

Many scientists advocate for the use of zebrafish as a model organism. Zebrafish are commonly found in pet shops and home aquaria. They are small, hardy, breed readily, lay many eggs, and have genes more closely related to humans than fruit flies or worms. Their eggs are fertilized externally and embryos develop quickly, are transparent, and can be genetically manipulated. Zebrafish were therefore particularly attractive for studying developmental biology and modeling human disease. Currently, there are at least **600 laboratories** around the world that use zebrafish, and several researchers use only zebrafish in their research.

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* TIME PERIOD III
1999

A new animal rights group calling itself **Stop Huntingdon Animal Cruelty (SHAC)** began using radical and violent means against Huntington Life Sciences (HLS), one of the largest companies employing animal research in England and later the U.S. HLS employees were **harassed** and sometimes **assaulted**. Cars were **firebombed** and homes **vandalized**. Actions included splattering homes with paint, filling locks with glue, breaking windows, and setting off smoke bombs in offices. SHAC also picketed companies with ties to HLS (banks, brokerage houses, and investment companies) and flooded them with threatening letters, faxes, and e-mails.

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RESOURCE

TIME PERIOD III
2002

The Coulston Foundation (TCF) facilities housed hundreds of primates. These facilities were closed after **violations of the Animal Welfare Act (AWA)** were brought to light by an animal welfare group called **In Defense of Animals**. TCF was also cited by the USDA numerous times for housing and care violations and lack of qualified veterinarians. TCF was also in trouble with the Food and Drug Administration (FDA) regarding its animal testing procedures. **Save the Chimps**, an organization that had formed a small, well-respected chimp sanctuary in southern Florida, raised millions of dollars to buy out TCF.

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TIME PERIOD III
2009

The European Union (EU) **bans the use of animals to test cosmetic ingredients**. They also implement a "marketing ban" that prohibits the sale of products from outside the EU that contain ingredients tested on animals. The marketing ban will be implemented slowly, with some animal tests allowed until 2013. The European Union is uncertain whether the 2013 deadline can be met because replacement tests have not yet been fully developed. The ban also contradicts laws requiring safety testing of certain chemicals.

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TIME PERIOD III
Current

The vast majority of the scientific community agrees that **healthy and well-maintained** animals are beneficial to and necessary for quality research. Most institutions voluntarily comply with regulations that are above and beyond what is mandated by law.

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TIME PERIOD III
Current to Future

As technology and information improve, so do models used to carry out simulated experiments **in place of experiments on animals**. Currently, computers model the structure and actions of new drugs and predict their safety. A model of the human placenta and fetus helps treat problems affecting unborn babies. A 3-dimentional human skin model has been internationally approved for assessing skin irritation from new drugs and products. Hopes for the **future** include computer models of **whole biological systems** with which "virtual" experiments can be conducted as alternatives to experiments on animals.

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LESSON 4:
Exploring Ethical Viewpoints

INTRODUCTION

In this lesson, students are introduced to **duties-based** and **outcomes-based ethical theories** through a series of actual quotes from people who hold different views on animal research. Students then role-play the stakeholder positions. First, students identify their stakeholder's stance as coming from a primarily duties-based or outcomes-based ethical perspective, when possible, and then students align themselves around the room based on their stakeholder's assumed support or opposition to the use of animals in research. While standing with other student stakeholders holding similar views, students record their group's top three supporting arguments. Groups with different perspectives then join together for a Structured Academic Controversy to present and listen to alternative viewpoints. Lastly, students drop their **stakeholder** roles and further define and justify their individual positions on the issue.

LEARNING OBJECTIVES

Students will know:

- An outcomes-based ethical perspective is focused on the outcomes of an action.
- A duties-based ethical perspective is focused on the moral rules and duties of an action.

Students will be able to:

- Describe major bioethical frameworks.
- Consider alternative perspectives and engage in shared decision-making.
- Explain why someone would be for or against the use of animals in research.
- Recognize that each individual has benefitted from the use of animals in research.

KEY CONCEPTS

- Positions on both sides of the animal research debate can be evaluated using various ethical perspectives. Two of the ethical perspectives that are relevant to this issue focus on the following:
  - The **outcomes** of an action (*outcomes-based* ethical perspective).
  - The **moral rules** and **duties** of that action (*duties-based* ethical perspective).
- The discipline of ethics provides a structured way to analyze conflicting views in order to come to well-reasoned arguments.
- Personal beliefs and values influence behavior.
- A strong justification for a position requires clearly stating the position, referencing accurate facts and science content, considering alternative views and options, and referencing ethical principles.

CLASS TIME

One and a half to two class periods of 50 minutes each.

MATERIALS

Materials	Quantity
Student Handout 4.1—*Outcomes-based and Duties-based Ethical Theories*	1 per student
Student Handout 4.2—*Structured Academic Controversy Worksheet*	1 per student
Student Handout 4.3—*Structured Academic Controversy FOR Arguments*	1 per student for half the class
Student Handout 4.4—*Structured Academic Controversy AGAINST Arguments*	1 per student for half the class
Student Handout 4.5—*Your Own Stand Homework Assignment*	1 per student
Teacher Resource 4.1—*Stakeholder Cards*	1 set
Teacher Answer Key 4.2—*Structured Academic Controversy Worksheet*	1
Teacher Answer Key 4.3—*Your Own Stand Homework Assignment*	1
Two signs and tape. Signs should read: AGREE and DISAGREE	2 signs

TEACHER PREPARATION

- Make copies of Student Handouts.
- Make one single-sided copy of the Stakeholder Cards found on Teacher Resource 4.1—*Stakeholder Cards*. Cut out the cards to make one set.
- Make two signs. The signs should read: AGREE and DISAGREE. Tape the signs in two different areas of the classroom.

TEACHER BACKGROUND

Ethics is a field of study that looks at the moral basis of human behavior *("Why do we act as we do?")* and attempts to determine the best course of action in the face of conflicting choices *("How do we decide what to do when people disagree about a complex issue?")*. It is a key component to living within a society in a civilized way. Many teachers find the following analogy helpful in describing the difference between values, morals and ethics. Additional information can be found in the *Appendix*.

- ***Values*** are represented by the ***heart***. They signify what is important, meaningful, and true for each of us.
- ***Morals*** are represented by the ***hands***. They are demonstrated by our behavior. They signify how values are "put into practice" as actions.
- ***Ethics*** is represented by the ***head***. Ethics rely on reasoned judgment, and provide a systematic, rational way to determine the best course of action in the face of conflicting choices.

PROCEDURE

ACTIVITY ONE: ETHICAL PERSPECTIVES IN ACTION

1. Tell students that they will be introduced to two ethical theories in this lesson that help frame the debate on animal research.
2. As a way of introducing ethical theories to students, ask them, "***Is cheating on a test unethical? Why or why not?***"
3. Write down the students' answers (or key words from their answers) on the board.
4. Focus on student comments that are aligned with one of the three ethical theories, as described in ***Table 1***:

Table 1: Ethical Theories

Possible Student Comments	Ethical Theory	Focus of Theory	Theoretical Questions and Definitions
"Cheating on a test is unethical because you ***might get caught***." "Cheating is OK if it helps you ***get a better grade*** on a test." "Cheating will ***hurt you in the long run*** because you're not learning the material."	**Outcomes-based ethical theory**	The consequences, or outcomes, of an action.	"Does the ***result*** of my action cause benefit or harm?" "Do the ends ***justify*** the means?"
"Cheating is just ***wrong***. If everybody cheated, grades wouldn't mean anything." "Cheating is ***against the school rules*** and we should follow the rules." "Cheating is ***unfair*** to the person being used for cheating."	**Duties-based ethical theory**	The act itself.	"Would it be acceptable if everyone else were to act in this way?" "Is the action, no matter the consequences, right or wrong?" "Are people being used in the process?"
"Cheating is wrong because it shows the cheater to be of ***poor character***."	**Virtues ethics**	The character of the person performing the act.	Our actions both build and reflect our character and core commitments.

5. ***Outcomes-based ethical theory:*** A student will likely say something along the lines of, "Cheating on a test is unethical because you ***might get caught***." Point out that this view reflects an outcomes-based ethical perspective.

   Outcomes-based ethical theory focuses on the ***consequence*** of an action and asks the question, "What are the consequences of the action?" It can also be stated as, "The ends ***justify*** the means." In getting caught, the bad outcome (e.g., getting in trouble, losing points on the assignment, or being seen as dishonest) would outweigh any benefits from the cheating.

   Conversely, if the student does ***not*** get caught cheating, the good consequences of a higher grade may outweigh the bad act. This is one of the ***limitations*** of this particular theory—it can allow for bad acts with good consequences.

6. ***Duties-based ethical theory:*** A student may say something along the lines of, "Cheating is just wrong. If everybody cheated, grades wouldn't mean anything." This view reflects the duties-based ethical perspective.

Duties-based ethical theory focuses on the ***act*** itself (as opposed to the consequences of that act), and asks the questions, "Would it be acceptable if everyone else were to act in this way?" and "Is the action, no matter the consequences, right or wrong?" It can also be stated as,

"The ends do ***not*** justify the means."

Another student might ask if a person is still cheating if he or she is given someone else's work to use. The duties-based ethical perspective also recognizes individual rights and dictates that people not be treated as a means to an end. Ask students, "***How does this affect the person being used for the cheating, either willingly or unwillingly?***"

Duties and obligations can conflict with each other at times, and a ***limitation*** of this particular ethical theory is that it does not offer a way to reconcile this conflict. For example, when faced with a test for which the student has not adequately prepared, a student might feel a conflict between the duty to excel in school due to high family expectations, and the duty to be honest.

7. ***Virtues ethics:*** Another student may say that cheating is wrong because it shows the cheater to be of poor character. This view reflects **virtues ethics**, which emphasize that our actions both build and reflect our character and core commitments. This lesson will not focus on this ethical theory as it pertains to animal research.

   Additional information on ethical theories and perspectives can be found in the *Appendix*.

ACTIVITY TWO: ETHICAL THEORIES AS APPLIED TO ANIMAL RESEARCH

8. Tell students that, as a society, our views on animal research are varied, complex, and have competing moral solutions. For this reason, ethical theories can provide a structured way to help students analyze arguments on both sides of the animal research debate.
9. Hand out Student Handout 4.1—*Outcomes-based and Duties-based Ethical Theories*, one copy per student. Ask students to read through the text as a class, in pairs, or individually.
10. Point out that both ethical viewpoints can be used to support either side of the debate. However, supporters of animal research often use the outcome-based perspective, and those in opposition to animal research often use the duties-based perspective.

ACTIVITY THREE: WHO ARE THE STAKEHOLDERS?

11. Tell students that a **stakeholder** is any person, institution, or entity that is interested in, invested in, or will be affected by the outcome of a decision. For this lesson, some of the stakeholders are philosophers who helped frame the debate on the use of animals in research.
12. Hand out one Stakeholder Card to each student (found on Teacher Resource 4.1—*Stakeholder Cards*). For large classes, student pairs can share one card. There are 21 stakeholder cards.
13. Tell students that the statements featured on the Stakeholder Cards are actual quotations from real people.
14. Explain to students that some of the quotations featured on the Stakeholder Cards are aligned with either a duties-based or an outcomes-based perspective. Highlight the stakeholder positions that have ties to duties-based and outcomes-based perspectives, as listed below. Ask the students with the following stakeholder cards to read their cards out loud and, as a class, identify the ethical position:

Table 2: Select Stakeholder Perspectives

Name	Ethical perspective	Key words or phrases
Tom Regan	Duties-based	"*We owe it [to animals]…to treat animals in a certain way.*" It is the moral duty of humans to not treat animals as a means to an end.
Nancy Haigwood	Outcomes-based	"*Leads to improved human health.*" (The outcome) is justified when accomplished by "*highly regulated*" studies (the means).
David Jentsch	Duties-based	"*We have a moral responsibility to use our skills…*" It is the moral duty of researchers to seek cures.
Peter Singer	Outcomes-based	"*…Suffering be counted equally with the like suffering…*" Causing animals to suffer (the means) for the benefit of humans (the ends) is not justified.

15. Challenge students to read their stakeholder card and decide on their own if they think their cards clearly align with one of the ethical perspectives. You may also want to ask students to highlight or underline the text that supports the ethical perspective they have chosen. Point out that there is a place at the bottom of each card for students to circle the perspective to which the quotation is most aligned. [**Note:** Many stakeholder cards have elements of both ethical perspectives or may not have strong ties to either ethical theory.]
16. To support students who read at a lower level, point out that definitions to challenging words are provided on the Stakeholder Cards. In addition, you may choose to have students conduct a Think-Pair-Analyze-Share activity. First, have students read their own cards. Then, have each student read his or her card aloud to a partner. Each pair should then work together to analyze the cards and the meaning of the quotations. If the pair is unable to comprehend the quotations, they can then meet with another student pair for their assistance deciphering the text. Finally, have each pair share their quotations, and meanings, with the class.
17. Point out the two signs in the room (AGREE and DISAGREE). Tell students that they are going to position themselves around the room according to the perceived view of their stakeholder.

Many of the stakeholder comments are complex and require students to think critically about how the statement relates to an ethical theory.

Class time dedicated to working through the stakeholder perspectives can lead to rich discussion; however, if it is too challenging for students to identify a stakeholder's ethical perspective, then teachers should skip to Step #15.

18. Remind students that they are ***not*** representing their own views, but those of their stakeholder. It may be helpful to revisit your classroom discussion norms at this point.
19. Read the first statement outlined in ***Table 3***. Have students show their stakeholder's agreement or disagreement with the statement by moving to the area of the room that represents their stakeholder's position. Give students one or two minutes to talk with others in the group to make sure their stakeholder view has been interpreted correctly. Students can move around the room as needed. Repeat the process with the remaining three statements in ***Table 3***.

Table 3: Stakeholder Statements

Statements	Student Alignment
"I believe that it is unethical to conduct ***any*** research involving animals."	This statement should split stakeholders into basic "for" or "against" groups, with those ***against*** animal research under the ***Agree*** sign.
"I am concerned with the welfare of animals."	This statement would likely apply to all stakeholders, with everybody under the ***Agree*** sign.
"I am willing to resort to violence to get my point across."	Very few stakeholders should agree with this view.
"I believe that it is acceptable to conduct important research using animals that are treated in a humane manner."	This statement should also split stakeholders into basic "for" or "against" groups, with those ***for*** animal research under the ***Agree*** sign.

20. With students still separated according to their stand on the last statement, ask the following questions to further explore ***stakeholder views*** (not student views):

- Are there any stakeholders missing? Which ones? *Possible answers may include:*

  a) The animals.

  b) Scientists who agree with unethical or inhumane treatment of animals.

  c) Religious perspectives on human dominion and/or stewardship of animals.

- Have you, as a stakeholder, personally benefitted from research on animals?

  Unless the stakeholder does not use any drug, medical device or treatment, and has never been immunized, he or she has benefitted.

- What behaviors might reflect one's beliefs on the issue of using animals in research? Some stakeholders might not: eat meat; use animal products such as eggs, dairy, and honey; wear leather; or own pets.

ACTIVITY FOUR: ANIMAL RIGHTS OR ANIMAL WELFARE?

21. Explain that some of the Stakeholder Cards feature quotations from people who are members of ***animal rights groups*** and ***animal welfare groups***. Tell students that the difference between ***animal rights groups*** and ***animal welfare groups*** can be difficult to determine, and these terms are often used interchangeably. They do not, however, mean the same thing. Share the following meanings with students:

- **Animal Rights:** These organizations advocate that non-human animals deserve the same rights as humans and that the use of them in any way, including household pets, entertainment, and foods is inhumane and unethical. Some animal rights organizations advocate violence to prevent the use of animals, but not all. Those that do tend to be underground organizations to avoid prosecution.
- **Animal Welfare:** These organizations work with biomedical research regulatory bodies and agencies that promote animal research to ensure the ethical and humane use of animals. These organizations do not argue that animals should never be used by humans and do not advocate violence.

22. Ask students if they think that their stakeholders would consider themselves to be animal rights or animal welfare activists.

23. Next, ask students if they personally hold views that are aligned with animal rights or animal welfare organizations.

24. A partial list of animal rights and animal welfare organizations can be found in the *Appendix*.

ACTIVITY FIVE: STRUCTURED ACADEMIC CONTROVERSY

Structured Academic Controversy is a text-based, small group deliberation model where students explore both sides of an issue before examining their own personal views. Active listening is an important part of the process.

25. Provide a few minutes for students standing under the ***Agree*** and ***Disagree*** signs to talk with like-minded stakeholders and identify the strongest arguments that support their position.

26. Next, create new groups of four students each for the Structured Academic Controversy activity. Each group should have two students from the stakeholder group that is ***FOR*** humane animal research and two students from the stakeholder group that is ***AGAINST*** animal research. Students may sit down with their groups at their desks.

27. Students may draw on the best arguments put forth by any stakeholder with the same ***FOR*** or ***AGAINST*** stance, and may drop their individual stakeholder viewpoint at this time.

28. Share with students the framework of a Structured Academic Controversy. The basic framework is outlined below:

- Two students represent the FOR position; two argue the AGAINST position.
- Each pair reads background for their position and prepares their argument.
- The FOR pair presents while the AGAINST pair listens.
- The AGAINST pair paraphrases the FOR pair's arguments and asks clarifying questions only.
- The AGAINST pair presents while the FOR pair listens.
- The FOR pair paraphrases the AGAINST pair's arguments and asks clarifying questions only.

- Students drop their assigned roles and discuss their own personal positions.
- Students clarify areas of agreement and disagreement.

29. Introduce the ethical question that students will be exploring during the Structured Academic Controversy:

    "Should the humane use of animals be allowed in biomedical research?"

30. Remind students of your classroom discussion norms. For example, students should speak one at a time, hear all sides equally, listen well enough to respond, and back up their opinions with clear reasons.

31. Distribute one copy of each of the following handouts to each student: Student Handout 4.2—*Structured Academic Controversy Worksheet* and Student Handouts 4.3 and 4.4—*Structured Academic Controversy FOR and AGAINST Arguments*.

32. In their pair groups, have students fill out the *Relevant Facts and Stakeholders and their primary concerns* sections of Student Handout 4.2—*Structured Academic Controversy Worksheet*. Students should represent their stakeholder positions, not their personal positions.

33. ***Ask each pair to read the background*** information supporting their position. Together, have each pair plan a presentation of their position and arguments. Students should focus on the ***three most important arguments***.

