

Responsible Research Lesson Using Mock Review Boards

Author:

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Grades: 6-8

Subjects: Science

Overview:

This lesson was created to introduce middle school science students to the process researchers must navigate in order to complete scientific research using animal or human subjects.

Suggested Time Allowance:

Two 90-minute block periods or four 45 minute periods

Objectives:

Students will:

Gain an understanding of the Institutional Review Board approval process

Gain a new appreciation for the importance of regulated, responsible research.

Identify why animals are used in biomedical research.

Evaluate the positive and negative effects of biological research.

Resources / Materials:

PowerPoint Introduction

Student Handouts

[Research Proposal Evaluation Sheet](#)

4-Hypothetical Research Proposal

[Proposal 1](#) - Shampoo Lethality Levels in Common Brown Rats

[Proposal 2](#) – Using Shark Cartilage to Fight Breast Cancer

[Proposal 3](#) – Does In-ear Headphone Use Damage Sheep Ears?

[Proposal 4](#) – MTBE Pollution In Rivers

[Proposal 5](#) – Anesthetic Methods in Dog Neuter Surgery

[Proposal 6](#) – Air Pollutions’ Effects on the Circulatory System

[Proposal 7](#) – High Fat Diet on the Brain

Procedures:

Begin by dividing the class into “lab” groups of 5-6 students for the duration of this project.

Part One ~ PowerPoint Introduction

Do not give much of an introduction, other than telling the students they are going to be part of a review panel that decides if the research proposal at the beginning of the slideshow should be approved. The research proposal is pretty outlandish and probably won't be approved by the class as it is. Run the first part of the class reaction to the proposal as a modified Think-Pair-Share.

1. Begin the PowerPoint by reading the proposed research study to the class (slide 2)

2. Give students a few minutes, *on their own*, to come up with a list of reasons to accept or decline the proposal.
3. After a few minutes, have them share their ideas with their group.
4. After another few minutes, discuss as a class and compile a list of reasons to decline the project on the chalkboard. If you go through the PowerPoint in advance, you can see the actual criteria used to evaluate research and try to guide the student responses.
5. Once you have created a good list as a class, continue on through the PowerPoint and reinforce what a good job the kids did coming up with such a thorough list of criteria.

Note: About halfway through the slideshow, switch from a human research focus to using animals as the research subjects. This is done partly to touch on both human and animal models for research, and partly to use a slightly less emotionally charged topic for the bulk of the project. If you are running low on time, this is a good place to stop (slide 18) for the first class period.

Part Two ~ Animals as Research Subjects – Research Proposal Evaluation

1. Continue with the remainder of the slideshow. Near the end (slide 19), introduce the group portion of the project and briefly discuss the possible decisions the groups should make for their assigned proposals.
2. Remind the students, with the last slide, that the proposals they will be evaluating are hypothetical. The proposals do incorporate real scientific principles and areas of research that could almost be real, but none of the scenarios are based on any real study. Any similarities are purely coincidental or developed into current research after this project was designed.
3. When you're finished with the Slideshow, hand out the hypothetical research proposals to the groups. To save paper, make a class set of each handout and use for all classes. Student should be told not to write on the proposals.
4. Also hand out the Research Proposal Evaluation Sheets. Each student is responsible for turning in their own sheet, even though the work is done as part of the group.
5. Instruct students to take a few minutes to read the proposal to themselves or jump directly into reading and discussing as a group, depending on your time constraints.
6. End of hour two should have student working within their groups to evaluate the research proposal using each criteria on the evaluation sheet. They will likely need more time in hour three.

Part Three ~ Group Work

1. The beginning of day two of the block, or hour/class three of a shorter block should be allotted for student work time within their group. Groups should continue working through each criterion on the list and determining whether to accept, defer, or decline the proposal.
2. As student groups finish, have them answer the questions on the bottom of the evaluation sheet and begin preparing to present their decision to the class.

