



LP1 TEACHING PLAN

Introduction to Animal Use in Science and the 3Rs



LEARNING PLAN OVERVIEW

This learning plan will introduce the role of animals in scientific research. You will explore the types and amounts of animals used, why animals are used in research, and some regulations that oversee their use in the U.S. This learning plan will also introduce the 3Rs principles of animal research (Replacement, Reduction, and Refinement).

ESTIMATED TOTAL TIME

85-100 minutes plus an additional 30 min -1 hour of project work outside of class

WHAT STUDENTS WILL LEARN

Competency: Examine the use of animals in scientific research in the U.S.

Learning Objectives:

- Identify animals used in scientific research
- Identify how many animals are used in scientific research in the U.S.
- Identify the types of scientific research that utilize testing on animals
- Relate regulatory requirements to animal testing
- Define the 3Rs of animal research

Assessment:

Research Activity - Animal Use in Scientific Research Product: Infographic, Poster, or Presentation

- product identifies one key animal commonly used in scientific research
- product identifies at least three different types of research that use this animal
- product identifies how many animals are used in research in a year
- product describes how each of the 3Rs could be applied to research studies using that animal

Linked External Standards:

NGSS

- HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems

CCSS- Math

- HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays

CCSS- ELA

- RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) to address a question or solve a problem.
- RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
- W.9-10.2.A Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
- W.9-10.2.B Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- W.9-10.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.

TEACHING PLAN

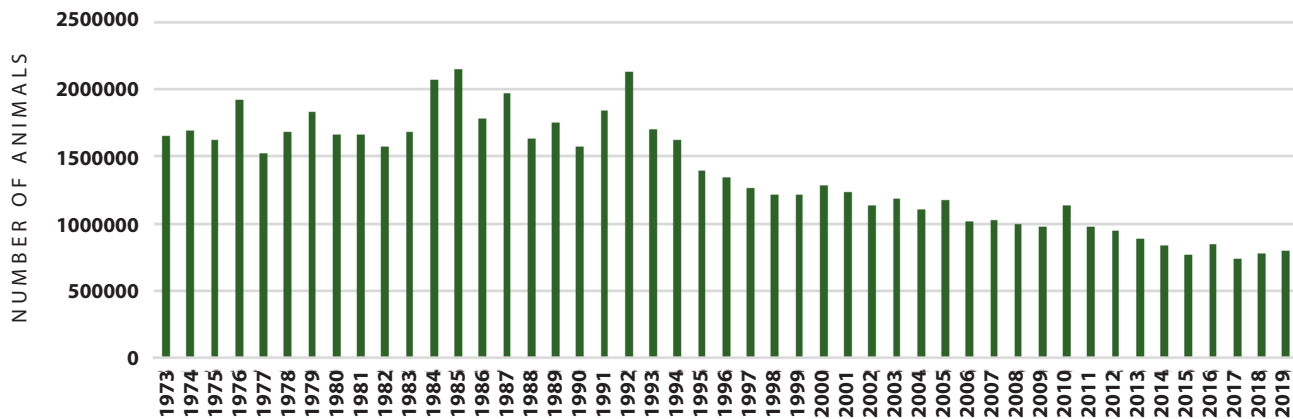
#	Learning Activities	Teaching Notes	Materials and Supplies
1	<p>LEARNING PLAN OVERVIEW Review information detailed in the Student Learning Plan.</p>	<p>TIME: 5 minutes</p> <p>ACTIVITY NOTES: Provide a brief introduction to the learning plan.</p>	Student Learning Plan
2	<p>MOTIVATION ACTIVITY Participate in a quick poll: If you could have one of the following as a pet, which would you choose? A guinea pig, rabbit, cat, dog, or monkey? Why?</p> <p>These animals are also top choices by scientific researchers. Write down a guess on how many of your chosen animal are used per year in scientific research and testing in the U.S.</p>	<p>TIME: 5 minutes</p> <p>ACTIVITY NOTES: Students can be polled online or live in class with quick hand raising. For the top choices, ask why this was chosen. These animals are also top choices by scientific researchers. Ask the students to guess how many of their chosen type of animal is used in research during a year in the U.S.</p>	Polling software or whiteboard to document numbers
3	<p>COMPREHENSION ACTIVITY Review the information and graphs provided about the use of animals in research in the U.S. How close were you on your guess?</p>	<p>TIME: 10 minutes</p> <p>ACTIVITY NOTES: Provide the information to the student. Discuss how to interpret graphics presented. The following numbers reflect reported use in 2019: Guinea pigs: 181,993 All Other Covered Species: 165,017 Rabbits: 142,472 Hamsters: 98,296 Nonhuman primates: 68,257 Dogs: 58,511 Pigs: 50,777 Cats: 18,270 Sheep: 13,953</p> <p>We don't know how many mice, rats, birds, reptiles, amphibians, fish, and invertebrates were used because they aren't covered under the Animal Welfare Act.</p>	<p>LP1_3_Infographic_AnimalsUsedinScience</p> <p>LP1_3_Infographic_AnimalsUsedinScience_AnswerKey</p>
4	<p>COMPREHENSION ACTIVITY View a presentation on regulations for animal testing in the U.S.</p>	<p>TIME: 10 minutes</p> <p>ACTIVITY NOTES: Present the "Regulations for Animal Testing" slides provided.</p>	LP1_4_AnimalTestingRegulations
5	<p>PRACTICE ACTIVITY Interpret the graphs on animal research in the U.S. to answer the questions provided.</p>	<p>TIME: 10 minutes</p> <p>ACTIVITY NOTES: This activity focuses on interpreting graphs while learning about the numbers of animals used for research in the U.S. Students will use the graphs to answer the questions on the Graphic Interpretation: Animals in Science worksheet.</p>	<p>LP1_5_AnimalsInScienceGraphicInterpretation</p> <p>LP1_5_AnimalsInScienceGraphicInterpretation_AnswerKey</p>