34. ***Have one side present, while the other side listens and then repeats.*** Have one side present their three most important arguments to the other side. The other side needs to listen carefully, take notes, and then paraphrase the arguments to be sure that they understand them, while asking clarifying questions as necessary. Emphasize that there is no discussion at this point. The presenters should be satisfied that their position has been heard and understood.

35. ***Have the pairs switch*** and repeat the process.

36. ***Next, ask students to drop their roles.*** Challenge students to proceed as their own individual selves with their own opinions and positions. They should use information from their own experiences as well as the background readings. Ask students to hear the positions of everyone in their group. When everybody has had a chance to share, have the students identify areas of agreement and disagreement. Tell students that they are free to change their minds.

37. While working as a group, students should identify possible solutions and options as they are prompted on Student Handout 4.2—*Structured Academic Controversy Worksheet*.

38. If students reach an impasse and have difficulty reaching common ground, provide them with the list of **possible solutions** found on the Teacher Answer Key 4.2. The list can be used to generate areas of agreement and disagreement.

CLOSURE

39. Gather student attention back from the small groups, and ask students to share the ***Areas of agreement and disagreement*** reached in the argument (referring to the last part of Student Handout 4.2—*Structured Academic Controversy Worksheet)*.

40. Ask the students who are holding the stakeholder cards from Peter Singer and Jerry Vlasic to read their cards out loud to the class. Ask the students, ***"How do Peter Singer's views differ from Jerry Vlasic's views? They both oppose animal research, yet have very different tactics. How can we look beyond the label and look for nuanced views on the subject?"***

42. Ask students to identify the extreme positions on the spectrum of stakeholder views. How do extreme positions advance a cause? Or does change come from a more central stance?

HOMEWORK

- Distribute copies of Student Handout 4.5—*Your Own Stand Homework Assignment*, one per student, to be completed as homework. This will give students a chance to express their own views on the subject of animal research. Make sure to let students know that their answers will be assessed for completeness and level of reasoning, not their position on the issue.

GLOSSARY

Animal Rights: Animal rights organizations advocate that non-human animals deserve the same rights as humans and that the use of them in any way, including as household pets, entertainment, and food is inhumane and unethical. Some animal rights organizations advocate violence to prevent the use of animals, but not all. Those that do tend to be underground organizations to avoid prosecution.

Animal Welfare: Animal welfare organizations work with biomedical research regulatory bodies and agencies that promote animal research to ensure the ethical and humane use of animals. Animal welfare activists believe that it is morally acceptable to use animals for human purposes, as long as the animal's welfare (physical and psychological well-being) is protected. These organizations do not argue that animals should never be used by humans and do not advocate violence.

Duties-based Ethical Theory: An ethical theory that focuses on the ***act*** itself (as opposed to the consequences of that act), and asks the question, "Would it be acceptable if everyone else were to act in this way? Is the action, no matter the consequences, ***right*** or ***wrong***?" This theory can also be thought of as, "The ends do ***not*** justify the means."

Ethics: A field of study that looks at the moral basis of human behavior and attempts to determine the best course of action in the face of conflicting choices.

Humane: Treating animals with respect and care.

Moral: Codes of conduct governing behavior; an expression of values reflected in actions and practices.

Moral Duty: The duty or obligation that arises out of a consideration of what is right and wrong.

Outcomes: The consequences or end results of an action.

Outcomes-based Ethical Theory: An ethical theory that focuses on the ***consequence*** of an act, and asks the question, "What are the ***consequences*** of the action?" In getting caught, the bad outcome (e.g., getting in trouble, losing points on the assignment, or being seen as dishonest) would outweigh any benefits from the cheating. This theory can also be thought of as, "The ends ***justify*** the means."

Speciesism: Belief that the human species is superior to all other species, and therefore, different rights and values should be assigned to humans and other animals on the basis of their species.

Stakeholder: Any person, institution, or entity that is interested in, invested in, or will be affected by the outcome of a decision.

Virtues Ethics: As one of the approaches of normative ethics, virtues ethics emphasize the moral character (virtues), rather than duties (actions) or outcomes (consequences of actions).

RESOURCES

Teachers who would like more information on ethical theories and their application in the classroom will find lessons, activities, student handout and teachers resources in *An Ethics Primer: Lesson Ideas and Ethics Background* by Jeanne Ting Chowning and Paula Fraser, produced through the Northwest Association for Biomedical Research. The complete Ethics Primer is available free for download from http://www.NWABR.org.

CREDIT

Nancy Haigwood Quotation
http://www.oregonlive.com/opinion/index.ssf/2010/04/human_health_and_animal_rights.html

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Bruce Fuchs Quotation
Bruce A. Fuchs in "Use of Animals in Biomedical Experimentation," in *Scientific Integrity: An Introductory Text with Cases.* (2000). Francis L. Macrina, ed. Washington, DC. ASM Press, p. 121.

David Jentsch Quotation
http://speakingofresearch.com/2010/11/19/open-letter-to-the-justice-department/

Frank Lautenberg Quotation
http://www.naiaonline.org/pdfs/oct.%2026,%202005%20eco-terrorism%20transcript.pdf

Tom Regan Quotation
http://www.think-differently-about-sheep.com/Animal_Rights_A_History_Tom_Regan.htm

Peter Singer Quotation
Singer, Peter. (1975). *Animal Liberation*. HarperCollins.

Eric Mills Quotation
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http://www.animalpeoplenews.org/ap7808.htm#arsons

Ingrid Newkirk Quotation
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Pam Ferdin Quotation
Johnson, Curt. (2007). *Your Mommy Kills Animals.* Indie Genius.

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Dr. Jerry Vlasic Quotation
Johnson, Curt. (2007). *Your Mommy Kills Animals*. Indie Genius.

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Rev. Dale Turner Quotation
Originally from the "By Religion" section of the *Seattle PI*. Reprinted from Northwest Associate for Biomedical Research. (2004). *For the Greater Good Curriculum Guide*.

Dr. Geneviève Clavreul Quotation
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http://www.redorbit.com/news/health/234538/aids_activists_target_charlize_theron__peta/

Kevin Elliot Quotation
Letter to the *Oxford Times*, 15 January 2009.
http://www.understandinganimalresearch.org.uk/your_views/your_stories

Kevin Kjonaas Quotation
Johnson, Curt. (2007). *Your Mommy Kills Animals*. Indie Genius.

Gary Berthold Quotation
http://newsblaze.com/story/20090226054411allm.nb/topstory.html

Alaron Lewis Quotation
Personal conversation, 9 December 2010.

Laurie Hassell Quotation
Personal conversation, 8 November 2010.

Lillian Zalduondo Quotation
American Association for Laboratory Animal Science. (2006). *Accept the Challenge to Care; Careers in Laboratory Animal Science*.

STUDENT HANDOUT 4.1

Outcomes-based and Duties-based Ethical Theories

Name_____ Date_____ Period_____

The animal research debate is filled with voices expressing differing views and perspectives. Views on both sides of the argument are often accompanied by strong feelings, and the ethical issues that arise may involve conflicting moral choices.

The field of **ethics** helps us analyze the arguments in a structured way to come to well-reasoned decisions. Ethics is a branch of philosophy that explores questions of morality, such as concepts of right and wrong. Ethics helps us choose the best course of action (how shall we behave?) in the face of conflicting choices.

The two ethical theories that are often applied to this debate are described below.

Outcome-based Ethics	
How can we bring about the greatest good for the greatest number? An action is right if good consequences outweigh bad consequences. Costs and benefits are analyzed, and the action is ethically appropriate if ***"the ends justify the means."*** This ethical theory is also referred to as Consequentialist or Utilitarian Ethics.	**In support of research:** The vast benefits of research to both humans and animals outweigh the cost to animals if the research is conducted in a **humane** way. Humane treatment means to treat animals with respect and care. The ***ends*** (elimination of polio, smallpox, and measles; treatments for cancer and heart disease, etc.) ***justify the means*** (using animals—mostly rodents and fish—in studies in which pain and suffering have been minimized or eliminated). **In opposition to research:** Animals should be given equal moral weight and value to humans, in which case ***the ends*** (better health for humans) ***do not justify the means*** (harm to a larger number of animals). Bringing about the greatest good for one species at the expense of another species is **speciesism**, which is similar to sexism or racism. Speciesism is the belief that the human species is superior to all other species, and therefore, different rights and values should be assigned to humans and other animals on the basis of their species.

Duties-based Ethics	
How shall we treat each other and other living things? What are our moral duties to each other? An action is right if it follows certain fundamental rules or duties, such as respecting individuals and not treating people as a means to an end. The focus on "animal rights" often falls under duties-based ethics. This ethical theory is also referred to as Deontological or Moral Rules-based Ethics.	**In support of research:** As human beings with the capacity to study and treat disease, we have the moral duty to minimize pain and suffering of people afflicted with disease. A **moral duty** is the duty or obligation that arises out of a consideration of what is right and wrong. As **humane** research with animals also helps animals, our duty to study and treat disease extends to animals with diseases. Humane treatment means treating animals with respect and care. **In opposition to research:** Animals have the basic moral right to be respected for their inherent value and worth, and should not be treated as a "means to an end." It is our **moral duty** to speak up for those who are oppressed and cannot speak up for themselves, including animals.

HANDOUT

HANDOUT

STUDENT HANDOUT 4.2

Structured Academic Controversy Worksheet

Name_____ Date_____ Period_____

The Issue: ***Should the humane use of animals be allowed in biomedical research?***

Team Members **FOR**:

1.

2.

Team Members **AGAINST**:

1.

2.

Relevant facts:
Stakeholders and their primary concerns:

HANDOUT

Main argument(s) **FOR**: 1. 2. 3.	Main argument(s) **AGAINST**: 1. 2. 3.
List of possible solutions: (What are the options furthest out on each side? What options occupy the middle ground?)	
Areas of agreement and disagreement:	

HANDOUT

STUDENT HANDOUT 4.3

Structured Academic Controversy FOR Arguments

Name_____ Date_____ Period_____

Team members *FOR*:
Yes, the humane use of animals should be allowed in biomedical research.

1.

2.

Select Stakeholder *FOR* Arguments

"Responsible use of animals in research aimed at improving the health and welfare of the mentally ill is the right thing to do, and we will continue because we have a moral responsibility to society to use our skills for the betterment of the world."

-David Jentsch

"I absolutely do not want to see even one animal die by being force-fed foundation or eye shadow to prove favorable formulations. Yet, if sacrificing an animal's life can help find the cure for Alzheimer's, prevent more cancers, or reduce the risks of high blood pressure and a host of other illnesses, I would and do support that research…. Children who survive leukemia owe their lives to animal testing."

-Paula Begoun

"…Our view is that because animal studies lead to improved human health, they should be considered acceptable—provided the studies are highly regulated, the animals are well cared for, and suffering is not allowed."

-Nancy Haigwood

"If we [biomedical researchers] were able to acquire the information needed to adequately answer compelling research questions without the use of animals, who among us would not gladly do so? Nevertheless, one of the best methods we have developed to advance biomedical knowledge involves the use of animals…however…any such use should be preceded by a moral judgment. Do the benefits derived from the biomedical research that is being considered offset the associated moral costs?"

-Bruce Fuchs

"I believe that laboratory tests involving animals can be necessary and important for the advancement of science and medicine and the protection of public health. I would hope that that wasn't the case. But if that is determined that that is the only way to establish the safety and efficacy of a product that is going to be used on humans, unfortunately, so be it. When such testing is necessary, it must be conducted under strict standards and subject to regular inspection and oversight."

-Frank Lautenberg

HANDOUT

Ethical Arguments *SUPPORTING* Animal Research

Outcomes-based perspective: The vast benefits of research to both humans and animals outweigh the cost to animals if the research in conducted in a humane way. The ***ends*** (elimination of polio, smallpox, and measles; treatments for cancer and heart disease, etc.) ***justify the means*** (using animals—mostly rodents and fish—in studies in which pain and suffering have been minimized or eliminated).

Duties-based perspective: As human beings with the capacity to study and treat disease, we have the **moral duty** to minimize pain and suffering of people afflicted with disease. A moral duty is the duty or obligation that arises out of a consideration of what is right and wrong. As **humane** research with animals also helps animals, our duty to study and treat disease extends to animals with diseases. Humane treatment means to treat animals with respect and care.

HANDOUT

STUDENT HANDOUT 4.4

Structured Academic Controversy AGAINST Arguments

Name_____ Date_____ Period_____

Team members *AGAINST:*
The use of animals should not be allowed in biomedical research.

1.

2.

Select Stakeholder *AGAINST* Arguments

"Many people think that we should be nice to animals because if we are not nice to animals we will not be nice people, and then we will end up beating up our children and our neighbors and so on. The problem is, these views don't focus on our duty to animals but only on the effects our treatment of animals has on us. The rights view says, "We owe it as a matter of strict justice to treat animals in a certain way." In particular we owe it to these animals not to eat them, for example, or not to put them in cages for our entertainment, or not to use them in education or in surgery."

-Tom Regan

"We cannot justify [killing animals] by arguing that such a practice brings about intrinsically valuable experiences for others."

-Tom Regan

"The goal of PETA is total animal liberation and the day when everyone believes that animals are not ours to eat, not ours to wear, not ours to experiment on, and not ours for entertainment, or for any exploitive purpose."

-Ingrid Newkirk

"Speciesism is a prejudice or attitude of bias in favor of the interests of members of one's own species... Members of the exploited group cannot themselves make an organized protest against the treatment they receive (though they can and do protest to the best of their abilities individually). We have to speak up on behalf of those who cannot speak for themselves. You can appreciate how serious this handicap is by asking yourself how long blacks would have had to wait for equal rights if they had not been able to stand up for themselves and demand it. The less able a group is to stand up and organize against oppression, the more easily it is oppressed."

-Peter Singer

"If you are killing an animal, I don't care if it is to beautiful music. I don't care if it is with pretty floral wallpaper. I don't care if they are killed on velvet sheets. They are killed. And that is not our right. It is not ours."

-Pam Ferdin

HANDOUT

Ethical Arguments *AGAINST* Animal Research

Outcomes-based perspective: Animals should be given equal moral weight and value to humans, in which case ***the ends*** (better health for humans) ***do not justify the means*** (harm to a larger number of animals). Bringing about the greatest good for one species at the expense of another species is **speciesism**, which is similar to sexism or racism. Speciesism is the belief that the human species is superior to all other species, and therefore, different rights and values should be assigned to humans and other animals on the basis of their species.

Duties-based perspective: It is our **moral duty** to speak up for those who are oppressed and cannot speak up for themselves, including animals. A moral duty is the duty or obligation that arises out of a consideration of what is right and wrong. Animals should not be treated as a "means to an end" without respecting their inherent value and worth.

HANDOUT

STUDENT HANDOUT 4.5

Your Own Stand Homework Assignment

Name_____ Date_____ Period_____

1. What is your position on the use of animals in research?

2. With which of the stakeholder viewpoints from this lesson do you most closely align? Why?

3. In what way does an ethical perspective best support your view?

4. What scientific facts will you use to support your position?

5. What sort of personal actions can you take that support your position on this issue?

HANDOUT

HANDOUT

TEACHER RESOURCE 4.1
Stakeholder Cards

Nancy Haigwood

"I'm a health researcher who studies animals in order to develop new treatments and cures. When you hear protesters claiming that research animals are mistreated, they're yelling about me. So what drives animal researchers like me? Simply put, our view is that because ***animal studies lead to improved human health***, they should be considered acceptable—provided the studies are highly regulated, the animals are well cared for, and suffering is not allowed. This is not a unique view. It's also shared by the National Institutes of Health, the American Medical Association, and the American Veterinary Medical Association."

~ Nancy Haigwood is a senior scientist and director of the Oregon National Primate Research Center.

Duties-based perspective • Outcomes-based perspective • Both

Tom Regan

"Many people think that we should be nice to animals because if we are not nice to animals we will not be nice people, and then we will end up beating up our children and our neighbors and so on. The problem is, these views don't focus on our ***duty to animals*** but only on the effects our treatment of animals has on us. The rights view says, '***We owe it*** as a matter of strict justice to treat animals in a certain way.' In particular we owe it to these animals not to eat them, for example, or not to put them in cages for our entertainment, or not to use them in education or in surgery."

"We cannot justify [killing animals] by arguing that such a practice brings about **intrinsically** valuable experiences for others."

~ Tom Regan is a philosopher and author of the book *The Case for Animal Rights*.

Intrinsically: Essentially.

Duties-based perspective • Outcomes-based perspective • Both

David Jentsch

"Responsible use of animals in research aimed at improving the health and welfare of the mentally ill is the right thing to do, and we will continue because we have a moral ***responsibility*** to society to use our skills for the betterment of the world."

~ David Jentsch is a UCLA Neuroscience Professor.

Duties-based perspective • Outcomes-based perspective • Both

RESOURCE

Peter Singer

"**Speciesism** is a prejudice or attitude of bias in favor of the interests of members of one's own species..."

"We have to speak up on behalf of those who cannot speak for themselves. The less able a group is to stand up and organize against oppression, the more easily it is oppressed."

"If a being suffers there can be no moral justification for refusing to take that suffering into consideration. No matter what the nature of the being, the principle of equality requires that its ***suffering be counted equally with the like suffering***—insofar as rough comparisons can be made—of any other being."

~ Peter Singer is a philosopher and author of the book Animal Liberation.

Speciesism: The belief that the human species is superior to all other species, and therefore, different rights and values should be assigned to humans and other animals on the basis of their species.

Duties-based perspective • Outcomes-based perspective • Both

Paula Begoun

"I absolutely do not want to see even one animal die by being force-fed foundation or eye shadow to prove favorable formulations. Yet, if sacrificing an animal's life can help find the cure for Alzheimer's, prevent more cancers, or reduce the risks of high blood pressure and a host of other illnesses, I would and do support that research….***Children who survive leukemia owe their lives to animal testing***."

~ Paula Begoun is the owner of Paula's Choice skin care and cosmetics line. Begoun is an author and consumer expert for the cosmetics industry. She has appeared on CNN, Oprah, The Today Show, The View and others. Her cosmetics are not tested on animals.

Duties-based perspective • Outcomes-based perspective • Both

Ingrid Newkirk

"The goal of PETA is total animal liberation and the day when everyone believes that ***animals are not ours*** to eat, not ours to wear, not ours to experiment on, and not ours for entertainment, or for any **exploitive** purpose."