Part Four ~ Group Presentations

This section can be as short or as long as you wish. The important thing for the presentations is that the groups justify their decisions and that the class gets a decent overview of what the proposal wanted to do and why it was or wasn't acceptable.

Have students do the following during their presentations:

- Read the research proposal to the class as it was presented on a projector/overhead.
- Briefly discuss the positive aspects of the proposal.
- Briefly discuss the negative aspects of the proposal.
- State whether they accepted, deferred, or declined the proposal, as it was written.
- Suggest improvements to the proposed research to make it viable.

Evaluation / Assessment:

Students were graded on their completion of the research evaluation sheet and their contribution to the group discussion and presentation. You may want to have students complete an additional written response to the project.

Vocabulary:

Institutional Review Board
Institutional Animal Care and Use Committee
Research Proposal
Species
Scientific Method

Extension Activities:

In place of the student presentations, you may want to have students discuss the proposals in a Socratic seminar format. Begin by setting-up the seminar expectations. For example: "Address one another respectfully. Be respectful of people who are talking. Listen carefully. Present your own thoughts, but be willing to change your mind as new evidence is presented". Set-up the room by placing 7 chairs at the front of the room so that students will be facing each other (not the class) when they are sitting in the chair. Ask for 6 volunteers. Have students sit in the chairs facing each other and then let the 6 students respond to the first question, "Does the shampoo study from proposal on show a benefit to human or animal health, advancement of knowledge, or the good of society?" (Continue throwing open ended questions out as the conversation progresses) Students in the audience that want to make a statement or ask another question may take the 7th chair for a quick interaction with the seminar group. Students in the audience may also be given tasks during the seminar such as tally the number of times each student speaks, time how long each student speaks, or jot down main points made by each student. After about 5 minutes, call up a different set of 6 students to continue the seminar. Continue in this manner until all students have had a chance to participate in the seminar.

Interdisciplinary Connections:

Social Studies

Supporting Information on the Web

University of Pittsburgh's working IRB website - <http://www.irb.pitt.edu/>

Information about the IRB

http://www.ohsu.edu/xd/research/about/integrity/irb/about_irb_review.cfm

Institutional Animal Care and Use Committee information

<http://www.ohsu.edu/xd/research/about/integrity/iacuc/index.cfm>

Academic Content Standards:

SC.08.SI.02 Design a scientific investigation to answer questions or test hypotheses.

SC.08.SI.03 Collect, organize, and display sufficient data to support analysis.

SC.08.SI.04 Summarize and analyze data including possible sources of error. Explain results and offer reasonable and accurate interpretations and implications.

Future CCG Standards

Explain risks and benefits in personal and community health from a science perspective.

Understand the relationship that exists between science and technology.

Understand the process of technological design to solve problems and meet needs.

Research Proposal Evaluation Sheet

Title: _____

<input type="checkbox"/> Accept <input type="checkbox"/> Decline	<p>The study must show a benefit to human or animal health, advancement of knowledge, or the good of society.</p> <p><u>Comments:</u></p>
<input type="checkbox"/> Accept <input type="checkbox"/> Decline	<p>The animal species used in the study must be appropriate.</p> <p><u>Comments:</u></p>
<input type="checkbox"/> Accept <input type="checkbox"/> Decline	<p>The number of animals used in the study must be appropriate.</p> <p><u>Comments:</u></p>
<input type="checkbox"/> Accept <input type="checkbox"/> Decline	<p>There must be an attempt to limit the amount of discomfort, distress, pain, or death for the animals.</p> <p><u>Comments:</u></p>
<input type="checkbox"/> Accept <input type="checkbox"/> Decline	<p>The scientific methods used in this study will lead to valid data and will help to answer the research question.</p> <p><u>Comments:</u></p>

<input type="checkbox"/> Accept <input type="checkbox"/> Decline	Animal care/breeding must be performed and supervised by qualified people. <u>Comments:</u>
<input type="checkbox"/> Accept <input type="checkbox"/> Decline	Qualified scientists must do actual experimentation on living animals. <u>Comments:</u>
<input type="checkbox"/> Accept <input type="checkbox"/> Decline	The fate of the animals after the conclusion of the study must be justified. <u>Comments:</u>

Final Decision: Accepted Deferred Declined

Why did you choose to accept, defer, or decline this proposal? Be specific and site specific reasons from the guidelines above.