#	Learning Activities	Teaching Notes	Materials and Supplies
6	<p>COMPREHENSION ACTIVITY Watch videos on reasons for animal testing and the reasons that animal testing may not be effective. Use the “Animals as Research Models - Pros and Cons” worksheet to take notes on the benefits and drawbacks of using animals for research.</p> <p>Video: Animal Testing Pros and Cons (3:40)</p>	<p>Time: 5 min</p> <p>ACTIVITY NOTES: As science and our understanding of animals advances, questions and concerns have been raised about the use of animals in research. Encourage students to take notes on pros and cons of animal research.</p> <p>Play the following video: Animal Testing Pros and Cons (3:40)</p>	<p>Animal Testing Pros and Cons (3:40) https://youtu.be/QwzofzcsaVw</p> <p>LP1_7_ProCons_worksheet</p>
7	<p>PRACTICE ACTIVITY Participate in a group discussion to complete the “Animals as Research Models - Pros and Cons” worksheet.</p>	<p>TIME: 5 minutes</p> <p>ACTIVITY NOTES: Encourage participants to consider video material and other sources. Sample pro/con list and answer key provided.</p>	<p>LP1_7_ProCons_worksheet</p> <p>LP1_7_ProCons_AnswerKey</p>
8	<p>COMPREHENSION ACTIVITY View a short presentation on the 3Rs of animal research</p>	<p>TIME: 10 minutes</p> <p>ACTIVITY NOTES: Utilize the presentation slides provided.</p>	<p>LP1_8_IntroductionToThe3R_Presentation.pptx</p>
9	<p>PRACTICE ACTIVITY Participate in a group discussion on how the 3Rs principles could apply to the provided goldfish scenario. Complete the Goldfish Scenario Worksheet.</p>	<p>TIME: 10 minutes</p> <p>ACTIVITY NOTES: Guide students through ways that Replacement, Reduction and Refinement could be applied to a classroom experiment using goldfish. This can be done as a large group together or in small groups.</p>	<p>LP1_9_GoldfishScenario_worksheet</p> <p>LP1_9_GoldfishScenario_AnswerKey</p>
10	<p>APPLICATION ACTIVITY Create an infographic/poster/presentation about one animal commonly used in research. Identify what type of research is done on the animal and how many are used in research (identify year of data). Identify ways that the 3Rs could be applied to research done with that animal. Cite your resources.</p>	<p>TIME: 15-30 minutes plus an additional 30 min-1 hour of project work outside of class</p> <p>ACTIVITY NOTES: This activity can be completed individually as a homework assignment or can be done in pairs or as a jigsaw activity with class sharing.</p>	<p>LP1_10_AnimalUseInResearch_Rubric</p>