"Even if animal tests produced a cure for AIDS, we'd be against it."

~ Ingrid Newkirk is president of People for the Ethical Treatment of Animals (PETA).

Exploitive: Using a person, animal, or group for one's own profit or advantage.

Duties-based perspective • Outcomes-based perspective • Both

RESOURCE

Bruce Fuchs

"If we [biomedical researchers] were able to acquire the information needed to adequately answer compelling research questions without the use of animals, who among us would not gladly do so? Nevertheless, ***one of the best methods we have developed to advance biomedical knowledge involves the use of animals***, which, unlike the test tube, have interests…The fact that animals have interests does not necessarily mean that we should never use them in biomedical experiments; however, it does mean that any such use should be preceded by a moral judgment. Do the benefits derived from the biomedical research that is being considered offset the associated moral costs?"

~ Bruce Fuchs is Director of the NIH Office of Science Education. He is also a vegetarian.

Duties-based perspective • Outcomes-based perspective • Both

Pam Ferdin

If you are killing an animal, I don't care if it is to beautiful music. I don't care if it is with pretty floral wallpaper. I don't care if they are killed on velvet sheets. They are killed. And that ***is not our right***. It is not ours.

~ Pam Ferdin is member of the Animal Defense League in Los Angeles.

Duties-based perspective • Outcomes-based perspective • Both

Frank Lautenberg

"I believe that laboratory tests involving animals can be necessary and important for the advancement of science and medicine and the protection of public health. I would hope that that wasn't the case. But if that is determined that that is the only way to establish the safety and **efficacy** of a product that is going to be used on humans, unfortunately, so be it. When such testing is necessary, it must be conducted under strict standards and subject to regular inspection and oversight.

I helped establish [the Lautenberg Cancer Research Center] because my father died when he was 43 years old. My uncle died when he was 52, also of cancer. Their father died also of cancer when he was 56. And when I had the good fortune of success in business, I put some resources into a group of New Jersey scientists who were moving abroad to learn more about cancer research. After watching my father suffer for a year and finally die, I made the decision then that I would do whatever I can to try and ***prevent another family from undergoing the same torture and grief***."

~ Frank Lautenberg is a senator from New Jersey.

Efficacy: Having the capacity to produce a desired effect.

Duties-based perspective • Outcomes-based perspective • Both

RESOURCE

Jerry Vlasic

"I think, tactically, if you were to take animal experimenters and if you were to ask them to stop experimenting on animals but they didn't, and if you explained to them why they should and they still didn't, and you told them to stop and they still didn't, that if you stopped them physically, whether you killed them or otherwise stopped them I think you wouldn't have to kill more than ten or fifteen of these animal abusing research scientists to get a lot of people to start thinking, 'Do I really want to do animal research?' Here are people who are abusing animals, are getting paid to abuse animals. You ask them to stop, and they don't want to stop. You tell them to stop, and they still don't want to stop. ***Then you stop them, using whatever means are necessary.*** I think that's a morally defensible argument."

~ Jerry Vlasic is a trauma surgeon and Animal Liberation Front (ALF) press officer.

Duties-based perspective • Outcomes-based perspective • Both

Dale Turner

"A dog was one of my earliest companions, and I have treasured the company of dogs and other animals through the years. Animals are such agreeable friends. They ask no questions and pass no criticism…"

"Thoughtful people today are asking if we have the right to experiment on animals and sacrifice their lives to discover ways to improve the lot of humans. What are the alternatives [to animal research], imperfect though they may be? To ban all medical research using animals would be to abandon millions of human beings, now living and not yet born, to suffering and premature death that might be prevented through supervised animal research. Many famed surgeons attest to the fact that ***millions of lives have been prolonged and improved*** through research on kidney disease, cancer, diabetes, Alzheimer's disease, blindness, and many other maladies to which humans are subject."

~ Dale Turner was a minister with the United Church of Christ and public representative on the University of Washington Animal Care and Use Committee (IACUC).

Maladies: Diseases and illnesses.

Duties-based perspective • Outcomes-based perspective • Both

Kevin Kjonaas

After receiving his conviction and sentencing to jail time: "All this for animals? It's the same sort of question I imagine **abolitionists** were asked: All this for a black? Or men involved in the **suffrage movement**. All this so women can vote? All this so kids don't have to work in those sweatshops? So these people can have fair labor laws? For the Irish? For the Jews? The same questions have been asked over and over again in every other social justice movement, and now it's finally being asked of animals. Yes. ***All this for an animal***."

~ Kevin Kjonaas is a member of Stop Huntingdon Animal Cruelty (SHAC). He was sentenced to six years in prison and $1 million fine under the Animal Enterprise Terrorism Act.

Abolitionists: Activists who fought for the abolition—or banning—of slavery.

Suffrage Movement: A social justice movement fighting for women's right to vote.

Duties-based perspective • Outcomes-based perspective • Both

RESOURCE

Laurie Hassell

"I don't want to get into an argument over what is right and what is wrong with animal research. I am simply grateful for the animals used in research. Without the animals used in asthma research, ***my son would have died*** when he was three years old."

~ Laurie Hassell is the regional manager for the Northwest Association for Biomedical Research.

Duties-based perspective • Outcomes-based perspective • Both

Merritt Clifton

"If you ***want to achieve a reduction in the animal suffering*** involved in experimentation what you really want to do is put it in the places where it is under a microscope, where it's under constant supervision, like England and the United States and a couple of other countries in western Europe. They [Animal Liberation Front (ALF)] are basically working for the other side, because they are removing animal experimentation from a part of the world where there is some transparency, some regulation, ***some regular governmental inspection***. You've got freedom of speech and press so that you can protest if things are not being done as they should. Work that used to be done in places like New Jersey and England is now being done in places like Ghana, Pakistan, and South Korea where you have limited [regulation].

~ Merritt Clifton is editor of the *Animal People News*.

Duties-based perspective • Outcomes-based perspective • Both

Kevin Elliot

"Until recently I had a serious spinal condition, which left me in massive pain and hardly able to work. Thanks to animal-based research I had an operation where bone was taken out of my pelvis and placed into my spine to reinforce it. ***The pain has now completely gone***; I can work full-time and have a social life."

~ Kevin Elliot is a patient.

Duties-based perspective • Outcomes-based perspective • Both

RESOURCE

Eric Mills

"I call it [firebombs detonated on a porch and in a home belonging to a university researcher] terrorism. ***Such actions put people in danger, and do nothing to help animals***, or further our cause; indeed, they are ***counter-productive***, and will serve only to make things more difficult for the law-abiding. I think we, as a **humane** movement—both organizations and individuals—need to speak up loud and clear in condemning these tactics. We all deserve better, humans and nonhumans alike. Which is not to **condone** animal research—I hate it. Even if it were to save the entire human race, which of course it won't and can't, I am opposed to invasive research on animals for ethical and moral reasons."

~ Eric Mills is founder of *Action for Animals* and is a veteran animal rights lobbyist.

Humane: Humane treatment means treating animals with respect and care.

Condone: To approve, accept, or allow.

Duties-based perspective • Outcomes-based perspective • Both

Gary Berthold

"We lost three of our Siberian Huskies, who were our close family members, to cancer." When no readily available or practical solutions were found, the Bertholds vowed: "We would spend the rest of our lives for the sake of our living dogs—in addition to all other dogs—attempting to find ***better, improved cancer treatments***." They say, "We certainly hope our treatments will provide a better quality of life to companion animals with cancer, in addition to the possibility of increasing lifespan."

~ Gary Berthold is founder of PharmaCom BioVet, which conducts research, development, and testing (on dogs) to bring canine cancer treatment devices and formulas to the market.

Duties-based perspective • Outcomes-based perspective • Both

Ann Berlin

"The Animal Liberation Front consists of small **autonomous** groups of people all over the world who carry out direct action according to the ALF guidelines. Because non-human animals lack political power, **speciesism** will be harder to overcome than sexism or racism. There will always be a need for people to take direct action to protect animals from abuse, just as there will always be a need for people to intervene, ***regardless of the consequences***, in all other forms of domestic violence. We'll know our work is nearly complete when the public understanding of animal **sentience** reaches the point where people accept that violence is just as acceptable to use in defense of animals as it is in defense of human beings."

~ Ann Berlin is a member of the Animal Liberation Front (ALF).

Autonomous: Self-governing.

Speciesism: The belief that the human species is superior to all other species, and therefore, different rights and values should be assigned to humans and other animals on the basis of their species.

Sentience: Consciousness and the ability to think and feel.

Duties-based perspective • Outcomes-based perspective • Both

RESOURCE

Geneviève Clavreul

Dr. Clavreul's group targeted Hollywood celebrities, such as Charlize Theron, who support PETA, "calling them to account for their high-profile role in hindering the search for a cure to AIDS." She was motivated to take action because of her long-time work with scientists who are focused on developing vaccines for HIV. "We are going to have to go to an animal model to do it," Clavreul said, "and I don't want to have to be fighting every five minutes against PETA."

"You cannot wear an AIDS ribbon and call yourself a PETA supporter. It is an insult to the 37 million people living with HIV/AIDS and it is an insult to the memory of the 20 million people who have died from this terrible disease."

~ Dr. Genevieve Clavreul is an organizer of Patient Advocates Against PETA (PAAP). PAAP is made up of a number of HIV/AIDS advocacy groups.

Duties-based perspective • Outcomes-based perspective • Both

Alaron Lewis

"I know that the goal is to reduce the number of animals used in research by moving to cell and tissue cultures and computer models. But animal systems are extremely complex. Even if we could, by the time we build the same sort of whole-animal complexity in a culture dish, we would basically have **a whole, brain-dead mouse in a culture dish**. And is it better to have a man-made almost-animal in your dish, than it is to have a mouse in a cage that is treated **humanely** during the research process? I think using the mouse as a model is the best alternative."

~ Alaron Lewis is an adjunct Professor at the University of Puget Sound.

Humanely: In a manner that is respectful and careful of animals.

Duties-based perspective • Outcomes-based perspective • Both

Lillian Zalduondo

"I know that ***these animals are not suffering***. I know that if I see something that's not what I feel is right, or I feel the animal is in some type of discomfort, then I can say, 'Hey, that is not right,' and they stop it. Everyone stops everything, and looks at it and analyzes it. If the animal needs pain medication, then it gets pain medication or whatever the case may be."

~ Lillian Zalduondo is a Vet Tech/Lab Animal Tech.

Duties-based perspective • Outcomes-based perspective • Both

RESOURCE

TEACHER ANSWER KEY 4.2

Structured Academic Controversy Worksheet

THE ISSUE:

SHOULD THE HUMANE USE OF ANIMALS BE ALLOWED IN BIOMEDICAL RESEARCH?

Relevant facts:

Student responses should include relevant facts pulled from any lesson in the curriculum.
Sample answers may include:

- *Ninety percent of research animals are rodents.*
- *Animal research is regulated by IACUC committees, the Animal Welfare Act, the FDA, and others.*
- *Abuses to animals have occurred in the past.*
- *Researchers are guided by the principles found in the 3 Rs.*
- *Different ethical viewpoints frame the animal research argument.*
- *Specific animals are used to answer specific research questions.*

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Provides five or more relevant facts.	Provides three or four relevant facts.	Provides one or two relevant facts.	Does not provide a response.

Stakeholders and their primary concerns:

Student responses should identify the stakeholders that align with the two sides of the issue and briefly identify each stakeholder's primary concern(s). Responses should identify stakeholders by the groups to which they belong, rather than listing the names of individuals from the Stakeholder Cards. Examples of stakeholder groups and interests include, but are not limited to, the following:

- ***Biomedical researchers:*** *Animals are critical to their research.*
- ***Medical professionals (e.g. doctors, pharmacists, surgeons, etc.):*** *Discoveries from animal research form the foundation of medical treatments, surgical techniques, and therapies for human patients.*
- ***Patients:*** *Discoveries from animal research ensure that treatments, surgical techniques, and therapies are safe and effective.*
- ***Veterinarians:*** *Discoveries from animal research form the foundation of medical treatments, surgical techniques, and therapies for animal patients.*
- ***Pharmaceutical and biomedical company executives:*** *Maintaining product quality and safety, as well as the company's public image, is critical for success.*
- ***Animal welfare advocates:*** *Desire that the welfare (physical and psychological) of animals used in research is maintained.*
- ***Animal rights activists:*** *Desire the assignment of rights to all animals and the elimination of speciesism.*
- ***Philosophers:*** *Ethical perspectives provide a framework for discussing and thinking about the issue of animal research.*
- ***The public:*** *Public health initiatives, such as vaccinations for childhood diseases, increase the level of heath for all.*

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Provides a list of stakeholder groups and identifies the primary concern(s) of each group.	Provides a list of stakeholder groups.	Provides a list of names from the Stakeholder Cards.	Does not provide a response.

RESOURCE

Main arguments *FOR*:

Student responses should include three main arguments in support of animal testing.
Student responses may include:

- *When animals are treated humanely, the benefits to humans (past and future) outweigh the cost to selectively-used animals.*
- *We have the moral duty to seek cures for the sick and ailing among us.*
- *People have died in the past when medicines haven't been tested first on animals. That is too high a risk.*
- *The law states that animal testing is a requirement for medicines before human use.*
- *Research with animals benefits animals, too.*
- *Current rules and regulations adequately protect the animals used for research.*

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Provides three arguments ***FOR*** animal testing drawn from any lesson. The arguments are well formed, evidence-based, and clearly argue in support of animal testing.	Provides three arguments ***FO***R animal testing drawn from any lesson.	Provides one or two arguments ***FOR*** animal testing drawn from any lesson.	Does not provide a response or the provided arguments are not in support of animal testing.

Main arguments *AGAINST*:

Student responses should include three main arguments against animal testing.
Student responses may include:

- *Animals should be respected for their inherent value and worth, and not used for human gain.*
- *Using animals is "speciesism" and humans need to stand up for and protect animals that cannot speak for themselves.*
- *Even if done humanely, it is not a human right to kill an animal for any reason.*
- *Current rules and regulations do not adequately protect the animals used in research.*
- *Because animal research exists, not enough money and effort are put towards other research methods.*

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Provides three arguments ***AGAINST*** animal testing drawn from any lesson. The arguments are well formed, evidence-based, and clearly argue against animal testing.	Provides three arguments ***AGAINST*** animal testing drawn from any lesson.	Provides one or two arguments ***AGAINST*** animal testing drawn from any lesson.	Does not provide a response or the provided arguments are not against animal testing.

List of possible solutions:

Student responses should include a list of solutions to the ethical arguments concerning animal research. It may be helpful for students to brainstorm options furthest out on each side. Students do not need to agree on the solutions at this step. Student responses may include:

- *Allow NO research on any animal and shoulder the repercussions of halting the biomedical research process.*
- *Allow research on lower animals only. Students can work together to define "lower."*
- *Allow research on animals for drugs and medical treatments but not cosmetics.*
- *Allow research on all animals as long as there is regulatory oversight to insure humane treatment.*
- *Reduce the amount of regulations around animal research so that researchers can find cures and treatments more quickly.*
- *Allow animals (especially higher organisms) to be released after a study instead of being euthanized, when possible.*
- *Add rodents and birds to the species covered under the Animal Welfare Act, and increase funding to this agency for appropriate supervision.*

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Provides three or more possible solutions.	Provides two possible solutions.	Provides one possible solution.	Does not provide a response or provided solutions are unreasonable.

Areas of agreement and disagreement:

Student responses should describe areas of agreement and disagreement or, when possible, the common ground reached by group members from both sides of the issue. Common ground may be reached by students agreeing to ***any of the possible solutions*** *proposed in the previous section, or agreeing to certain principles such as:*

- *Biomedical researchers should follow the principles of the 3 Rs, thereby reducing the need for animals over time.*
- *Any animal research should be done under tightly regulated, supervised and humane conditions.*
- *Using violence to further a cause is not acceptable.*

If students have a difficult time reaching agreement on concepts or principles, it may be helpful for each side to simply come to agreement about the type of language, or terms used, that are acceptable to everybody taking part in the discussion. For example, some people in favor of research find the use of the words "vivisectionist" and "torture" to be misused and inflammatory; some people against research find the word "humane" misused, and find reference to all people interested in animal rights as "extremists" inflammatory. Coming to agreement over the terms themselves may lead a team to reach some common ground.

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Clearly describes areas of agreement or disagreement reached among group members, including a description of the concessions made by the **FOR** and the **AGAINST** sides.	Describes two or more areas of agreement or disagreement reached among group members.	Describes one example of areas of agreement or disagreement reached among group members.	Does not provide a response.

RESOURCE

TEACHER ANSWER KEY 4.3

Your Own Stand Homework Assignment

1. What is your position on the use of animals in research?

Student responses should be personal in nature, but a position should be clearly stated and should show some level of thought about the content delivered throughout the curriculum.

2. With which of the stakeholder viewpoints from this lesson do you most closely align? Why?

Student responses should identify one or more stakeholder viewpoints and describe why their personal position is aligned with the position of the stakeholder(s).

3. In what way does an ethical perspective best support your view?

Student responses should describe how an outcomes-based or duties-based ethical perspective supports their personal views about animal testing.

4. What scientific facts will you use to support your position?

Student responses should identify several scientific facts that clearly support their personal position.

5. What sort of personal actions can you take that support your position on this issue?

Student responses should identify at least one reasonable action that they could take personally. Students interested in the general welfare of animals could choose to eat less meat, use fewer animal products, volunteer at an animal shelter, or use what they've learned to support their current practices.

Scoring Rubric for Questions #1-5

Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Provides thoughtful responses to all five questions. Shows a deep level of reasoning.	Provides thoughtful responses to only three or four of the questions. -OR- Most provided responses are brief and do not show depth in the level of reasoning.	Provides thoughtful responses to only one or two of the questions. -OR- All provided responses are brief and do not show depth in the level of reasoning.	Does not provide a response.

RESOURCE

LESSON 5:
Case Study Decisions

INTRODUCTION

In this lesson, students read one of three case studies involving animals in research. Students work through a Decision-Making Framework in small groups, in which they identify the ethical question, determine which facts are known or unknown, consider the values of different stakeholder groups, generate possible solutions, and then make and justify a decision about the case. This is a jigsaw exercise, in which students first meet in "like" stakeholder groups to become experts on the values and concerns of that group. Teams are then rearranged so that each new group has students from different stakeholder viewpoints. After sharing the views and values of each stakeholder group with their peers, groups work together to generate options for solutions to the case study. Lastly, students come to individual decisions about the case and write a thorough justification. [**Note:** Some field test teachers suggest transitioning from *Lesson Four* directly to the *Assessment Activity* and using this lesson as a reflective tool for re-visiting the topic at a later date].