What changes or improvements should be made to this study?

Proposal One

Shampoo Lethality Levels in Common Brown Rats

Abstract:

Dandruff is caused by a small yeast fungus (*Malassezia sp.*) that is normally found nearly everywhere on the skin. In some people, either an increase of this yeast fungus or sensitivity to the yeast causes the skin to produce more skin flakes than normal, leading to the telltale white flakes on the scalp and on the shoulders. However, these flakes can also be caused by dry scalp.

While there are many different dandruff shampoos on the market, most use pyrithione zinc as the active ingredient to control the yeast outbreak. Unfortunately, pyrithione zinc has been shown in previous studies to be highly toxic to a variety of animals including fish, insects, rabbits, and mice, causing irreversible damage to the kidneys even at very low doses. This research study will attempt to determine if Flake-B-Gone® anti-dandruff shampoo poses a significant poisoning risk when absorbed through the skin.

Rats are being used in this study due to their similar hair structure to humans and because the density of hair follicle per square inch of skin is similar to most non-balding human adults. If toxic levels of pyrithione zinc are shown to enter the body through the skin, limiting or eliminating pyrithione zinc from shampoo may cause a decrease in cases of kidney disease in humans.

Proposed Experimental Procedure:

1. One million live rats will be used for the study; 500,000 adult males and 500,000 adult females.
2. Rats will be held in specially-designed, individual cages so that they will partially submerged in 100% pure Flake-B-Gone® shampoo at all times.
3. After thirty days in constant skin contact with the shampoo, the rats will be removed from the shampoo bath and rinsed in distilled water.
4. Once cleaned, the rats will be euthanized and dissected to have their kidneys removed.
5. Kidney tissue will then be tested for a presence of pyrithione zinc. Levels of .0005mg of pyrithione zinc per 1.0g of kidney tissue will be considered toxic.
6. Any rats that die before the end of thirty days in shampoo contact will not be used for the final study.

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Proposal Two

Using Shark Cartilage to Fight Breast Cancer

Abstract:

Breast cancer is the most common form of cancer in women (excluding skin cancer) and is the second leading cause of cancer deaths in women today. According to the World Health Organization, more than 1.2 million people will be diagnosed with breast cancer each year worldwide and over 500,000 will die from the disease. The American Cancer Society estimates that greater than 180,000 new cases of breast cancer will be diagnosed in 2008.

In order for cancer cells to flourish, they need a blood supply. Inside rapidly growing cancerous tumors, a special enzyme called MMP is responsible for the formation of the new blood vessels vital for the cancer to grow. This process of new blood vessel formation is called angiogenesis.

Sharks have long been suspected of being largely immune to certain forms of cancer. In particular, shark cartilage has been shown to contain powerful inhibitors of MMP (anti-MMP) that effectively halt the new blood vessel formation. The rationale for the use of shark cartilage in this study is based on the hypothesis that cartilage administered to animals and humans can introduce the anti-MMP, cancer-fighting chemicals into the body in high enough levels to stop the development of the blood supply for the cancerous tumor. While not necessarily a cure for cancer, positive results could lead the way to life-saving cancer treatments.