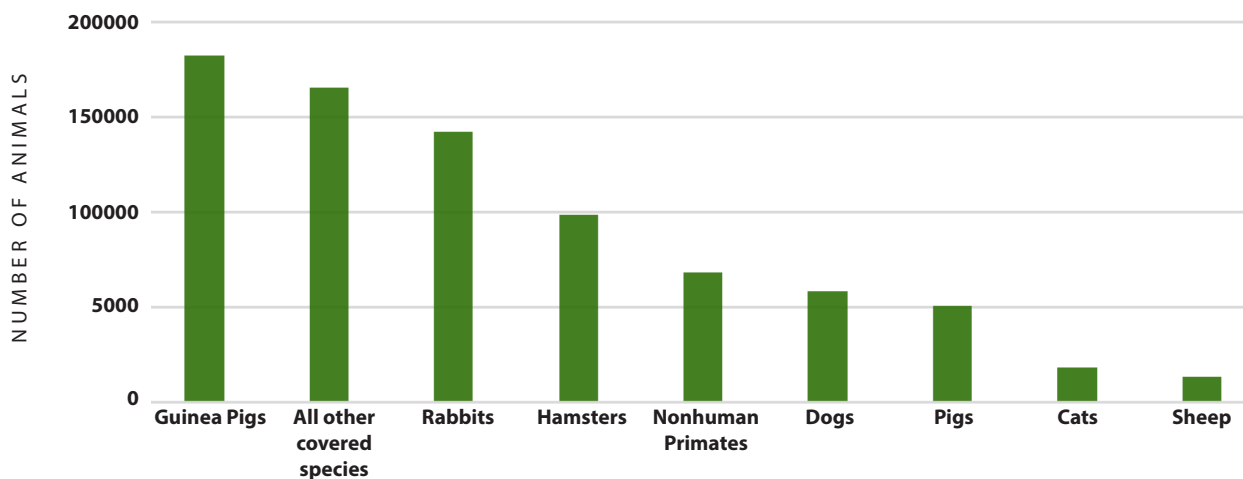
Animals Used in Research, Testing, Teaching, and Experimentation

The charts below show the numbers of animals used in research, testing, teaching, and experimentation in the U.S.

Total Number of Animal Welfare Act-Covered Animals Used in Research, Testing, Teaching, and Experimentation in the U.S. 1973-2019*



Number of Animal Welfare Act-Covered Animals Used in Research, Testing, Teaching, and Experimentation in the U.S. in 2019



*Although mice and rats are estimated to account for >90% of animals used in research in the U.S., they are not included in these numbers because they are not covered by a federal law called the Animal Welfare Act. As a result, we do not know how many of these animals are used in research annually in the U.S.

Exercise: Describe trends you observe in animal usage over the time frame provided. Has the scientific use of animals covered under the Animal Welfare Act increased, decreased, or stayed the same over time?

The Animal Welfare Act excludes mice, rats, birds, cold-blooded animals and invertebrates; therefore, these animals are not included in the bar graph above. Also, several species of animals are lumped into the “all other covered species” category and not given their own individual category, including ferrets and squirrels. Do you think having information about additional animal species would be beneficial to include in the annual animal use statistics? Why or why not?



Answer Key

Exercise: Describe trends you observe in animal usage over the time frame provided. Has the scientific use of animals covered under the Animal Welfare Act increased, decreased, or stayed the same over time?

The use of animals covered under the Animal Welfare Act stayed fairly consistent throughout the 70's and 80's and then starting in the early 90's it began to decrease.

The Animal Welfare Act excludes mice, rats, birds, cold-blooded animals and invertebrates; therefore, these animals are not included in the bar graph above. Also, several species of animals are lumped into the “all other covered species” category and not given their own individual category, including ferrets and squirrels. Do you think having information about additional animal species would be beneficial to include in the annual animal use statistics? Why or why not?

Sample Answer: It would be beneficial to have more information about other animal species because otherwise we get an incomplete picture of the extent of lab animal use in the US. A set of data that excludes many popular lab species is not useful for observing animal use trends in research.