KEY CONCEPTS

- A decision-making framework provides a structured format for logical student thought.
- Difficult decisions can be reasoned through in a systematic way, even if the different solutions are not without challenges for diverse stakeholder groups.

LEARNING OBJECTIVES

Students will know:

- A decision about a difficult ethical dilemma can be made by using the following process: identify the ethical question; determine which facts are known or unknown; consider the values of different stakeholder groups; generate possible solutions; and then make and justify a decision about the case.

Students will be able to:

- Reason through a case study using a decision-making framework.
- Apply ethical viewpoints to a case study.
- Create a strong justification for their decision about the case study.

CLASS TIME

One class period of 50 minutes.

MATERIALS

Materials	Quantity
Student Handout 5.1—*Ethical Decision-Making Framework*	1 per student
Student Handout 5.2—*Justify the Answer*	1 per student
Case Studies chosen from the three options: Student Handout 5.3—*Case Study A: Karen's Dilemma* Student Handout 5.4—*Case Study B: Mice and Memory* Student Handout 5.5—*Case Study C: A Trip to the Zoo*	1 per student
Teacher Answer Key 5.1—*Ethical Decision-Making Framework*	1

TEACHER PREPARATION

- Make copies of the Student Handouts.
- Read through the Case Studies and choose which one you will assign to students. Case Studies A and B are appropriate for high school students and those who function at a higher reading level. Case Study C is appropriate for middle school students and those who function at a lower reading level.

PROCEDURE

WARM-UP: CHALK TALK

As students enter the room, have them participate in the Chalk Talk sheets posted around the room. Have a different colored marker than previous days (but still the same for all students) to help distinguish the evolution of thought from day to day.

ACTIVITY ONE: ETHICAL QUESTION, FACTS, AND STAKEHOLDERS

1. Tell students that they will be introduced to a case study involving animals in research in this lesson. They will then use a decision-making framework to help them reason through the case.

2. Have students read the Case Study of choice.

3. Distribute copies of Student Handout 5.1—*Ethical Decision-Making Framework*; one per student. As a class, decide on the ethical question for the Case Study.

4. Give students approximately five minutes to write down the facts from the case and any questions that they have on Student Handout 5.1—*Ethical Decision-Making Framework*.

5. Ask students to brainstorm a list of stakeholders in the case individually.

6. Ask for student volunteers to share the names of stakeholders from their lists. Record the list of the stakeholders on the board.

7. As a class, choose the top four stakeholders that are most affected by the decision and have students list these on Student Handout 5.1—*Ethical Decision-Making Framework*.

ACTIVITY TWO: 'LIKE' STAKEHOLDER GROUPS

8. Divide the class into groups of four and assign one stakeholder to each small group (more than one group can represent the same stakeholder, if needed).

9. Students should consider the values and concerns of that stakeholder group and record them on Student Handout 5.1—*Ethical Decision-Making Framework*. What are their concerns? What do they care about?

10. Each group should also consider duties-based and outcomes-based ethical perspectives from the viewpoint of that stakeholder. Which perspective seems to best fit each stakeholder's view?

11. Allow about five minutes for each stakeholder group to discuss the values and concerns of that stakeholder.

ACTIVITY THREE: 'MIXED' STAKEHOLDER GROUPS

12. Rearrange the class into groups of four, so that each new small group has one representative from each stakeholder set. If there are an odd number of students, two students can represent the same stakeholder in the same group, if needed.

13. Each stakeholder should share, in turn, their values and concerns with the other students in the group until each stakeholder has reported.

14. Students should record this information on Student Handout 5.1—*Ethical Decision-Making Framework*.

15. In this mixed group, have students proceed to the Possible Solutions section on the handout. What are the options for this case? What are the extreme positions? What options occupy the middle ground?

16. Each student should come to a decision. This does not have to be a team consensus, nor does the student have to share his or her decision.

ACTIVITY FOUR: STUDENT-WRITTEN JUSTIFICATION

17. Each student should write a thorough justification for their decision, using the guidelines found on Student Handout 5.2—*Justify the Answer*. Explain to students that a good justification will touch upon all parts of the Decision-Making Framework. Student Handout 5.2—*Justify the Answer* is organized the same way as the framework, beginning with the question and ending with the solutions.

18. If time permits, have students meet in pairs to discuss their justifications. Students can give each other feedback on the strength of their justifications based on Student Handout 5.2—*Justify the Answer*. Students should ***not*** critique each other's position directly, but focus on the strength of the reasoning.

19. Collect the students' written justifications.

CLOSURE

20. Share with students that the decision-making framework and bioethical analysis tools that students have learned over the course of the curriculum will help them as they encounter other bioethical cases. Students may also find them helpful as they consider dilemmas they may encounter personally in the future.

HOMEWORK

- Students can continue to work on their justifications as homework.

TEACHER BACKGROUND

Additional information on ethics can be found in the *Appendix*.

Arguments for using non-human primates in biomedical research

Currently, there are no **non-human primate** substitutes for answering some of the research questions of significant human health importance. Researchers must look for alternatives when proposing their research protocols for approval. Less than one half of one percent of the animals used in research are non-human primates. Every attempt is made to **replace**, **reduce**, and **refine** in order to minimize impacts to primates. Research with primates is subject to guidelines imposed by the **Animal Welfare Act** and the Public Health Service. Researchers are required to show that their research cannot be met without using animals. Additionally many questions can be answered by using "lower" animal species such as zebrafish or mice. Each research institution also maintains an **Institutional Animal Care and Use Committee** which, among other duties, must ensure that protocols avoid or minimize discomfort, pain, and distress. For instance, if a procedure is found to cause any more than slight or fleeting pain, the animal must be anesthetized, sedated, or given other pain relief. There are high standards for animal use, and sometimes there is no other alternative for research whose goal is human health intervention. These are our closest "relatives." Harm to them is minimized.

Many significant advances in human health have been achieved through use of non-human primates in research. Included among these is the culture of the polio virus in monkey kidney, still being carried on today as a source of the virus in the vaccine. Other vaccines, for instance for yellow fever, and disease progressions, for example typhus, have been studied in non-human primates. Non-human primate research has also been used to develop surgical and imaging techniques, such as **MRI**, which have revolutionized the practice of medicine. Some of the above work has been awarded the Nobel Prize. This work has saved lives, extended the lifespan, and improved the quality of life for ***millions*** of humans. These are clear ***benefits*** to humans.

Currently much research around neurological and psychological illnesses, basically brain-based, is conducted in such primates. These conditions include depression, drug addiction, Alzheimer's disease, and Huntington's disease. The study of Huntington's disease is being made possible by the development of a rhesus monkey model with a human gene. The brain similarities among primates make this work possible. Mouse brains with the human gene proved ineffective for such study. Neurological and psychological illnesses are among the more poorly understood conditions experienced by humans and are responsible for much human suffering. Relief of such human suffering is an obvious potential benefit of this research.

Research conducted in animals often leads to benefits for the animal species as well. Vaccines against rabies, distemper, cholera, and other diseases are used on a variety of non-human species. Surgical and imaging techniques are likewise applied to animals. It is not unusual to treat diabetic pets with insulin developed for human use. Non-human animals benefit greatly from research in animals.

Arguments against using non-human primates in biomedical research

Non-human primates express recognizable emotions, establish family groups, exhibit self-awareness, and possess a higher intelligence than other groups of animals. Because of their evolutionary closeness to humans, they are capable of feeling distress when deprived of social interactions. Laboratories sometimes cannot provide the level of social interaction that would alleviate stress, boredom, and anxiety. The goal is to avoid ***harm***, whether it is physical, emotional, or social.

Immediate distress of animals should be avoided out of respect for individual animal lives. Animals with a close evolutionary connection to humans should be treated as individuals, just as humans are. Some say that, because animals cannot speak for themselves, we have an even greater obligation to protect them from harm. Humans volunteer for biomedical research and animals are given no such choice. Often advocates of equal status for animals extend this to a ban on animals as food, companions, or sources of fiber. They state that an animal should be treated with as much respect as a human.

Animal models will not always predict human response to a treatment or drug. There are examples in the literature of treatments found to be effective in animals that were not effective in humans. This is because no other animal is identical to a human in its anatomy and physiology. Even animals engineered to have human genes, such as the mouse model of Huntington's disease, are not always predictive.

Certain research experiments should never be performed on animals or humans because the ***harms*** to the animals and humans are far too high. Included in this category of research is traumatic brain or spinal cord injury, producing burns, and giving lethal doses of radiation. When the ***benefits*** are compared to the harms, the animals bear most of the harms while the humans receive all or most of the benefits.

GLOSSARY

Animal Welfare Act of 1966 (AWA): A federal law that governs the care, handling, treatment, and transportation of animals in situations that include: laboratories, animal dealers and breeders, exhibitors, and transporters of animals. The law sets out minimum standards for housing, ventilation, lighting, shelter, and veterinary care.

Biochemical Pathways: A series of chemical reactions that occur within a cell and are catalyzed by one or more enzymes.

Cytokines: Protein molecules that are secreted by the nervous system and immune system. These signaling molecules play a role in the communication between cells.

Dementia: A loss of brain function that may affect thinking, language, memory, and behavior.

Duties-based Ethical Theory: An ethical theory that focuses on the ***act*** itself (as opposed to the consequences of that act), and asks the question, "Would it be acceptable if everyone else were to act in this way? Is the ***action***, no matter the consequences, ***right*** or **wrong**?" This theory can also be thought of as, "The ends do ***not*** justify the means."

Embryo: An organism at its earliest stages of development, after fertilization of the egg and first cell division. In humans, an embryo is the first eight weeks after fertilization, after which the developing organism is called a fetus.

Free Radicals: Atoms or groups of atoms with an unpaired number of electrons. These highly reactive atoms can damage DNA.

Humane: Treating animals with respect and care.

Institutional Animal Care and Use Committee (IACUC): Federal law states that any organization that uses laboratory animals for research or instruction must have an IACUC that oversees the care and use of laboratory animals.

Magnetic Resonance Imaging: Also known as a MRI, this imaging technique is used to look at structures inside the body.

Mitochondrial Function: The mitochondria are organelles that generate ATP, the cell's source of energy. The mitochondria also perform functions that include controlling cell growth and death, signaling, and cellular differentiation.

Molecular Genetics: A specialty within the field of biology that studies the structure and function of genes at the molecular level.

Motor Neurons: Neurons (nerve cells) in the central nervous system that help control muscle movement.

Neurological Diseases: Disorders that affect the brain, spinal cord, and nerves.

Non-human Primate: Member of the order Primates, not including humans.

Outcomes-based Ethical Theory: An ethical theory that focuses on the ***consequence*** of an act, and asks the question, "What are the consequences of the action?" In getting caught, the bad outcome (e.g., getting in trouble, losing points on the assignment, or being seen as dishonest) would outweigh any benefits from the cheating. This theory can also be thought of as, "The ends ***justify*** the means."

Primate: Member of the order Primates, which includes anthropoids (monkeys and apes—which include humans) and prosimians (galagos, lemurs, lorises, and tarsiers).

Reduction: One of the 3 Rs of animal research proposed by Russell and Burch. Reduction means using the fewest number of animals possible in a research project to gain statistically significant results.

Refinement: One of the 3 Rs of animal research proposed by Russell and Burch. Refinement means using any technique or procedure that decreases the suffering, or enriches the life of, an animal used in research.

Replacement: One of the 3 Rs of animal research proposed by Russell and Burch. Replacement means replacing conscious, living vertebrates with cell or tissue cultures, computer models, and/or less developed animal species.

Stakeholder: Any person, institution, or entity that is interested in, invested in, or will be affected by the outcome of a decision.

Transgenic Organism: A living organism in which genes, or gene regulatory regions, have been added, removed, or modified. The change in DNA will cause the organism to exhibit a new property (immune system change, genetic disorder, etc.) which can be passed to its offspring.

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STUDENT HANDOUT 5.1

Ethical Decision-Making Framework

Name_____ Date_____ Period_____

Ethical Question:		
1. Relevant facts (known)	2. Questions that remain (unknown, need to know)	
3. Stakeholders (people and/or entities affected by the decision)	4. Concerns/values of each stakeholder	5. Ethical viewpoints
_____ →	_____ →	_____
_____ →	_____ →	_____
_____ →	_____ →	_____
_____ →	_____ →	_____
6. Possible decisions/options a. b. c.		
7. Decision and justification:		

HANDOUT

HANDOUT

STUDENT HANDOUT 5.2

Justify the Answer

Name_____ Date_____ Period_____

A strong justification should have the following components:

✔	A good justification includes:	Which means...
☐	A DECISION	A position (claim) has been clearly stated. The decision relates directly to the ethical question.
☐	FACTS	The facts and science content can be confirmed or refuted regardless of personal or cultural views. This can be used as evidence to support the claim.
☐	ETHICAL CONSIDERATIONS	Ethical considerations ***may*** include duties-based and outcomes-based ethical perspectives. This can be used as evidence to support the claim.
☐	STAKEHOLDER VIEWS	There are a variety of views and interests in the decision and more than one individual or group will be affected by the outcome.
☐	ALTERNATE OPTIONS and REBUTTALS	No one decision will satisfy all parties. A thorough justification considers strengths and weaknesses of various positions.
☐	REASONING and LOGIC	A logical explanation that connects the evidence to the claim is provided.

For our purposes, the justification for the decision is more important than the position on the decision.

HANDOUT

HANDOUT

STUDENT HANDOUT 5.3

Case Study A: Karen's Dilemma

Name_____ Date_____ Period_____

Twenty-seven-year old Karen Goodman is a rising star in **molecular genetics** having just completed her PhD at the University of Washington. Her research involved the production and use of **transgenic** mice—mice that have had their genetic makeup altered by the introduction of genes from another organism. In her case, a gene for Amyotrophic Lateral Sclerosis (ALS), also known as Lou Gehrig's Disease, was introduced into the mice and then she was able to study a protein produced by this gene that initiated the onset of the ALS symptoms. Her research will be published in the international journal *Cell Biology* next month.

Karen has been offered a four year contract to work at one of the largest primate research centers in the U.S., the Adams/Hamper labs of Portland, Oregon. Adams/Hamper does both behavioral and physiological research on several species of monkeys in hopes of finding **biochemical pathways** for several human diseases. From this information they hope to develop drugs and other forms of intervention to cure or reduce the effect of the diseases. They are currently doing work on HIV, Huntington's disease, cystic fibrosis, autism, Tay-Sachs disease, ALS, and others. Much of their work has involved the replication and verification of work done in other labs using transgenic mice or other non-primate animal models. However, Adams/Hamper is using **non-human primates** exclusively because of their greater similarity to humans than other animal models. The next step for successful development of treatments would be to try them on human subjects. Karen is particularly impressed with their functional **Magnetic Resonance Imaging** facility, perhaps the best on the West Coast, which can track biochemical changes in the brain. This imagery has helped greatly in tracking the changes in brain biochemistry as diseases progress, as well as changes brought about by the introduction of drugs.

Karen's job, if she accepts it, would be to develop a line of transgenic **monkeys** (*rhesus macaques*) that contain the human gene for Huntington's disease. The rhesus monkeys Karen would be working with are non-human primates, but are not in the same category as **apes** which include orangutans, chimpanzees, and gorillas.

Transgenic rhesus monkeys with the human Huntington's gene have already been produced. However, in breeding, the gene is lost in the second generation. Karen's expertise would be very valuable in correcting this problem so that a ready population of monkeys with the Huntington's disease gene would be available for research.

Adams/Hamper currently does not seem to have a specific design for experiments that would be conducted using the transgenic Huntington's monkeys once they are developed. There is some indication that the Huntington's protein, which is produced by animals with the disease, somehow stimulates the immune system to cause an overproduction of **cytokines** in the brain which brings on Huntington's symptoms. There also is an indication that **mitochondrial function** is modified resulting in the production of toxic **free radicals**. All of these findings have been studied using Huntington's transgenic mice. Similar processes seem to be occurring in transgenic ALS mice. However, these studies have not been verified in non-human primates and Adams/Hamper has no specific experiments designed.

Huntington's is a terrible disease resulting in the gradual degeneration of the nervous system. It slowly incapacitates the **motor neurons** resulting in uncontrolled movements. It progresses to loss in intellectual capacity and frequent emotional outbursts. Eventually it shuts down major body systems until death occurs.

As a company, Adams/Hamper has the advantage of having several scientists working collaboratively on a number of neurological diseases and excellent equipment and technical support staff. The culture of the organization is to share results and insights in hopes that research in one area could introduce ideas and techniques that might be used in another area. The company is publicly traded and has a strong financial footing with a board that sees research into new treatment as the key to its future.

Karen is concerned and has reservations about her involvement in introducing Huntington's to primates. She sees herself as the agent that would be introducing a terrible disease to a monkey population. She wonders if the monkeys' high level of awareness and ability to think in terms of the future and the past make introducing a disease like Huntington's different from introducing it to the non-primate animal models she has worked with in the past. She also can't see how pain and anxiety can be effectively addressed in the test animals.

HANDOUT

Adams/Hamper has agreed to follow strict international guidelines for the use and care of non-human primates in research. These rules are designed to minimize pain and distress as well as promote the welfare of the animals. Because of the highly developed social structure and intelligence of primates, this care involves special training by handlers and researchers and specific procedures such as:

- Housing animals in socially harmonious groups.
- Providing a mentally stimulating environment.
- Systematic positive human contact.
- Weaning of animals at an appropriate age.

Adams/Hamper has been fined twice by the U.S. Department of Agriculture for mistreating animal subjects and not following research protocols that were agreed to in advance.

Karen is also concerned about some recent trends to move away from research using non-human primates in some other countries. The Netherlands has banned all research on chimpanzees. Spain is in the process of granting near human rights to the great apes such as chimpanzees, gorillas, and orangutans. They would ban all research on these great ape species, though not monkey species like the rhesus macaque she would be studying at Adams/Hamper.

Should Karen accept the job at Adams/Hamper?

Contributed by Rod Mitchell.