Proposed Experimental Procedure:

1. Shark cartilage for this study will be harvested from a single male, farm-raised leopard shark (*Triakis semifasciata*) grown specifically for this study.
2. Cartilage will be concentrated and mixed with MouseChow® pellets to be fed to common female lab mice (*Mus musculus*) as part of their daily diet.
3. Mice for this experiment will be injected with cancerous cells in the breast tissue and monitored until cancerous breast tumors form. Once testing positive, body scans showing the cancer tumor will be kept for comparison to later scans.
4. Two groups of female mice will be used in this study:
 - a. 8 female control mice that will be given standard MouseChow® containing no shark cartilage.
 - b. 8 female experimental mice that will be given experimental MouseChow® containing shark cartilage.
5. Weekly body scans of all mice will be compared to original scans to measure effectiveness at shrinking or stopping the growth of tumors.
6. The study will run for a period of 12 weeks, at which time, any mice still testing positive for cancer will be euthanized. Healthy mice will be re-checked at six months.

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Proposal Three

Does In-ear Headphone Use Damage Sheep Ears?

Abstract:

Increased use of in-ear-canal-style headphones with personal listening devices like MP3 players may be contributing to increased numbers of cases of hearing loss in humans, as compared to the standard exterior ear-bud-style headphone typically sold with MP3 players. In order to determine the danger these in-ear-canal-style headphones pose, this study will use yearling lambs (juvenile sheep) to test the hearing loss associated with headphones of different types.

Lambs are being used for this study because of the ideal size of the ear canal compared to humans. While the pinna, or outer ear flap is very large, the size and shape of the actual ear canal is nearly identical to adult humans. Over the course of the study, lambs will be subjected to Top40 music at a volume of 90 decibels for one hour periods three times each day for a period of four weeks.

In order to determine hearing loss, adult sheep warning calls (a very specific, threatening “baaaaaaa”) will be played at different volumes through lab speakers and the lambs’ responses will be monitored. If the lamb attempts to exit the restraint area, it will be counted as hearing the test sound. The volume the lambs can no longer hear the test sound will be compared to their minimum volume from before the test. Hearing loss will be defined as a decrease of 10% or more in hearing capacity throughout the study.

No significant health risk is expected with this study. Upon completion of this study, the lambs will be donated to a local petting zoo.

Proposed Experimental Procedure:

1. Four groups of eight lambs each will be divided as follows:
 - a. Experimental Group 1: Standard external ear-bud-style headphones at 90dB
 - b. Experimental Group 2: In-ear-canal-style headphones at 90dB
 - c. Control Group 1: Standard external ear-bud style headphones at 0dB (no music)
 - d. Control Group 2: In-ear-canal-style headphones at 0dB (no music)
2. Lambs will be fitted with a collar-mounted MP3 player and 90dB music will be played for one-hour periods, three times a day for experimental group lambs. Control group lambs will wear identical headphones and MP3 players, but no music will be played.
3. At the end of each week, lambs will be brought into the lab for their hearing test. The warning call noise will be played at increasing volumes until the lamb shows that he/she has heard the noise and attempts to follow the call. Data will be recorded for each lamb according to an individual identification number so results will be unique for each lamb throughout the study.
4. At the end of the study, data will be analyzed to determine the amount of hearing loss for each type of headphone. Lambs will be donated to a local petting zoo unharmed.

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Proposal Four

MTBE Pollution in Rivers

Abstract:

Methyl t-Butyl Ether (MTBE) is a popular and common gasoline additive that aims to reduce carbon monoxide pollution in automobiles. Recent speculation about possible pollution into the groundwater when gasoline that contains MTBE is spilled makes this study necessary. If MTBE does, in fact pollute groundwater, humans might be in danger.

When even small amounts of certain chemical are introduced into streams and rivers, one of the first species to die from the pollution is the stonefly. In this study, artificial streams containing Giant Stoneflies (*Pteronarcys californica*) will be subjected to MTBE at varying levels to determine if common MTBE levels associated with fuel spilling are a danger to the environment and, ultimately, human health.