Animals in Science

Graphic Interpretation

Name(s): _____

The Animal Welfare Act Reviewed

In the United States, regulations established under a federal law called the Animal Welfare Act (AWA) set the standards for the humane care and treatment of animals sold as pets, transported commercially, exhibited to the public, and used in research.

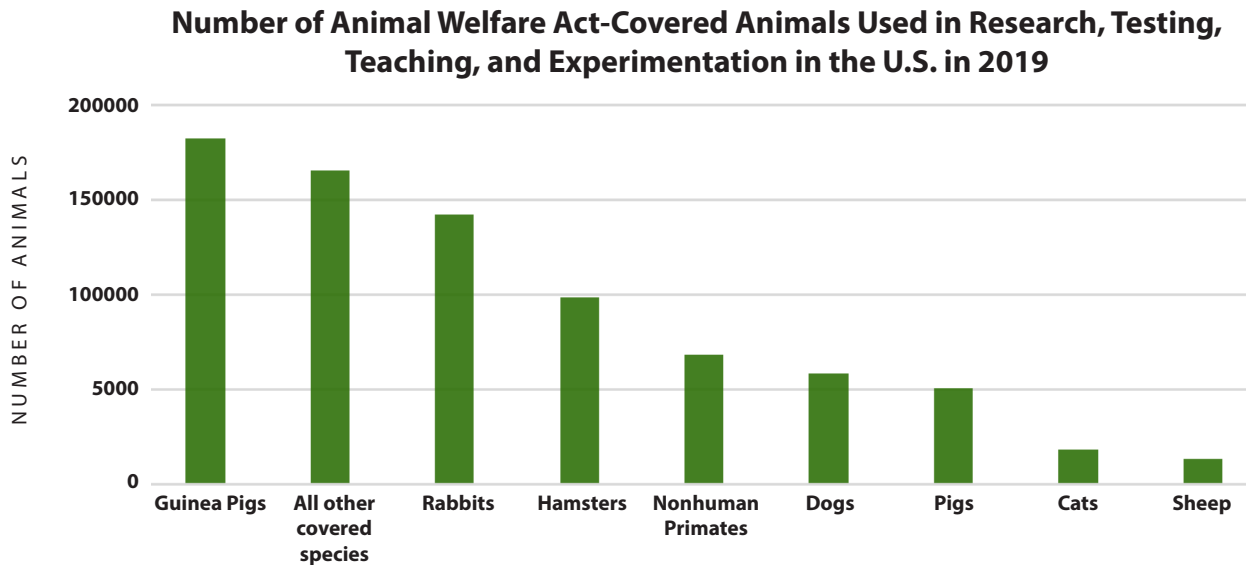
It is important to note that the AWA does not cover every type of animal used for these purposes. The following animals used in research are not covered: cold-blooded species (amphibians, reptiles, and fish), invertebrates (crustaceans, insects, etc.), birds, and mice and rats.

Research facilities using laboratory animals are required to submit annual reports on the numbers and types of AWA-covered animals used for research purposes during a given year.

The following pages contain animal use data from 2019. Answer the questions using the graphs provided.



Use the bar graph below to answer questions 1-2:

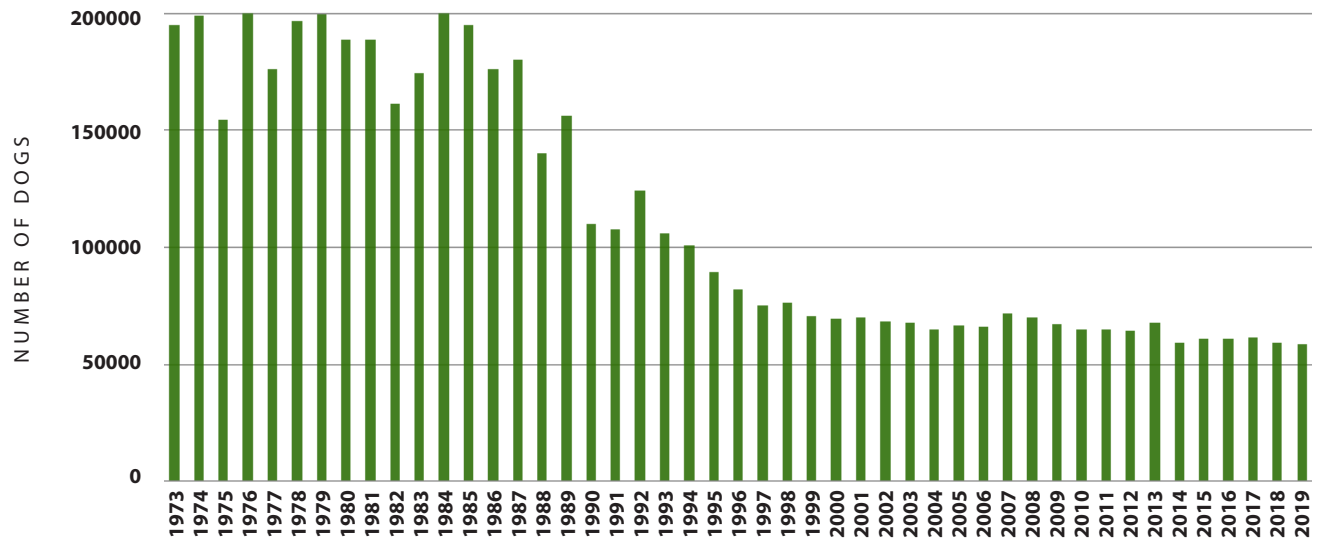


1. Approximately how many of the following animals were used in research in 2019?
 - a) Guinea pigs
 - b) Rabbits
 - c) Nonhuman primates
2. Approximately how many dogs were used in research in 2019?
 - 20,000
 - 40,000
 - 60,000
 - 80,000



Use the following graph to answer questions 3-4 about the use of dogs in science over time.

**Number of Dogs Used in Research, Testing, Teaching and Experimentation in the U.S.
1973-2019**



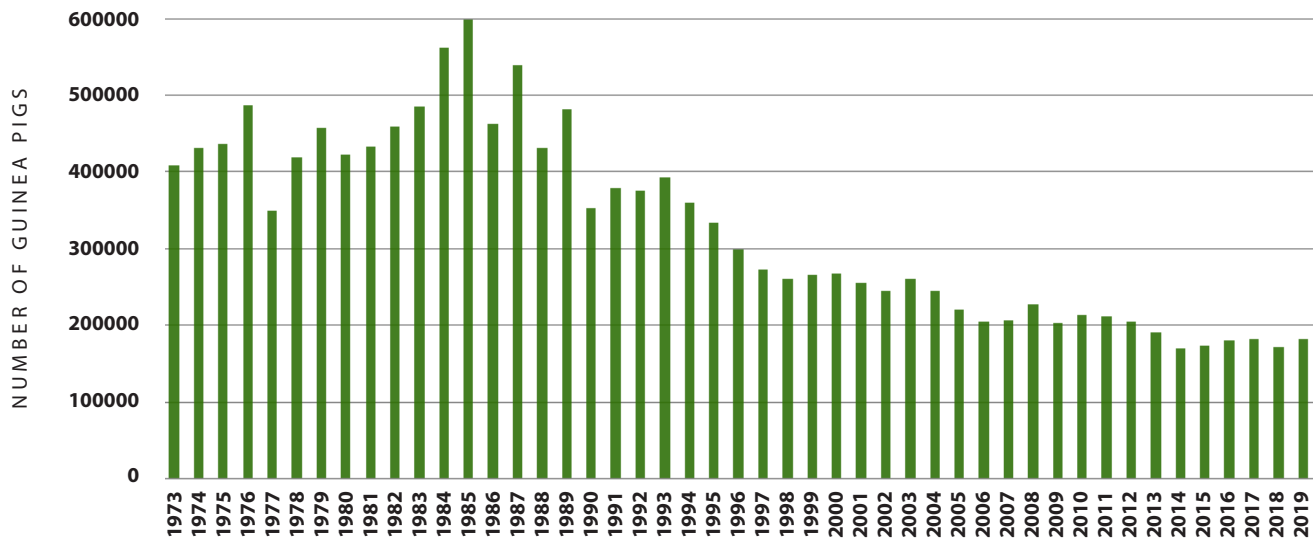
3. Of the following options, in what decade were the most dogs used in research?
 - 1980s
 - 1990s
 - 2000s
 - 2010s

4. How would you describe the trend regarding the number of dogs used in research from the 1980s to 1990s?
 - Significant increase
 - No change
 - Slight decrease
 - Significant decrease



Use the following graph to answer questions 5-6 about the use of guinea pigs in science over time.