GLOSSARY

Ape: Members of the superfamily *Hominoidea* that includes gorillas, chimpanzees, orangutans, and siamangs. Their use in biomedical research is extremely rare and banned in some countries.

Biochemical Pathways: A series of chemical reactions that occur within a cell and are catalyzed by one or more enzymes.

Cytokines: Protein molecules that are secreted by the nervous system and immune system. These signaling molecules play a role in communication between cells.

Free Radicals: Atoms or groups of atoms with an unpaired number of electrons. These highly reactive atoms can damage DNA.

Magnetic Resonance Imaging: Also known as a MRI, this imaging technique is used to look at structures inside the body.

Mitochondrial Function: The mitochondria are organelles that generate ATP, the cell's source of energy. The mitochondria also perform functions that include controlling cell growth and death, signaling, and cellular differentiation.

Molecular Genetics: A specialty within the field of biology that studies the structure and function of genes at the molecular level.

Monkey: Non-human, non-ape primates, including rhesus macaques, baboons, and marmosets. Rhesus monkeys are the most common type of non-human primate used in biomedical research.

Motor Neurons: Neurons (nerve cells) in the central nervous system that help control muscle movement.

Non-human Primate: Member of the order Primates, not including humans.

Primate: Member of the order Primates, which includes anthropoids (monkeys and apes—which include humans) and prosimians (galagos, lemurs, lorises, and tarsiers).

Transgenic Organism: A living organism in which genes, or gene regulatory regions, have been added, removed, or modified. The change in DNA will cause the organism to exhibit a new property (immune system change, genetic disorder, etc.) which can be passed to its offspring.

HANDOUT

STUDENT HANDOUT 5.4

Case Study B: Mice and Memory

Name_____ Date_____ Period_____

Twenty-seven-year-old Karenna Goodman is a rising star in molecular genetics having just completed her PhD at Pennsylvania State University. Her research involved the production and use of **transgenic** yeast—yeast that have had their genetic makeup altered by the introduction of genes from another organism. In her work, Karenna was able to insert a gene for Amyotrophic Lateral Sclerosis (ALS) – Lou Gehrig's Disease – into the yeast and then study a protein produced by this gene. This protein is thought to be instrumental in the onset of the ALS symptoms. Her research will be published in the international journal *Cell Biology* next month.

Karenna has been offered a position at a thriving research lab at the University of Washington, the Adams/Hamper lab. The Adams/Hamper lab does research on transgenic mice in hopes of finding **biochemical pathways** for several human diseases. From this information they hope eventually to develop drugs and other forms of intervention to cure or reduce the effect of the diseases. They are currently doing work on HIV, Huntington's disease, cystic fibrosis, autism, Tay-Sachs disease, ALS, and others.

Karenna's work will involve working with transgenic mice that contain the human gene for Huntington's disease. Huntington's is a terrible disease resulting in the gradual degeneration of the nervous system. It slowly incapacitates the **motor neurons** resulting in uncontrolled movements. It progresses to loss in intellectual capacity and frequent emotional outbursts. Eventually it shuts down major body systems until death occurs. Studies have shown that the Huntington's protein, which is produced by animals with the disease, may affect both the immune system and the function of the **mitochondria**. However, these studies have not been verified in **non-human primates**. Because of their greater similarity to humans than other animal models, Karenna's department is also working to develop a line of transgenic rhesus monkeys that contain the human gene for Huntington's disease. If the work in mice and non-human primates produces successful treatments, the next step would be to try them on human subjects. The Adams/Hamper lab group works collaboratively with a number of other groups studying **neurological diseases**. They share results and insights in hopes that ideas and techniques developed in one area might be used in another.

During her first week in the lab, Karenna is surprised to see a group of animal rights activists protesting animal research outside the university entrance. The posters they carry are graphic and disturbing. Karenna has always felt comfortable about her work with transgenic mice, but knows that her research, if successful, will lead to the use of non-human primates in research. She believes that the university follows strict international guidelines for the use and care of non-human primates in research—rules designed to minimize pain and distress as well as promote the welfare of the animals. But where did the activists get those pictures? Karenna also knows that, for many animal activists, there are ***no*** acceptable research animals. Karenna remembers reading about a researcher in California whose house was firebombed by animal activists—and that researcher worked with fruit flies.

Karenna marches past the animal rights activists to enter her building and considers her situation. They might consider her work to be unethical, but she does not. ***Is it?***

Modified from a case study contributed by Rod Mitchell.

HANDOUT

GLOSSARY

Biochemical Pathways: A series of chemical reactions that occur within a cell and are catalyzed by one or more enzymes.

Mitochondria: The mitochondria are organelles that generate ATP, the cell's source of energy. The mitochondria also perform functions that include controlling cell growth and death, signaling, and cellular differentiation.

Molecular Genetics: A specialty within the field of biology that studies the structure and function of genes at the molecular level.

Motor Neurons: Neurons (nerve cells) in the central nervous system that help control muscle movement.

Neurological Diseases: Disorders that affect the brain, spinal cord, and nerves.

Non-human Primate: Member of the order Primates, not including humans.

Primate: Member of the order Primates, which includes anthropoids (monkeys and apes—which include humans) and prosimians (galagos, lemurs, lorises, and tarsiers).

Transgenic Organism: A living organism in which genes, or gene regulatory regions, have been added, removed, or modified. The change in DNA will cause the organism to exhibit a new property (immune system change, genetic disorder, etc.) which can be passed to its offspring.

STUDENT HANDOUT 5.5

Case Study C: A Trip to the Zoo

Name_____ Date_____ Period_____

As Jane and Amanda settled into their seats for the two and a half hour bus trip back to their high school, they heard their teacher ask for the observation sheets they had completed that day. In the large enclosure of the Primate House at Franklin Park Zoo, the two students had seen gorillas for the first time, and sometimes it was up close and personal.

"I'll never forget how that gorilla, Kit, ran at the window when Bobby made eye contact with him," Jane said of the large male gorilla.

"Yeah," said Amanda, "I thought he was going to break the window when he pounded it so hard. Bobby's big for a sophomore, but he sure jumped when the gorilla did that. Even though the glass between them is very thick, you could tell he was surprised."

"Speaking of surprised! How about when Kiki brought Kumani up to the viewing window from their side?" Jane added. "It was almost like she was inviting that toddler on our side of the window to play with Kumani. And then they did play, sort of. That made me stop and think."

"About what?" asked Amanda.

"About mothers and daughters and families and stuff. You know, gorillas…and humans, too," answered her friend.

Jane looked for a response, but instead Amanda turned thoughtful as if she was having a hard time choosing her words. Jane waited and then realized that her friend needed a few moments to herself. As Jane switched her attention to the movie starting up on the bus monitors, Amanda continued thinking about families, gorillas, humans, and new connections.

Amanda's mother was spending more and more of her time with grandma Betty. Gram had Huntington's disease, a disease of the nervous system that does not usually show up until middle age. Amanda had gotten very interested in this condition since Gram was diagnosed four years ago. She knew it would get worse every year and that Gram's jerky body movements and the strange facial expressions she often made would progress to the point that she would no longer be able to move around or want to go out in public. The disease that had already robbed her of her independence would eventually confine her to bed and lead to **dementia**. Huntington's would slowly kill Gram in another five to fifteen years.

She had tried not to think of this today, but the gorilla interactions had brought it back. They had families, too. In so many ways they exhibited so-called human characteristics. They were big and hairy and didn't talk, but they had many recognizable behaviors. She knew from biology class that gorillas were genetically related to humans. What she had seen today had made that real.

Uneasiness grew inside Amanda as she thought about Huntington's disease and the prospects for helping her Gram. She also knew that other members of her family, including her mom and Amanda herself, were at increased risk of developing the condition later in their lives. Surfing the net she had come across a recent advance in Huntington research. Scientists had developed a primate model of Huntington's disease by genetically incorporating the Huntington's disease gene into rhesus monkey **embryos**. Rhesus **monkeys** are close cousins to the gorilla **apes** Amanda had just seen in the zoo. Now they had an animal, relatively close to humans in evolutionary terms, that could help them study this devastating disease.

All the biology students had been assigned to create a thesis statement about **non-human primates**, drawing on their classroom and zoo experiences. Before today she had believed she would argue for the use of non-human primates in researching **neurological diseases**. Now she was not so sure.

She knew where the uneasiness had come from. She loved Gram and her suffering was real. It would get worse consistently, taking away her mind and her body functions. And this would take five to fifteen years. It was an awful disease. She wanted this animal model to be used to help develop basic knowledge about Huntington's disease and then therapies for the disease. But what she had seen today concerned her. Because of their evolutionary closeness, non-human primates shared many physical and behavioral characteristics. The same thing that made them excellent research models for studying disease worried her. The similarities she had seen today reminded her of human qualities. Should such evolutionarily close animals be the subjects of research?

HANDOUT

Back at home Amanda found additional information about non-human primate research. Rhesus monkeys are the most widely used and most significant non-human primate model for biomedical research, sharing 93% of their genes with humans. They are considered the best animal model for investigations of AIDS, neurological disorders including addiction, vision research, aging, obesity, cardiovascular diseases, diabetes, and drug studies. The females even have a 28 day menstrual cycle, making them models for human birth control and other reproductive research. Their use has already led to the development of the polio vaccine, an understanding of blood types, and linkages between hormone levels and depression.

Monkeys and other non-human primates feel pain and are social animals like humans. This has often led people to object to their research uses. Many grant a right not to suffer, be harmed, and/or be killed to all animals. This view would essentially require us ***not*** to use animals in research at all. Some other opponents of animal research would extend these prohibitions only to certain groups of animals or would make a few exceptions, for instance where the benefit would also be given to the species studied. It has also been argued that animals should be considered individuals, just as we do people. This would give them a moral value we must respect, preventing their use in research.

Amanda further found that the **Animal Welfare Act** requires research facilities to treat animals responsibly and **humanely**. They must establish **Institutional Animal Care and Use Committees** (IACUCs) to oversee the research. Often called the 3 Rs, their approaches involve **reduction** of the number animals to the minimum needed, **refinement** of procedures to minimize pain or distress, and **replacement** by alternative methods of study, if appropriate. The IACUCs consider alternatives wherever possible. Still, to some, any pain or distress in a research animal is unacceptable.

What should Amanda write about? Should she defend the use of non-human primates in biomedical research, expressing her hopes for therapies to help humans such as her Gram? Or should she write in opposition to it, considering the experiences she had today? Both views could be supported by current understandings of genetics and natural history.

Is it ethical to use non-human primates in biomedical research?

Contributed by Karen O'Neil, Pioneer Valley Regional School.

HANDOUT

GLOSSARY

Animal Welfare Act of 1966 (AWA): A federal law that governs the care, handling, treatment, and transportation of animals in situations that include: laboratories, animal dealers and breeders, exhibitors, and transporters of animals. The law sets out minimum standards for housing, ventilation, lighting, shelter, and veterinary care.

Ape: Members of the superfamily Hominoidea that includes gorillas, chimpanzees, orangutans, and siamangs. Their use in biomedical research is extremely rare and banned in some countries.

Dementia: A loss of brain function that may affect thinking, language, memory, and behavior.

Embryo: An organism at its earliest stages of development, after fertilization of the egg and first cell division. In humans, an embryo is the first eight weeks after fertilization, after which the developing organism is called a fetus.

Humane: Treating animals with respect and care.

Institutional Animal Care and Use Committee (IACUC): Federal law states that any organization that uses laboratory animals for research or instruction must have an IACUC that oversees the care and use of laboratory animals.

Monkey: Non-human, non-ape primates, including rhesus macaques, baboons, and marmosets. Rhesus monkeys are the most common type of non-human primate used in biomedical research.

Neurological Diseases: Disorders that affect the brain, spinal cord, and nerves.

Non-human Primate: Member of the order Primates, not including humans.

Primates: Member of the order Primates, which includes anthropoids (monkeys and apes—which include humans) and prosimians (galagos, lemurs, lorises, and tarsiers).

Reduction: One of the 3 Rs of animal research proposed by Russell and Burch. Reduction means using the fewest number of animals possible in a research project to gain statistically significant results.

Refinement: One of the 3 Rs of animal research proposed by Russell and Burch. Refinement means using any technique or procedure that decreases the suffering, or enriches the life of, an animal used in research.

Replacement: One of the 3 Rs of animal research proposed by Russell and Burch. Replacement means replacing conscious, living vertebrates with cell or tissue cultures, computer models, and/or less developed animal species.

HANDOUT

HANDOUT

TEACHER ANSWER KEY 5.1

Ethical Decision-Making Framework

1. Relevant facts (known)

Student responses should provide a list of known facts and science content that can be confirmed or refuted regardless of personal or cultural views.

2. Questions that remain (unknown, need to know)

Student responses should include a list of questions that demonstrate that they have thought about what they still need to know to form their decision.

3. & 4. Stakeholders & concerns/values of each stakeholder

Student responses should list the names of stakeholders, the stakeholders' views on the subject, and the concerns and/or values that group brings forward. Student responses should show that there is a variety of views and interests in the decision and that more than one individual or group will be affected by the outcome.

5. Ethical viewpoints

Student responses should link the stakeholders' views to ethical considerations, including, but not limited to, duties-based and outcomes-based ethical perspectives.

6. Possible decisions/options

Student responses should include more than one possible decision, since no one decision will satisfy all parties. Students should demonstrate a consideration of the strengths and weaknesses of various positions.

7. Decision and justification

A position should be clearly stated and the decision should directly relate to the ethical question. For additional scoring guidance, refer to the scoring rubric below.

RESOURCE

Scoring Rubric for Student Justifications

Dimension	Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
What is your ***decision***? (A position that relates directly to the ethical question has been clearly stated.)				
Decision	Student's choice of best option is clearly stated. The decision relates directly to the ethical question. Student shows thoughtful consideration and organized thinking.	The student's choice of best option is clearly stated, but the option may not relate directly to the ethical question. Student shows clear thinking.	Student does not clearly state an option or does not state what should be done. Student does not give any reasons to support his/her decision.	Student states an option that is not one of the options for the case or student response shows no understanding of the situation or the question being asked.
What ***facts*** support your decision? Is there information missing that could be used to make a better decision? (The facts and science content can be confirmed or refuted regardless of personal or cultural views.)				
Facts	The justification ***uses the relevant scientific reasons*** to support student's answer to the ethical question. Student demonstrates a solid understanding of the context in which the case occurs, including a thoughtful description of important missing information. Student shows logical, organized thinking. Both facts supporting the decision and missing information are presented at levels exceeding standard (as described above).	The main relevant facts are identified. All scientific concepts are correctly presented. Student shows clear thinking. Student references information missing from the case that would influence decision-making. Both facts supporting the decision and missing information are presented at levels meeting standard (as described above).	Factual information relevant to the case is described but some key facts may be missing and some irrelevant information may also be included. Student may not have mentioned information missing from the case that would influence decision-making. Student presents only facts or missing information.	Factual information relevant to the case is incompletely described or is missing. Irrelevant information may be included and student demonstrates some confusion.
Which ***stakeholders*** will be impacted by the decision and how will they be impacted? (There are a variety of views and interests in the decision, and more than one individual or group will be affected by the outcome.)				
Stakeholder Views	Three or more stakeholders, the ways in which they are impacted, and their values, interests, and/or concerns are identified OR four or more stakeholders and the ways in which they are impacted are identified.	Three stakeholders and the ways in which they are impacted are identified OR four stakeholders are identified without mention of the impacts on them.	Two stakeholders and the ways in which they are impacted are identified OR three stakeholders are identified without mention of the impacts on them.	Only one stakeholder and the way in which this stakeholder is impacted is identified OR two stakeholders are identified without mention of the impacts on them.

Scoring Rubric for Student Justifications – continued

Dimension	Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
What are the main ***ethical considerations***? (Ethical considerations may include duties-based and outcomes-based ethical perspectives.)				
Ethical Considerations	The student ***evaluates the case in depth using one or more ethical considerations.*** The student shows exceptional understanding of how one or more ethical considerations relates to the case. The student's decision is supported by the thorough, thoughtful application of the consideration(s) of the case. The student demonstrates organized thinking, and his/her conclusions flow logically from premises.	The student demonstrates an understanding of the ethical consideration(s) related to the case. The student provides clear explanation of how ethical considerations support his/her decision.	The student demonstrates a general awareness of ethical considerations and how they relate to the case, but may not articulate the relationship clearly or provide enough explanation. The student demonstrates mostly clear and organized thinking, but portions of the answer may be unclear, disorganized, or incomplete.	The student lacks an awareness of ethical principles or does not properly relate them to the case. The student demonstrates some confused or disorganized thinking. Student response does not include ethical considerations (i.e., legal considerations).
What are the strengths and weaknesses of ***alternate solutions?*** (No one decision will satisfy all parties. A thorough justification considers various positions.)				
Alternate Solutions	Thorough analysis of the alternate solutions that includes multiple strengths and weaknesses and/or multiple alternate solutions. The writing is clear and organized.	Presents both the strengths and the weaknesses of the alternate solution(s).	Only discusses the strengths or the weaknesses of the alternate solution or contains either misconceptions or unrealistic strengths or weaknesses.	No alternate solutions are discussed, or presents strengths and/or weaknesses for solution, not alternate solutions, or presents unrealistic alternatives.

ASSESSMENT

INTRODUCTION

At the beginning of *Lesson One*, students engaged in a silent Chalk Talk regarding their personal understandings and beliefs about animal research. By beginning successive lessons with students adding to these conversations, students are able to observe how these understandings and beliefs change and/or grow through the unit as they add to the "conversation."

At the culmination of the unit, students engage in a whole class discussion about what they observed and how their understandings and beliefs about animal research have or have not changed as a result of the activities. This provides teachers with a formative assessment of student understanding of animal research and the use of animals in and by society.

As a summative assessment, students will create an Action Plan outlining how they will exercise their personal position on the use of animals in and by society based on background information and ethical principles.

KEY CONCEPTS

- The biomedical research process is driven by the future benefit to humans and animals.
- The biomedical research process has evolved due to analytical reflection by society and scientists on accepted practices, and continues to do so as our knowledge expands.
- The biomedical research process requires active participation by scientists, consumers, voters, and research participants.

LEARNING OBJECTIVES

Students will know:

- Each individual can take personal actions to exercise their personal position on the use of animals in research.

Students will be able to:

- Identify why scientists use animals.
- Explain the history of animal research and how it has shaped current research guidelines/regulations.
- Identify how they can be a participant in the use of animals in/by society.