**Number of Guinea Pigs Used in Research, Testing, Teaching, and Experimentation in the U.S.
1973-2019**



- In what year were the most guinea pigs used in research in the U.S.? _____
- What are the vertical (y-axis) scale increments for number of guinea pigs shown in this graph?
 - 10,000
 - 50,000
 - 100,000
- Compare the scale used in all three bar graphs.
Why do you think different scales are used in each graph?



Bonus questions:

Why do you think there has been a gradual trend for scientists to use fewer Animal Welfare Act-covered animals in research?

Compare the number of guinea pigs used in research to the number of dogs used in research. What do you think accounts for this difference?



Animals in Science

Graphic Interpretation

Answer Key

1. Approximately how many of the following animals were used in research in 2019?
 - a) Guinea pigs – **180,000**
 - b) Rabbits – **140,000**
 - c) Nonhuman primates – **70,000**
2. Approximately how many dogs were used in research in 2019?
 - a) 20,000
 - b) 40,000
 - c) 60,000**
 - d) 80,000
3. Of the following options, in what decade were the most dogs used in research?
 - a) 1980s**
 - b) 1990s
 - c) 2000s
 - d) 2010s
4. How would you describe the trend regarding the number of dogs used in research from the 1980s to 1990s?
 - a) Significant increase
 - b) No change
 - c) Slight decrease
 - d) Significant decrease**
5. In what year were the most guinea pigs used in research in the U.S.? **1985**



Animals in Science

Graphic Interpretation

Answer Key Continued

6. What are the vertical (y-axis) scale increments for number of guinea pigs shown in this graph?
- a) 10,000
 - b) 50,000
 - c) **100,000**
7. Compare the scale used in all three bar graphs. Why do you think different scales are used in each graph?

Answers will vary. Sample answers may include that it is important for a graph to fit into an allotted space and for trends in graphs to be observed. The magnitude of animal use is different for each graph, and each graph needs to clearly display a different range of animal use data. Different scales are necessary to best illustrate the data and make it as easy as possible to interpret in each case.

Bonus questions:

Why do you think there has been a gradual trend for scientists to use fewer Animal Welfare Act-covered animals in research?

Public support of animal research has been decreasing over time. Animal research is time consuming and costly. Scientists are developing alternatives to animal use for many areas of research.

Compare the number of guinea pigs used in research to the number of dogs used in research. What do you think accounts for this difference?

Guinea pigs are smaller and reproduce faster than dogs, so they are cheaper to feed and house. Also, the public and research community may have more ethical concerns with using companion animals like dogs in research.



Animals as Research Models: Pros and Cons

Watch the video available here: <https://www.youtube.com/watch?v=QwzofzcsaVw>

List the four pros and four cons to using animals as research models as highlighted in the video. Brainstorm an additional two pros and cons that you can think of regarding animal research.

PROS

CONS



Animals as Research Models: Pros and Cons

Answer Key

PROS

Animal models have previously been used to develop many drugs and treatments for human and animal ailments.

Animals are considered inferior, and it is better to test on them than on humans.

Animals are very similar to humans and can serve as good models that share many of our characteristics.

Animal testing saves money by preventing harmful drugs from going to human trials, which could result in lawsuits.

Animals can be used instead of vulnerable groups of people who have previously been exploited in research, such as the incarcerated and the impoverished.

Animal trials increase the likelihood that when drug testing proceeds to human trials it will be safe and effective.

Testing drugs on animals allows researchers to see how the whole body and its interactive organ systems respond to the drug.

Animals have shorter lifespans, so the progression of diseases or treatments can be observed across multiple life stages.

CONS

Testing on animals is cruel and makes them suffer.

Cruelty against any being cannot be justified.

Animals are not similar enough to people to make accurate models for testing. Some drugs that work on animals cause harm in humans, and some drugs that harm animals could be useful to humans.

Animal testing is time consuming and costly because it frequently yields results that fail in human trials.

Unlike adult humans, animals cannot give informed consent, so all procedures performed on animals are exploitative.

Approximately 90% of drugs tested in preclinical models, including animal models, fail in people. Approximately 60% of drugs that show promise in preclinical animal models fail in human clinical trials because of lack of effectiveness. An additional 30% of drugs fail because they are toxic to people.

Animal models don't take genetic difference among humans into account. Subtle genetic differences among humans can affect many aspects of disease risk and progression and the response a person might have to treatments.

It can take years or even decades for some diseases to occur in people. Many animal models are artificially induced to have these conditions within their shorter life spans, making the results difficult to translate to humans.



Applying the 3Rs

Scenario:

You have learned that your school's AP Environmental Science class is conducting an experiment on water toxicity by exposing live goldfish to varying levels of pollution. The students are asked to take five goldfish and expose each one to a different concentration of copper, observing their symptoms, which include distress, loss of coordination, lethargy, and death.

Take what you have just learned about the 3Rs principles to come up with suggestions for making the goldfish experiment more humane.

Replacement:

How can you replace the goldfish used in the experiment? Give examples of comparative substitution and absolute replacement.

Reduction:

How can you reduce the number of goldfish used in the experiment?

Refinement:

How can you refine the experiment so it is more humane?

Does this type of animal-based experiment help students and scientists determine how to reduce the impact of human activities on natural systems? Why or why not?



Applying the 3Rs

Answer Key

Scenario:

You have learned that your school's AP Environmental Science class is conducting an experiment on water toxicity by exposing live goldfish to varying levels of pollution. The students are asked to take five goldfish and expose each one to a different concentration of copper, observing their symptoms, which include distress, loss of coordination, lethargy, and death.

Take what you have just learned about the 3Rs principles to come up with suggestions for making the goldfish experiment more humane.

Replacement:

How can you replace the goldfish used in the experiment? Give examples of comparative substitution and absolute replacement.

Comparative substitution: Instead of using goldfish, use an invertebrate like nematodes.

Absolute replacement: Instead of doing a live experiment, find a computer simulation that models the effects of water pollution on fish or develop a toxicity test using cell lines rather than live goldfish.

Reduction:

How can you reduce the number of goldfish used in the experiment?

Instead of having each student run their own experiment, have students work in groups or have a single experiment for the entire class to observe.

Instead of using five goldfish for the experiment, have students use three or four.

Refinement:

How can you refine the experiment so it is more humane?

Before adding the contaminant to the water, add a dose of analgesics so the fish experience less suffering.

Does this type of animal-based experiment help students and scientists determine how to reduce the impact of human activities on natural systems? Why or why not?

Answers will vary.



Animal Use in Scientific Research

Product: Infographic, Poster, or Presentation

Directions

Scientific research uses many different types of animals for a wide variety of studies. In this mini-research project, you will select an animal that is commonly used in scientific research.

Explore the areas of research that use this animal model. For instance, is the species you chose commonly used for drug testing? Is this species used for consumer cosmetic or product testing? What other kinds of research use this animal model? Find examples of at least three different research areas that use this animal model. What models or approaches are available to help replace, reduce, or refine the use of this animal species in these research areas? Begin your search and see what you discover!

Use the scoring guide below to direct your research and the product you create to showcase your findings. You may choose the format of your project (infographic, poster, or presentation).

Target Course Competencies

Examine the use of animals in scientific research in the U.S.

Rating Scale

Value	Description
3	Work fully meets or exceeds criterion; product shows attention to detail and information is presented clearly and accurately
2	Work meets criterion adequately
1	Work is incorrect or incomplete
0	Work is missing or does not meet criterion

Scoring Standard

You must achieve a rating of at least "2" on each criterion to demonstrate competence.



Scoring Guide

Criteria	Ratings
Product identifies one key animal commonly used in scientific research.	3 2 1 0
Product identifies at least three different types of research that use this animal.	3 2 1 0
Product identifies how many animals are used in research in a year (list the year of reference).	3 2 1 0
Product describes how each of the 3Rs could be applied to research studies using that animal.	3 2 1 0
Product visuals and content details are appropriate for the audience.	3 2 1 0
Product includes citation of resources used in research and data.	3 2 1 0
Product follows an effective organizational plan.	3 2 1 0
Product follows an effective organizational plan.	3 2 1 0