CLASS TIME

One to two class periods of 50 minutes each.

MATERIALS

Materials	Quantity
Student Handout 6.1—*Chalk Talk Debrief and Reflection Form*	1 per student
Student Handout 6.2—*My Animal Use Action Plan*	1 per student
Student Handout 6.3—*Animal Use Action Plan Rubric*	1 per student
Student Handout 6.4—*Animal Use Position Paper Rubric*	1 per student (optional)

FRAMING THE LESSON

The *Assessment* is intended for use after the five lessons in this curriculum have been delivered, as a formative and summative means of assessing students understanding. It is important to have students participate in the Chalk Talk in *Lesson One*, and re-visit the Chalk Talk in *Lessons Three* and *Five*, before doing these assessments. The Chalk Talk Debrief and Reflection activity provides a formative assessment of student learning, while the Action Plan activity provides a summative assessment of student learning.

TEACHER PREPARATION

- Make copies of Student Handouts.

PROCEDURE

ACTIVITY ONE: CHALK TALK DEBRIEF

(Formative Assessment)

1. Give students ten to fifteen minutes to go around the room and add to the Chalk Talk conversations on the posters.

2. Engage students in a Think-Write-Pair-Share activity using Student Handout 6.1—*Chalk Talk Debrief and Reflection Form*.

3. Provide five to ten minutes for students to silently reflect and write about the debrief questions on the handout.

4. Ask students to choose one question and discuss it with a partner. Be sure that each student is discussing a different question, so each pair will discuss two questions.

5. Engage students in a whole class conversation regarding the debrief questions. Be sure to discuss each question, as well as other questions that students might raise.

6. [**Note:** It is important to discuss that it is good that there are still different opinions among students. The goal was not to make all students think the same way, or to change any student's opinion. The goal was to ensure that students were able to justify their opinions with information learned through the activities!]

ACTIVITY TWO: STUDENT PERSONAL ACTION PLAN

(Summative Assessment)

7. Ask students to refer back to the stakeholders from *Lesson Five* and to reflect on which stakeholder they most identified with before engaging them in a short conversation about their reasons for choosing those stakeholders. Tell students that they will be using this conversation to help them determine their own position on animal use and write up an action plan.

8. Review Student Handout 6.2—*My Animal Use Action Plan* and Student Handout 6.3—*Animal Use Action Plan Rubric* with students. Explain to students that they will be creating a product (the type of product can be determined by you or you can leave it open to student choice) that meets the following criteria:

   - Explains the factors that go into conducting animal research.
   - Describes the history of animal research and how it is an evolving process.

- Identifies how you will exercise your personal participation in the use of animals in/by society and the choices you will make to support your view.
- Justifies your choice according to stakeholders, ethical principles, and knowledge gained from *Lessons One* through *Five*.

9. Lead the class in a group brainstorm of potential behaviors and actions that could be included in students' Action Plans. Also, brainstorm a list of possible products.

   Student behaviors and actions could include:

   - Requesting dog or cat food to donate to a local animal shelter in lieu of birthday presents.
   - Supporting organizations that work towards scientifically valid alternatives to animal testing, such as the Center for Alternatives to Animal Testing (CAAT) through Johns Hopkins University.
   - Eating as a vegetarian (or vegan) one day a week, or more often.
   - Volunteering time at a local animal shelter or veterinarian's office.
   - Continuing with current behavior after thoughtful analysis and justification.

   For students seriously interested in becoming a vegetarian, make sure that they know a vegetarian diet should be balanced, just like any healthy diet, with a variety of foods from all of the food groups. Information on healthy vegetarian diets can be found here:

   http://www.youngwomenshealth.org/vegetarian.html

10. It is helpful to review the rubric on Student Handout 6.3 with students at this time to help them visualize what will be expected of them before they begin to work on the assignment.

11. Instruct students to refer back to the previous lessons to help them fill in the first part of the Student Handout 6.2—*My Animal Use Action Plan*. You may choose to have students complete one section and then share with a partner before moving on to the next section.

12. Before allowing students to move on to the second section of the handout, review the S.M.A.R.T. goals with them, as outlined on Student Handout 6.2—*My Animal Use Action Plan*. It is also helpful to review the example as a class to clarify any questions.

13. Be sure to explain to students that the worksheets ***are not*** their final product. They are merely tools to get them started.

14. Allow class time for students to create their Action Plan products (or assign them as homework). Students can use Student Handout 6.3—*Animal Use Action Plan Rubric* as a guide to help them develop and refine their products.

EXTENSION

- Students can be challenged to develop, write, and revise a position paper that outlines their personal position on the use of animals in research. A position paper can be a quality artifact for students' portfolios. Students can use Student Handout 6.4—*Animal Use Position Paper Rubric* to guide them in the process of writing and revising a position paper. The rubric on this handout can also be used to assess the quality of students' position papers.
- Having students re-visit their Action Plans can be a powerful reflective experience. After one month—or another suitable length of time—ask students to re-read their Action Plans and write a brief reflection paper about how they have or have not been able to meet their plan. The paper should also include an analysis of how their current views do or do not match the views expressed in their Action Plans.

STUDENT HANDOUT 6.1
Chalk Talk Debrief and Reflection Form

Name_____ Date_____ Period_____

Over the past few days you and your classmates have engaged in a silent Chalk Talk conversation about the use of animals in and by our society. As you view the final posters, reflect on the conversations by answering the following questions:

What stood out most to you about the conversations?

Did you notice a trend in the evolution of thought over time?

What has your personal evolution of thought been since beginning this unit of study?

Has your personal opinion regarding animal research and/or the use of animals in and by our society changed? Why or why not?

HANDOUT

HANDOUT

STUDENT HANDOUT 6.2
My Animal Use Action Plan

Name_____ Date_____ Period_____

You will be creating a final product that meets the following criteria:

- Explains the factors that go into conducting animal research.
- Describes the history of animal research and how it is an evolving process.
- Identifies how you will exercise your personal participation in the use of animals in/by society and the choices you will make to support your view.
- Justifies your choice (even if it is to remain the same) according to stakeholders, ethical principles, and knowledge gained from the lessons in this unit.

Use the following worksheet to build your Action Plan. Remember – this is not your final product. You will be using this to develop a final product you will submit for assessment.

PART I

Animal Research	Why do researchers use animals?
	How do researchers determine what type of animal to use and how many to use?

Animal Research History	What events in history have led to the guidelines/regulations that we see now? (Be sure to consider all perspectives.)
	How are current events further shaping the way that animal research is conducted?

HANDOUT

Your Position	Are there additional facts or background information that is important about the use of animals in/by society, regardless of personal position?
	What is your position on the use of animals in/by society?

Justification	What ethical principle(s) (outcomes-based, duties-based, benefits vs. harms) support your position? Why?
	What stakeholders in animal use would support your position and action? Why?
	What stakeholders in animal use would not support your position and action? Why?
	What are some alternative options to be considered?

HANDOUT

PART II

Now that you have considered your position regarding animal use in/by society, it is important to set goals on how you will take action to support that position. To do this, it is important to set S.M.A.R.T. goals.

A "smart" goal fulfills the following criteria:

- **Specific:** The goal is straightforward and emphasizes what you will be doing.
- **Measurable:** There is a way to determine if the goal has been met.
- **Attainable:** The goal is something that can be met, ***with effort***.
- **Relevant:** The goal is something that matters to you; it applies to your life.
- **Timely:** A timeframe is given to accomplish the goal.

Use the S.M.A.R.T. format to help you format two goals (short-term and long-term) about how you will exercise your personal participation in the use of animals in/by society.

	Specific	Measurable	Attainable	Relevant	Timely
Short-Term Goals (within three months)	**What will you be doing?**	How will you know you have accomplished your goal?	What will you need to do to meet your goal?	Why is this goal important to you?	When will you have this goal accomplished?
	How will you do it?				
Long-Term Goals (within two years)	**What will you be doing?**	How will you know that you have accomplished your goal?	What will you need to do to meet your goal?	Why is this goal important to you?	When will you have this goal accomplished?
	How will you do it?				
Example	*Donate food to the local animal shelter by setting up a collection at school.*	*I will have collected 100 cans or bags of dog/cat food.*	*Find a teacher to help, get boxes for collection, put up flyers to tell people about it.*	*There are a lot of animals in shelters that are not cared for but should be.*	*I will start the collection next month and will end it two weeks later.*
Example goal in final format	*To help support a local animal shelter in caring for animals, I will work with a teacher to set up a two-week dog and cat food drive at school to collect 100 cans/bags of food to be donated to the local animal shelter.*				

HANDOUT

STUDENT HANDOUT 6.3
Animal Use Action Plan Rubric

Name_____ Date_____ Period_____

Part I

Dimension	Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Animal Research	• Student includes ***substantial*** description of the reasons animals are used in research. • Student identifies and discusses multiple (four or more) factors that researchers consider before, during, and after conducting animal research. • ***Student discusses how these factors may allow for an increase or decrease in research.*** • Student discusses the use of model organisms and the limitations of models.	• Student includes description of the reasons animals are used in research. • Student identifies and discusses multiple (three to four) factors that researchers consider before, during, and after conducting animal research. • Student mentions the use of model organisms.	• Student includes ***a basic*** description of the reasons animals are used in research. • Student identifies ***but does not discuss two or fewer*** factors that researchers consider before, during, and after conducting animal research.	• Student ***only identifies animal research as an issue but does not offer a*** description of the reasons animals are used in research. • Student identifies ***none or only on***e factor that researchers consider before, during, and after conducting animal research.
Animal Research History	• Student identifies and ***substantially*** discusses multiple (three to four) events in history that have shaped animal research. • Events in history come from multiple perspectives ***and student discusses how these multiple perspectives have shaped animal research history.*** • Student identifies and ***substantially*** discusses how animal research is continually evolving.	• Student identifies and discusses multiple (three to four) events in history that have shaped animal research. • Events in history come from multiple perspectives. • Student identifies and discusses how animal research is continually evolving.	• Student identifies ***but does not discuss two*** events in history that have shaped animal research. • Events in history come from multiple perspectives. • Student identifies ***but does not discuss*** how animal research is continually evolving.	• Student identifies ***but does not discuss any*** or only one event in history that has shaped animal research. • Events in history come from ***a single*** perspective. • Student identifies ***but does not discuss*** how animal research is continually evolving.

HANDOUT

Part I – continued

Dimension	Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Your Position	• Student identifies and ***substantially*** discusses ***three or more*** facts or background information important to the issue. • Student provides a ***clear, thoughtful, and fully developed*** personal position on	• Student identifies and discusses ***three or more*** facts or background information important to the issue. • Student provides a personal position on the use of animals in/by society.	• Student identifies and discusses one or two facts or background information important to the issue. • Student provides a personal position on the use of animals in/by society.	• Student identifies ***but does not discuss*** facts or background information important to the issue. • Student position does not show a personal alignment.
Justification	• Student identifies and substantially explains the ethical principle(s) that support their position. • Student identifies and substantially explains which stakeholders would support their position. • Student identifies and substantially explains which stakeholders would not support their position. • Student identifies ***three or more*** reasonable and insightful alternative options.	• Student identifies and explains the ethical principle(s) that support their position. • Student identifies and explains which stakeholders would support their position. • Student identifies and explains which stakeholders would not support their position. • Student identifies ***two*** reasonable and insightful alternative options.	• Student identifies ***but does not explain*** the ethical principle(s) that support their position. • Student identifies ***but does not explain*** which stakeholders would support their position. • Student identifies ***but does not explain*** which stakeholders would not support their position. • Student identifies ***one*** reasonable and insightful alternative options.	• Ethical principle(s) provided do not support student's position. • Stakeholders provided are not in alignment with student's position. • Alternative option provided is unreasonable and shows lack of analysis.

HANDOUT

Part II

Dimension	Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
Action Plan	• Student identifies ***three or more*** reasonable and insightful possible solutions/strategies to encourage change. • Student's action plan goals for change are S.M.A.R.T. goals (specific, measurable, attainable, relevant, timely).	• Student identifies two reasonable and insightful possible solutions/ strategies to encourage change. • Student's action plan goals for change are S.M.A.R.T. goals (specific, measurable, attainable, relevant, timely).	• Student identifies one reasonable and insightful possible solution/strategy to encourage change. • Student's action plan goal for change is a S.M.A.R.T. goal (specific, measurable, attainable, relevant, timely).	• Student identifies one possible solution/strategy to encourage change ***but it may not be reasonable or realistic.*** • Student's action plan goal for change ***is not a*** S.M.A.R.T. goal (specific, measurable, attainable, relevant, timely).
Justification of Action Plan	• Student identifies and discusses how their action plan goals support their clearly stated personal position on animal use. • Student supports their action plan goals using information from animal use history, current practice, and ***multiple*** ethical principles. • Student identifies and ***substantially*** discusses other stakeholders who would support their action plan goals. • Student identifies and ***substantially*** discusses other stakeholders who would not support their action plan goals.	• Student identifies and discusses how their action plan goals support their clearly stated personal position on animal use. • Student supports their action plan goals using information from animal use history, current practice, and at least one ethical principle. • Student identifies and discusses other stakeholders who would support their action plan goals. • Student identifies and discusses other stakeholders who would not support their action plan goals.	• Student identifies and discusses how their action plan goals support their personal position on animal use, ***but their position is not clearly stated***. • Student supports their action plan goals using information from animal use history, current practice, ***or*** at least one ethical principle. • Student identifies ***but does not discuss*** other stakeholders who would support their action plan goals. • Student identifies ***but does not discuss*** other stakeholders who would not support their action plan goals.	• Student identifies but does not discuss how their action plan goals support their personal position on animal use, ***but their position is not stated.*** • Student ***does*** not support their action plan goals using information from animal use history, current practice, or any ethical principles. • Student identifies ***but does not discuss*** other stakeholders who would support ***or*** stakeholders who would not support their action plan goals.

HANDOUT

HANDOUT

STUDENT HANDOUT 6.3

Animal Use Position Paper Rubric

Name_____ Date_____ Period_____

Dimension		Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
COMPLEX MODELS Accuracy of models for complex ystems	**Animals in Research**	• Provides a detailed and accurate description of the reasons animals are used in research. • Identifies and discusses multiple (three to four) factors that researchers consider before, during, and after conducting animal research.	• Provides a basic but accurate description of the reasons animals are used in research. • Identifies ***but does not discuss*** multiple (three to four) factors that researchers consider before, during, and after conducting animal research.	• Provides an inaccurate description of the reasons animals are used in research. • Identifies few (one or two) factors that researchers consider before, during, and after conducting animal research.	• Provides inaccurate description of the reasons animals are used in research. • Provides inaccurate facts that researchers consider related to animal research.
	History of Animal Research	• Identifies and discusses multiple (three to four) events in history that have shaped animal research. • Events in history come from multiple perspectives. • Identifies and discusses how animal research is continually evolving.	• Identifies ***but does not discuss*** multiple (three to four) events in history that have shaped animal research. • Events in history come from multiple perspectives. • Identifies ***but does not discuss*** how animal research is continually evolving.	• Identifies ***but does not discuss*** few (one or two) events in history that have shaped animal research. • Events in history come from a single perspective. • Identifies but does not discuss how animal research is continually evolving.	• Provides inaccurate historical events.
	Models for Complex Systems	• Identifies and discusses how animal research history and current practice do or do not make animals accurate models for complex systems.	• Identifies ***but does not discuss*** how animal research history and current practice do or do not make animals accurate models for complex systems.	• Does not identify how animal research history and current practices do or do not make animals accurate models for complex systems.	• Does not identify how animal research history and current practices do or do not make animals accurate models for complex systems.

HANDOUT

Dimension		Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
CRITICAL ISSUES Real world application	**Your Position**	• Identifies a clear position on the guiding question and its application to society. • Clearly supports position using information from animal use history, current practice, ***and*** at least one ethical principle. • Identifies and discusses the pros and cons of their position.	• Identifies a clear position on the guiding question and its application to society. • Supports position using information from animal use history, current practice, or at least one ethical principle. • Identifies ***but does not discuss*** the pros and cons of their position.	• Does not identify a clear position on the guiding question and its application to society. • Does not support position using information from animal use history, current practice, or any ethical principles. • Identifies ***but does not discuss*** the pros and cons of their position.	• Provided position is not relevant to the guiding question and its applications to society. • Position is not supported with evidence. • Pros and cons of the position are not identified.
	Stakeholders	• Identifies and discusses why other stakeholders would agree or disagree.	• Identifies ***but does not discuss*** why other stakeholders would agree or disagree.	• Identifies ***but does not discuss*** why other stakeholders would agree or disagree.	• Stakeholders are not identified.

HANDOUT

Dimension		Exemplary (5 points)	Proficient (3 Points)	Partially Proficient (1 Point)	Developing (0 Points)
WRITING & COMMUNICATION	Ideas & Content	• The writing is clear, focused and interesting. It holds the reader's attention. Main ideas stand out and are developed by supporting details suitable to audience and purpose.	• The writing is clear and focused. The reader can easily understand the main ideas. Support is present, although it may be limited or rather general.	• The reader can understand the main ideas, although they may be overly broad or simplistic, and the results may not be effective. Supporting detail is often limited, insubstantial, overly general, or occasionally slightly off-topic.	• The writing lacks a central idea or purpose.
	Organization	• The organization enhances the central idea(s) and its development. The order and structure are strong and move the reader through the text.	• Organization is clear and coherent. Order and structure are present, but may seem formulaic.	• An attempt has been made to organize the writing; however, the overall structure is inconsistent or skeletal.	• The writing lacks coherence; organization seems haphazard and disjointed. Even after rereading, the reader remains confused.
	Voice	• The writer has chosen a voice appropriate for the topic, purpose, and audience. The writer seems committed to the topic, and there is a sense of "writing to be read." The writing is expressive, engaging, or sincere.	• The writer's commitment to the topic seems inconsistent. A sense of the writer may emerge at times.	• The writing provides little sense of involvement or commitment. There is no evidence that the writer has chosen a suitable voice.	• The writing seems to lack a sense of involvement or commitment.
	Word Choice	• Words convey the intended message in an interesting, precise, and natural way appropriate to audience and purpose. The writer employs a broad range of words that have been carefully chosen and thoughtfully placed for impact.	• Words effectively convey the intended message. The writer employs a variety of words that are functional and appropriate to audience and purpose.	• Language is quite ordinary, lacking interest and variety, or may be inappropriate to audience and purpose. The writer doesn't employ a variety of words, producing a sort of "generic" paper filled with familiar words and phrases.	• The writing shows an extremely limited vocabulary or is so filled with misuse of words that the meaning is obscured. Only the most general kind of message is communicated because of vague or imprecise language.

Writing scoring guide adapted from "Salem-Keizer Scoring Guide: Communicate through Writing." http://www.aforcemorepowerful.org/resources/docs/lesson1/writing-scoring-guide.xls.

Biology scoring guide provided by Dawn Brown, Science Teacher, Career Academy at Truman High School, Tacoma, Washington.

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APPENDIX

TABLE OF CONTENTS

MASTER GLOSSARY

Alzheimer's Disease: A form of dementia, or loss of brain function, that gradually worsens over time and affects behavior, thinking, and memory.

Animal Rights: Animal rights organizations advocate that non-human animals deserve the same rights as humans and that the use of them in any way, including as household pets, entertainment, and food, is inhumane and unethical. Some animal rights organizations advocate violence to prevent the use of animals, but not all. Those that do tend to be underground organizations to avoid prosecution.

Animal Rights Activist: A person who believes that animals should be given similar considerations as human beings, should not be considered property, and should be awarded basic rights.

Animal Welfare: Animal welfare organizations work with biomedical research regulatory bodies and agencies that promote animal research to ensure the ethical and humane use of animals. Animal welfare activists believe that it is morally acceptable to use animals for human purposes, as long as the animal's welfare (physical and psychological well-being) is protected. These organizations do not argue that animals should never be used by humans and do not advocate violence.

Animal Welfare Activist: A person who believes that it is morally acceptable to use animals for human purposes, as long as the animal's welfare (physical and psychological well-being) is protected.

Animal Welfare Act of 1966 (AWA): A federal law that governs the care, handling, treatment, and transportation of animals in situations that include: laboratories, animal dealers and breeders, exhibitors, and transporters of animals. The law sets out minimum standards for housing, ventilation, lighting, shelter, and veterinary care.

Anti-inflammatory Drugs: Drugs used to treat inflammation. These drugs counteract the reactions caused by damaged cells, which release chemicals that stimulate the immune system, leading to swelling and increased flow of cells to the damaged site.

Ape: Members of the superfamily *Hominoidea* that includes gorillas, chimpanzees, orangutans, and siamangs. Their use in biomedical research is extremely rare and banned in some countries.

Bacteria: Tiny, single-celled organisms. These prokaryote organisms lack a nucleus and organelles within the membrane of the cell. Bacteria can form an association with other organisms that cause them to become pathogens, which can cause human disease and death from infections such as cholera, diphtheria, tuberculosis, and tetanus.

Basic Research: Fundamental questions that are asked in order to enhance the knowledge base of a subject, rather than to cure a specific disease or condition.

Biochemical Pathways: A series of chemical reactions that occur within a cell and are catalyzed by one or more enzymes.

Bioethics: A subfield of ethics applied to the life sciences. It helps us, as a society, to make decisions about how to best gain and use scientific knowledge in the fields of biology, biotechnology and medicine.

Biomedical Research: Research that supports the field of medicine, including clinical trials with animals and humans to study the safety and efficacy of new drugs, treatments, techniques, or devices.

Blood Glucose: Also called blood sugar, glucose is a simple sugar that is the basic fuel used by cells in the body. The blood glucose level is a measurement of glucose in blood.

Computer Model: A computer program that attempts to simulate the behavior of a system, generally through the use of a mathematical model.

Cytokines: Protein molecules that are secreted by the nervous system and immune system. These signaling molecules play a role in communication between cells.

Dementia: A loss of brain function that may affect thinking, language, memory, and behavior.

Diabetes: A disease characterized by a high blood glucose level and treated with injections of insulin and other medications. There are three main types of diabetes: Type I, Type II, and gestational diabetes, the latter of which only occurs in pregnant women.

Differentiation: The process by which a less specialized cell transforms into a more specialized type of cell.

Dissection: Surgery conducted for educational or experimental purposes on a non-living organism to view internal structures.

Dosage: A prescribed amount of a medication.

Duties-based Ethical Theory: An ethical theory that focuses on the ***act*** itself (as opposed to the consequences of that act), and asks the question, "Would it be acceptable if everyone else were to act in this way? Is the ***action***, no matter the consequences, ***right*** or ***wrong***?" This theory can also be thought of as, "The ends do not justify the means."

Embryo: An organism at its earliest stages of development, after fertilization of the egg and first cell division. In humans, an embryo is the first eight weeks after fertilization, after which the developing organism is called a fetus.

Ethics: A field of study that looks at the moral basis of human behavior and attempts to determine the best course of action in the face of conflicting choices.

Eukaryote: Any organism that has a nucleus and specialized organelles within its cell(s). All of the living research models are eukaryotes, except bacteria.

Euthanasia: The practice of ending an animal's life while minimizing pain, distress, and anxiety before loss of consciousness. Most often accomplished through the administration of drugs.

Free Radicals: Atoms or groups of atoms with an unpaired number of electrons. These highly reactive atoms can damage DNA.

Genome: An organism's entire genetic information, encoded in either DNA or RNA (for many viruses). Scientists have been able to sequence the genome of some organisms.

Hair Transplant: A surgical treatment for male pattern baldness that involves taking hair follicles from a donor part of the body and transplanting them into a recipient part of the body (usually the scalp). The donor site is chosen based on the hair follicles' genetic resistance to balding.

Hereditary Condition: Also called a genetic disorder, a hereditary condition is a condition or illness caused by abnormalities in genes or chromosomes. The genetic defect can be inherited from an individual's parents and/or passed down to his or her children.

Humane: Treating animals with respect and care.

Informed Consent: In a research study with human volunteers, each research subject must be capable of understanding the facts and risks of the study, and the researchers must clearly relay this information. Informed consent is this exchange of information, followed by the volunteer providing their consent to participate in the study.

Institutional Animal Care and Use Committee (IACUC): Federal law states that any organization that uses laboratory animals for research or instruction must have an IACUC that oversees the care and use of laboratory animals.

Insulin: A hormone that causes cells in the body to take glucose from the blood into the cells where it can be used.

Insulin Receptors: A receptor in the body that is activated by the presence of insulin, which causes uptake of glucose.

Lower/Higher Organisms: "Lower" organisms are those for which there is less ethical concern about their use due to their level of neurological development or complexity. "Higher" organisms are those for which there is more ethical concern about their use in research.

Magnetic Resonance Imaging: Also known as a MRI, this imaging technique is used to look at structures inside the body.

Male Pattern Baldness: A genetic condition that causes hair loss in a predictable pattern along the temples and crown of the head.

Microbe: Also called a microorganism, a microbe is one of a group of microscopic organisms that includes bacteria, fungi, archaea, protists, green algae, plankton, and planaria.

Mitochondrial Function: The mitochondria are organelles that generate ATP, the cell's source of energy. The mitochondria also perform functions that include controlling cell growth and death, signaling, and cellular differentiation.

Model: A representation of a phenomenon, object, or idea. A model can be developed to represent a phenomenon, object, or idea using a more familiar one (like using an analogy).

Model Organism: An organism that is used in research because it is easier to study a particular aspect in that organism, rather than in humans and higher organisms. Model organisms tend to be small, able to reproduce rapidly with many offspring, inexpensive to house and maintain, able to be manipulated genetically on the molecular level, and well-studied by other scientists. Major model organisms include E. coli bacteria, yeasts, slime molds, fruit flies, zebrafish, and mice.

Molecular Genetics: A specialty within the field of biology that studies the structure and function of genes at the molecular level.

Monkey: Non-human, non-ape primates, including rhesus macaques, baboons and marmosets. Rhesus monkeys are the most common type of non-human primate used in biomedical research.

Moral: Codes of conduct governing behavior; an expression of values reflected in actions and practices.

Moral Duty: The duty or obligation that arises out of a consideration of what is right and wrong.

Motor Neurons: Neurons (nerve cells) in the central nervous system that help control muscle movement.

Neurological Diseases: Disorders that affect the brain, spinal cord, and nerves.

Neuron: Also called a nerve cell, a neuron is a specialized cell in the nervous system (brain, spinal cord, and nerves) that processes and communicates information through electrical and chemical signals.

Non-human Primate: Member of the order Primates, not including humans.

Outcomes: The consequences or end results of an action.

Outcomes-based Ethical Theory: An ethical theory that focuses on the ***consequence*** of an act, and asks the question, "What are the ***consequences*** of the action?" In getting caught, the bad outcome (e.g., getting in trouble, losing points on the assignment, or being seen as dishonest) would outweigh any benefits from the cheating. This theory can also be thought of as, "The ends ***justify*** the means."

Primate: Member of the order Primates, which includes anthropoids (monkeys and apes—which include humans) and prosimians (galagos, lemurs, lorises, and tarsiers).

Prokaryote: Any organism that does not have a nucleus or membrane-bound organelles, such as bacteria.

Quadriplegia: The result of a paralyzing injury that causes partial or total loss of the use of arms, legs, and torso, as well as the loss of sensory functions in these areas.

Reduction: One of the 3 Rs of animal research proposed by Russell and Burch. Reduction means using the fewest number of animals possible in a research project to gain statistically significant results.

Refinement: One of the 3 Rs of animal research proposed by Russell and Burch. Refinement means using any technique or procedure that decreases the suffering, or enriches the life of, an animal used in research.

Regenerate: The process of growth and renewal that allows cells, organs, and organisms to be resilient to damaging events. For example, a sea star is capable of regenerating an arm that has been damaged by a predator.

Regulatory Oversight: The amount of supervision by an authoritative body over an activity (i.e. , laws, rules or regulations imposed by governments or institutions).

Replacement: One of the 3 Rs of animal research proposed by Russell and Burch. Replacement means replacing conscious, living vertebrates with cell or tissue cultures, computer models, and/or less developed animal species.

Sequenced Genome: A laboratory process that results in the cataloging of an organism's entire genetic information, encoded in either DNA or RNA (for many viruses).

Speciesism: Belief that the human species is superior to all other species, and therefore, that different rights and values should be assigned to humans than to other animals.

Spinal Cord Injury: An injury to the spinal cord as a result of trauma (not disease). An example of the result of a spinal cord injury is quadriplegia.

Stakeholder: Any person, institution, or entity that is interested in, invested in, or will be affected by the outcome of a decision.

Toxicity: The degree to which a substance can cause damage to an organism. A toxic substance is one that may be damaging or poisonous.

Transgenic Organism: A living organism in which genes, or gene regulatory regions, have been added, removed, or modified. The change in DNA will cause the organism to exhibit a new property (immune system change, genetic disorder, etc.) which can be passed to its offspring.

Type II Diabetes: One of the three types of diabetes. Also called Diabetes Mellitus Type II or Adult-Onset Diabetes. The disease is characterized by high blood glucose levels due to insulin resistance and insulin deficiency.

Vegan: A diet that avoids the consumption of all animal products, including milk, eggs, and honey. A vegan may also avoid buying products made from animals, including leather and wool.

Vegetarian: A diet that avoids the consumption of animal meat, such as red meat, poultry, fin fish, and shellfish.

Vertebrate: An animal with a vertebral column (backbone).

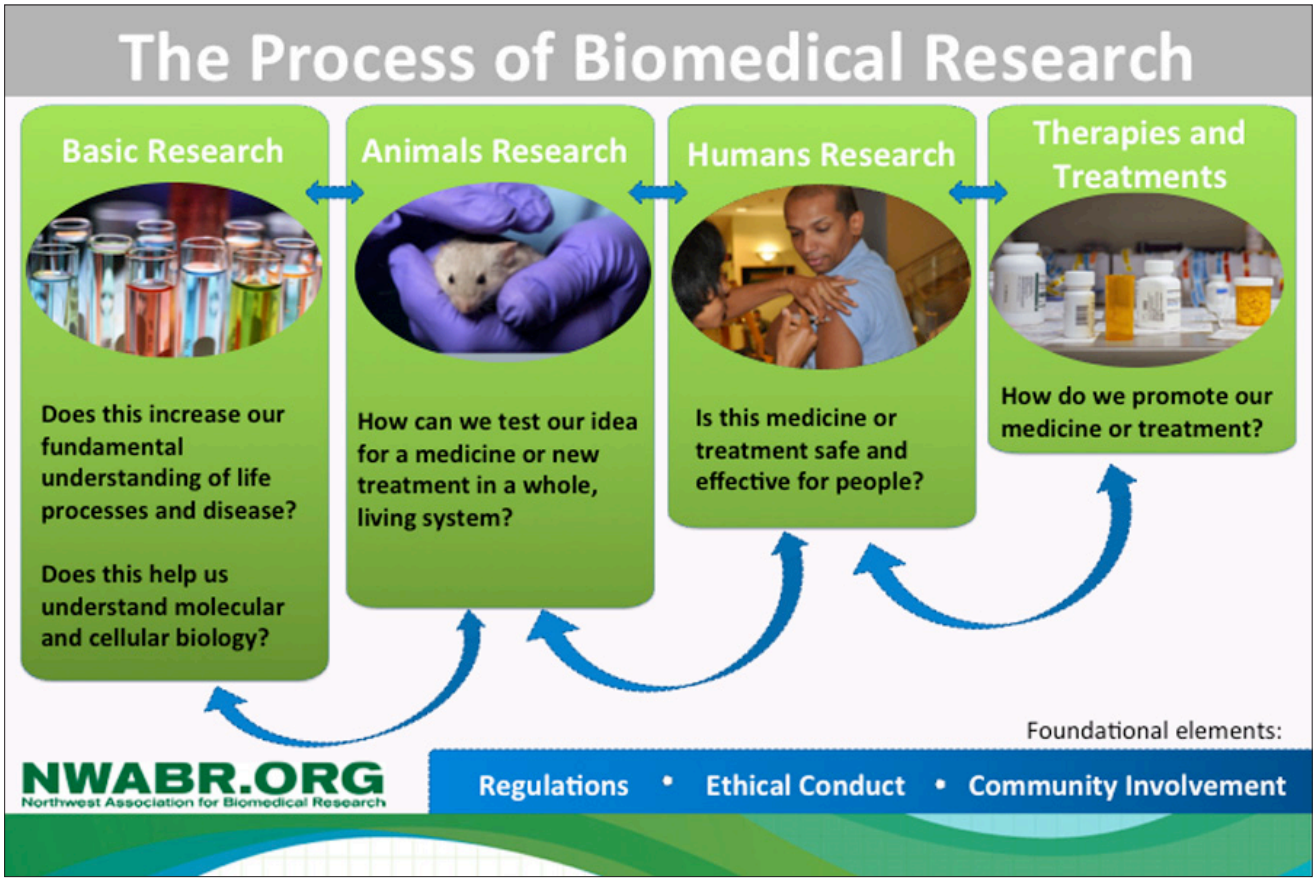
Virtues Ethics: As one of the approaches of normative ethics, virtues ethics emphasize the moral character (virtues), rather than duties (actions) or outcomes (consequences of actions).

Virus: A tiny organism that can transmit infections and disease, such as influenza and HIV.

Vivisection: Surgery conducted for experimental purposes on a living organism to view living internal structures. The term is sometimes more broadly defined as any experimentation on live animals. The term is often used by organizations opposed to animal experimentation and is no longer used by practicing scientists.

APPENDIX
A1: Process of Biomedical Research

Teachers may download a copy of this PowerPoint slide from http://www.nwabr.org. The document is designed to print at 20 x 30 inches. Teachers wishing to print this as a classroom poster may do so freely.



RESOURCE

APPENDIX
A2: Creating Discussion Ground Rules

INTRODUCTION

The study of ethics involves consideration of conflicting moral choices and dilemmas about which reasonable people may disagree. Since a wide range of positions is likely to be found among students in most classrooms, it is especially important to foster a safe classroom atmosphere by creating some discussion ground rules. These ground rules are often referred to as "norms." An agreed-upon set of ground rules should be in place before beginning *The Science and Ethics of Animal Research* curriculum.

OBJECTIVES

Students will be able to:

- Create and agree to classroom discussion norms.

PROCEDURE

Ask the students, "What can we do to make this a safe and comfortable group for discussing issues that might be controversial or difficult? What ground rules should we set up?" Allow students some quiet reflection time, and then gather ideas from the group in a brainstorming session. One method is to ask students to generate a list of ground rules in small groups and then ask each group to share one rule until all have been listed. Clarify and consolidate the ground rules as necessary.

Post norms where they can be seen by all, and revisit them often. If a discussion gets overly contentious at any time, it is helpful to stop and refer to the ground rules as a class to assess whether they have been upheld.

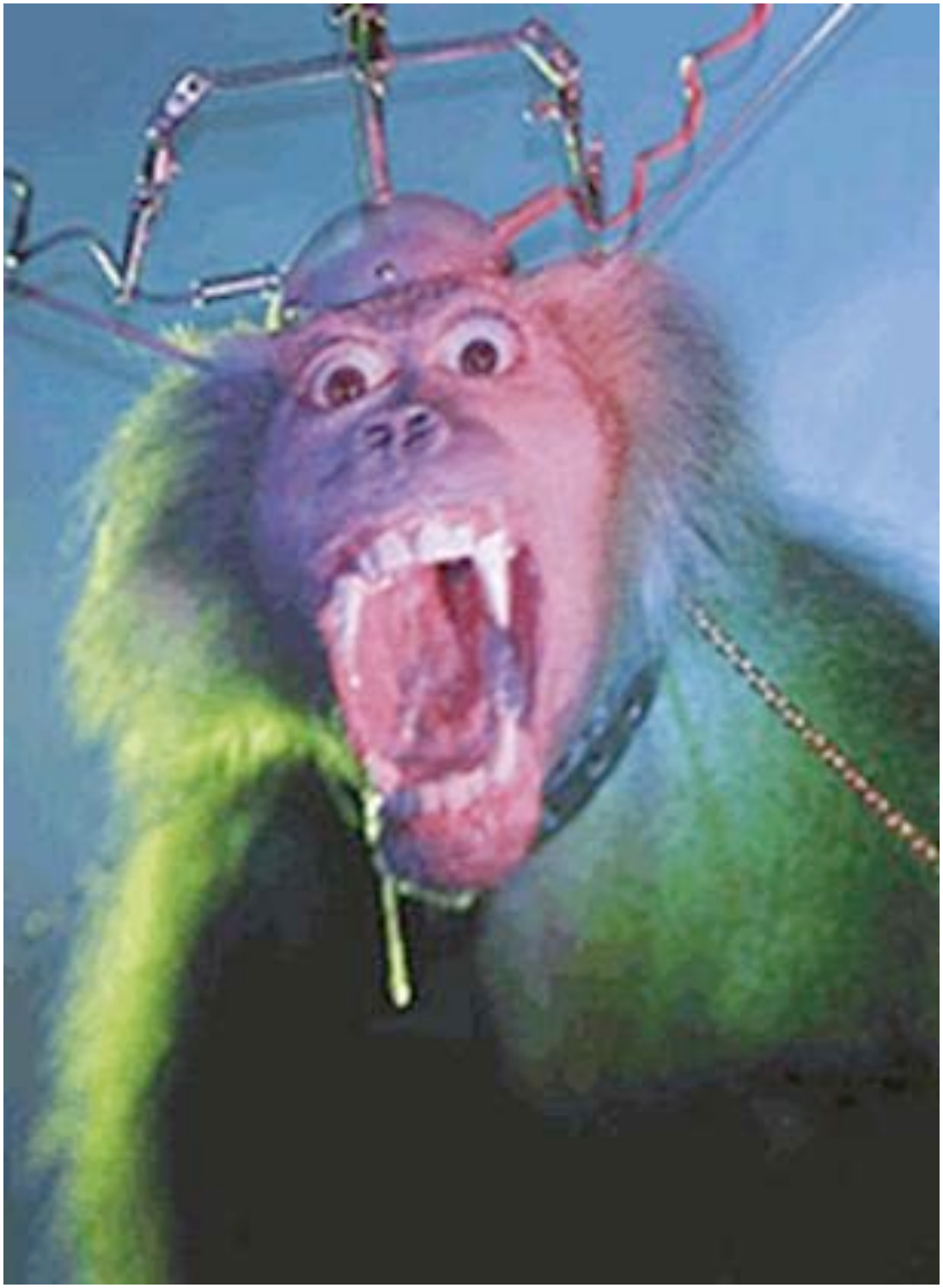
Some possible student ground rules/norms could include:

- A bioethics discussion is not a competition or a debate with a winner and a loser.
- Everyone will respect the different viewpoints expressed.
- If conflicts arise during discussion, they must be resolved in a manner that retains everyone's dignity.
- Everyone has an equal voice.
- Interruptions are not allowed, and no one person is allowed to dominate the discussion.
- All are responsible for following and enforcing the rules.
- Critique ideas, not people.
- Assume good intent.

RESOURCE

APPENDIX
A3: Chalk Talk Poster Image

Photocopy this image to use for the Chalk Talk posters in *Lesson One*.



RESOURCE

APPENDIX
A4: Animal Research Regulatory Bodies

Resource for teachers and students to understand laws, regulations, and advocacy groups.

Name	Mission & Vision	Actions
United States Department of Agriculture (USDA)	"We provide leadership on food, agriculture, natural resources, and related issues based on sound public policy, the best available science, and efficient management." http://www.usda.gov/wps/portal/usda/usdahome	A subset of the USDA, the Animal and Plant Health Inspection Service (APHIS) is composed of animal care and husbandry experts that work to set standards of human care and treatment of animals.Standards are implemented and compliance achieved through "inspection, education, and by working closely with states, industry, and non-governmental organizations." http://www.aphis.usda.gov/
Office of Laboratory Animal Welfare (OLAW)	"The Office of Laboratory Animal Welfare (OLAW) provides guidance and interpretation of the Public Health Service (PHS) Policy on Humane Care and Use of Laboratory Animals, supports educational programs, and monitors compliance with the Policy by Assured institutions and PHS funding components to ensure the humane care and use of animals in PHS-supported research, testing, and training, thereby contributing to the quality of PHS-supported activities." http://grants.nih.gov/grants/olaw/olaw.htm	Institutions that are funded with money from the Public Health Service (PHS) must provide OLAW with written evidence of how animals will be used in their laboratories. All use must adhere to the guidelines set by PHS policy on the Humane Care and Use of Laboratory Animals. OLAW conducts evaluations of the laboratories and investigates all allegations and/or indications of noncompliance. http://grants.nih.gov/grants/olaw/olaw.htm
Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC International)	"The Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC International) is a voluntary accrediting organization that enhances the quality of research, teaching, and testing by promoting humane, responsible animal care and use. It provides advice and independent assessments to participating institutions and accredits those that meet or exceed applicable standards." http://www.aaalac.org/about/mission.cfm	As well as adhering to local, state, and federal laws, institutions volunteer to participate in AAALAC's program. An AAALAC-accredited institution has demonstrated "that they meet the minimum standards required by law, and are also going the extra step to achieve excellence in animal care and use." http://www.aaalac.org/about/index.cfm
Institutional Animal Care and Use Committee (IACUC)	"The Institutional Animal Care and Use Committee (IACUC) is a self-regulating entity that, according to U.S. federal law, must be established by institutions that use laboratory animals for research or instructional purposes to oversee and evaluate all aspects of the institution's animal care and use program." http://iacuc.org/	IACUCs are formed at the institutional level. To begin animal research, researchers must submit all protocols and animal use procedures they will use to their local IACUC for approval and permission to begin. The IACUC conducts regular site visits to ensure that all approved protocols are being followed and that no unapproved protocols are taking place.

RESOURCE

APPENDIX
A5: Animal Welfare and Research Advocacy

Resource for teachers and students to understand laws, regulations, and advocacy organizations.

Animal welfare organizations work with biomedical research regulatory bodies and agencies that promote animal research to ensure the ethical and humane use of animals. These organizations do not argue that animals should never be used by humans and do not advocate violence. The animal welfare organizations below are only a few of the organizations at work today. There are many diverse organizations in existence and vary by types of animals advocated for and work done to achieve their goals.

Name	Mission & Vision	Actions
National Association for Biomedical Research (NABR) **and** **Foundation for Biomedical Research (FBR)**	"On behalf of the biomedical research community, the National Association for Biomedical Research advocates for sound public policy in support of ethical and essential animal research." http://www.nabr.org/About_NABR/Mission_Statement.aspx FBR educates the public about the essential role of humane animal research. http://www.fbresearch.org/default.aspx	NABR works to promote ethical use of animals by working with members and government to educate others and work toward supportive legislation. http://www.nabr.org/About_NABR.aspx
Pro-Test Standing up for Science	"Pro-Test aims to counter the irrational arguments of anti-vivisectionists by raising public awareness of the benefits of animal research and creating an environment where scientists can speak out about their work and be proud of the contributions they make. We stand for science, reasoned debate and, above all, the promotion of the welfare of mankind." http://www.pro-test.org.uk/about.php	Pro-Test is a student led organization in the United Kingdom that works to educate the public about the need for ethical animal research in the interest of developing medicine for humans and animals alike. Pro-Test advocates attending protests and sharing knowledge and information to ensure that continued research takes place and does so in an ethical and humane manner.
Understanding Animal Research	Understanding Animal Research aims to achieve understanding and acceptance of the need for humane animal research in the UK by maintaining and building informed public support and a favorable policy climate for animal research. http://www.understandinganimalresearch.org.uk/about_us/	Understanding Animal Research works to educate the public about animal research. They advocate contacting government to ensure the continued humane and ethical use of animals in animal research.
American Society for the Prevention of Cruelty to Animals (ASPCA)	The ASPCA's mission, as stated by Henry Bergh in 1866, is "to provide effective means for the prevention of cruelty to animals throughout the United States." http://www.aspca.org/about-us/about-the-aspca.html	The ASPCA has been given legal authority to investigate and arrest individuals for crimes against animals. They work to ensure that animal welfare and animal cruelty laws are imposed and upheld. http://www.aspca.org/about-us/about-the-aspca.html
Animal Welfare Institute (AWI)	"Since its founding in 1951, AWI has sought to alleviate the suffering inflicted on animals by people." http://www.awionline.org/ht/d/sp/i/208/pid/208	The AWI works to educate the public and encourage others to speak to Congress and other government officials to advocate for the ethical and humane use of animals in all aspects. http://www.awionline.org/

RESOURCE

Animal Welfare or Animal Rights?

Name	Mission & Vision	Actions
Humane Society of the United States (HSUS)	"Celebrating Animals, Confronting Cruelty." http://www.humanesociety.org/about/overview/	"The HSUS protects all animals through legislation, litigation, investigation, education, science, advocacy, and field work." http://www.humanesociety.org/about/contact/frequently_asked_questions.html

The Humane Society of the United States (HSUS) portrays itself as a moderate animal welfare group but is *not* affiliated with local county and state animal shelters also called the Humane Society. The *Center for Consumer Freedom* considers HSUS to be an animal rights group.

http://activistcash.com/organization_overview.cfm/o/136-humane-society-of-the-united-states

APPENDIX
A6: Animal Rights Organizations

Resource for teachers and students to understand laws, regulations, and advocacy groups.

Animal rights organizations advocate that non-human animals deserve the same rights as humans and that the use of them in any way—including as household pets, entertainment, and food—is inhumane and unethical. Some animal rights organizations advocate violence to prevent the use of animals, but not all. Those that do tend to be underground organizations to avoid prosecution.

The animal rights organizations below are only a few of the organizations at work today. There are many diverse organizations in existence. They vary by the type of animal they advocate for and the work they do to achieve their goals.

Name	Mission & Vision	Actions
Animal Liberation Front (ALF)	To effectively allocate resources (time and money) to end the "property" status of non-human animals. http://animalliberationfront.com/ALFront/mission_statement.htm	Members of ALF work to stop all uses of animals, including ownership, through active protest and demonstrations. In some instances, protests and demonstrations are organized at the private homes of individuals who work in the animal use fields. Some acts of demonstration include violence, threats, and release of animals. (A lot of other animal rights organization are spin-offs of ALF.)
People for the Ethical Treatment of Animals (PETA)	"PETA focuses its attention on the four areas in which the largest numbers of animals suffer the most intensely for the longest periods of time: on factory farms, in laboratories, in the clothing trade, and in the entertainment industry. We also work on a variety of other issues, including the cruel killing of beavers, birds, and other 'pests,' and the abuse of backyard dogs." http://www.peta.org/about/	"PETA works through public education, cruelty investigations, research, animal rescue, legislation, special events, celebrity involvement, and protest campaigns." PETA also works to eliminate the use of animals as household pets and works to humanely euthanize animals without homes to prevent crueler forms of death. http://www.peta.org/about/

APPENDIX

A7: Student Handout — *Justify the Answer*

Name_____ Date_____ Period_____

A strong justification should have the following components:

✔	A good justification includes:	Which means...
☐	A DECISION	A position (claim) has been clearly stated. The decision relates directly to the ethical question.
☐	FACTS	The facts and science content can be confirmed or refuted regardless of personal or cultural views. This can be used as evidence to support the claim.
☐	ETHICAL CONSIDERATIONS	Ethical considerations ***may*** include duties-based and outcomes-based ethical perspectives. This can be used as evidence to support the claim.
☐	STAKEHOLDER VIEWS	There are a variety of views and interests in the decision and more than one individual or group will be affected by the outcome.
☐	ALTERNATE OPTIONS and REBUTTALS	No one decision will satisfy all parties. A thorough justification considers strengths and weaknesses of various positions.
☐	REASONING and LOGIC	A logical explanation that connects the evidence to the claim is provided.

For our purposes, the justification for the decision is more important than the position on the decision.

HANDOUT

HANDOUT

INTRODUCTION TO ETHICAL THEORIES AND TERMS

HOW DO ETHICS DIFFER FROM MORALS AND VALUES?

The terms "values," "morals," and "ethics" are often used interchangeably. However, there are some distinctions between these terms that are helpful to make.

- **Values** signify what is important and worthwhile. They serve as the ***basis*** for moral codes and ethical reflection. All individuals have their own values based on many aspects including: family, religion, peers, culture, race, social background, gender, etc. Values guide individuals, professions, communities, and institutions. One expression of values might be that "life is sacred."
- **Morals** are codes of conduct governing behavior. They are an expression of values reflected in actions and practices. Morals can be held at an individual or communal level. For example, "one should not kill" provides a guideline for action based on values.
- **Ethics** provide a systematic, rational way to work through dilemmas and determine the best course of action in the face of conflicting choices. Ethics attempt to find and describe what people believe is right and wrong, and to establish whether certain actions are actually right or wrong based on the all the information available. For example, ethics might address a question such as, "If killing is wrong, can one justify the death penalty or kill in self-defense?"

Some teachers find the following analogy useful:

- ***Values*** are represented by the ***heart***. They signify what is important, meaningful, and true for each of us.
- ***Morals*** are represented by the ***hands***. They are demonstrated by our behavior. They signify how values are "put into practice" as actions.
- ***Ethics*** is represented by the ***head***. Ethics rely on reasoned judgment, and provide a systematic, rational way to determine the best course of action in the face of conflicting choices.

DUTIES-BASED ETHICAL THEORY

"Moral Rules and Duties" or *"Deontological Ethics"*

Summary

In this perspective, the focus is on the nature of an ***act*** itself and not what happens as a result of that action.

The emphasis is on being motivated by moral duties and acting in accordance with them. Respect for persons and other living organisms is also stressed in this view.

The German philosopher Immanuel Kant (1724-1804) was a major proponent and developer of this approach to ethics. Kant formulated a "categorical imperative" (a command that is absolutely binding, without exceptions), and stated it in several ways:

1. *"One must act only in such a way that one could will one's act to become a universal law or rule (maxim)."*

   One should act only in ways that would be acceptable if everyone else acted that same way.

2. *"Act in such a way that always the action treats humanity never simply as a means, but at the same time as an ends."*

   One should not treat persons as a means to an end only, where the outcome is the only concern.

Kant distinguishes between perfect and imperfect duties. Perfect duties must always be done—do not commit suicide, do not kill innocents, do not lie, etc. Imperfect duties must only sometimes be done—develop our talents and ourselves, contribute to the welfare of others, etc.

Contributions

- Offers consistent principles or rules.
- Treats persons as ends in themselves and never as only a means to an end.
- Recognizes individual rights.

Challenges

- Does not offer a way to deal with conflicting obligations.
- Perfect duties permit no exceptions, which can sometimes be morally difficult to reconcile.
- Does not offer much guidance about forming and applying moral rules in real-life settings.

From *An Ethics Primer*, http://www.nwabr.org.
Adapted with permission from Laura Bishop, Ph.D., Kennedy Institute of Ethics, Georgetown University.

OUTCOMES-BASED ETHICAL THEORY

"Consequentialist" or "Utilitarian" Ethics

Summary

The focus of this perspective is on the ***consequences*** of the action.

The morally appropriate act is one that maximizes the amount of whatever outcome is deemed good and identifies it as intrinsically valuable, useful, or desirable.

Consequentialists seek to bring about the greatest good for the greatest number of people.English philosophers Jeremy Bentham (1748- 1832) and John Stuart Mill (1806-1873) were crucial in the development of utilitarianism as a form of consequentialist ethics. In its most implicit and traditional form, utilitarianism identifies "pleasure" as the good that must be maximized and "pain" as the evil that must be minimized. Utilitarians want to maximize happiness so they determine which actions will have the best outcome in terms of happiness or pleasure, and act so as to bring them about. Moral action is that which results in good or desirable consequences. The rightness of the act is measured by the good or bad consequences it brings about—more good is better. Contemporary utilitarian philosophers identify other values as "good" such as friendship, health, knowledge, etc.

Terms associated with consequentialism: Utility, consequences, ends, outcomes, cost/benefit analysis, "the ends justify the means."

Contributions

- Considers the interests of all persons equally.
- Directs attention to the consequences of actions.
- Offers a familiar form of reasoning—thinking about consequences to guide actions.
- Can be used to establish public policy.

Challenges

- Interests of majority can override the rights of minorities.
- Bad acts with good consequences might be permissible.
- Ignores or does not do justice to the particular and morally significant relationships that make up our lives—the highly personal nature of "duty."
- Makes people responsible for too much; requires too broad a view. Must take into account all people and all consequences.
- Hard to determine what counts as a benefit or harm; hard to compare benefits/harms.

From *An Ethics Primer*, http://www.nwabr.org.
Adapted with permission from Laura Bishop, Ph.D., Kennedy Institute of Ethics, Georgetown University.

RESOURCE

ADDITIONAL ETHICAL PERSPECTIVES AND THEORIES

Ethicists defend their positions using different ethical perspectives and theories. In addition to duties-based and outcomes-based perspectives, three other major perspectives are described below.

Principles

An action is right if it follows the principles:

- ***Respect for Persons:*** Respect individuals and their autonomy (right to make independent choices).
- ***"Do Good" or Beneficence:*** Be of benefit.
- ***Do No Harm, or Non-maleficence:*** Minimize harm.
- ***Justice:*** Treat others equitably, distribute benefits/ burdens fairly.

The principles provide a combination of rules and outcomes-based perspectives. For example, respect for individuals and justice are focused more on rules, and beneficence and non-maleficence require looking at the outcome of an action. The principles are widely used in biomedical ethics. Suppose a person who was dying wished to be killed. The principle of autonomy might be interpreted to say that in order to respect that individual's wish, they should be killed. However, suppose the patient had asked a doctor to do the killing. A doctor who had vowed not to harm others might invoke the principle of non-maleficence and decide they could not kill the patient.

Virtues

An action is right if it conforms to a model set of attributes inherent in a particular community. Virtues-based ethics look at the overall character that is considered desirable by a community. It then asks, "What would the virtuous person do?" Ancient Greeks identified certain virtues that are still widely recognized today as important, such as compassion, honesty, courage, and forgiveness. Virtues ethics looks at the whole person and their behaviors over their lifetime in many situations. For example, killing may not be considered in harmony with a virtuous character that emphasizes forgiveness.

Care

An action is right if it acknowledges the importance and value of interpersonal relationships. Care ethics also looks at the underlying power structures of a situation. For example, an ethicist using the perspective of care might look at how an oppressive or exploitative social structure may underlie an act of killing.

Each of these perspectives allows different questions to be asked in an ethical dilemma. For example, in looking at different solutions one might ask: "Which one provides the greatest good for the greatest number?" "Which solutions are the most fair to the parties involved?" or "Which are consistent with moral rights and duties?" Familiarity with these perspectives can provide you with language to describe and defend your position, and help you see how your arguments align with established philosophical perspectives.