Proposed Experimental Procedure:

1. Four artificial river aquariums with stonefly populations will be studied:
 - a. Experimental Group 1: MTBE normal spillage equivalent
 - b. Experimental Group 2: MTBE spillage ten times normal amount
 - c. Experimental Group 3: MTBE spillage 1/10 normal amount
 - d. Control Group 1: No MTBE spillage introduced to river system
2. Normal MTBE spillage will be defined as 150mg per week, according to the American Association of Gas Stations, the reputable, national agency for gas station operation.
3. Artificial river aquariums will each be 10m long and will include 3m of riverbank dirt on each side of the river. The population of stoneflies in each river will be sampled before the study begins.
4. At the beginning of each week, the amount of MTBE for each river will be added to the surface of the ground at the farthest spot from the water near the upstream end of the river.
5. MTBE levels in the river will be monitored by both chemical analysis of the water and by sampling the Giant Stonefly population. Chemical data for each river will be recorded daily, but stonefly data will be taken once a week to limit the disruption to the stream.
6. MTBE levels and stonefly populations will be graphed at the end of the study and compared to each other to determine the amount of MTBE needed to become toxic.
7. At the end of this study, river rocks will be washed in distilled water before being returned to the natural river and all insects and plant life will be euthanized, so as not to introduce any pollution back into the natural local rivers.

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Proposal Five

Anesthetic Methods in Dog Neutering Surgery

Abstract:

Spay and neuter surgeries in pets are an important but controversial method of preventing unwanted pet pregnancies. In order to limit the pain and suffering caused during these surgeries, many veterinarians insist on general anesthetic for the pets, versus simply injecting a local anesthetic to numb the pain. Some vets, however, argue that the pain is minimal and only a local anesthetic is necessary.

This study will determine whether post-surgery healing improves when a male dog is put completely under anesthetic for testicle removal surgery. The study will be done entirely through local veterinarian offices where their owners have brought in the dogs for surgery. One vet office uses general anesthetic (dog completely asleep for surgery) and one uses only a local anesthetic (injection to numb the area, but the dog stays awake). Dogs in both cases will be kept in an isolated cage for one week after the surgery to monitor healing.

Proposed Experimental Procedure:

1. Four groups of five dogs each will be used for this study:
 - a. Experimental Group 1: Testicles removed using local anesthetic only
 - b. Experimental Group 2: Testicles removed using general anesthetic
 - c. Control Group 1: Testicles not removed, but local anesthetic shot was given
 - d. Control Group 2: Testicles not removed, but dog was put under general anesthetic without surgery
2. Surgeries will be performed as normal for the experimental groups, according to their treatment as outlined above.
3. For the control group dogs, no surgery will be performed, but the anesthetic treatment outlined above will be given. Control groups are being used to eliminate reactions to the anesthetic itself from post-surgery health.
4. After surgery, or the control anesthetic, all dogs will be placed in protective collar cones and placed into individual caged kennels for observation. Protective collar cones will be used to prevent dogs from licking their wounds.
 - a. Dogs will be evaluated each hour for three hours after the surgery/anesthetic treatment. After that, Dogs will be examined each day. Observational data will be collected according to a positive or negative result for each of the following:
 - i. Infection
 - ii. Vomiting
 - iii. Diarrhea
 - iv. Fever
5. Data will then be compared between each of the four groups to determine if any noticeable improvement in post-surgery healing can be seen in one method of anesthesia.

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Proposal Six

Air Pollutions' Effects on the Circulatory System

Abstract:

Millions of people throughout the United States live in areas of unhealthy air pollution. These millions unwittingly breathe in high levels of ozone, carbon monoxide, fine particles, sulfur dioxide, nitrogen dioxide or lead. On average, humans breathe in about 6 to 10 liters of air every minute (that's 5 two-liter soda bottles/minute). This air flows into tiny sacs called alveoli in the lungs. If the alveoli were spread out, they would cover 600 to 900 square feet of surface area. Air pollution has long been known to cause harm to the lungs, but scientists are beginning to see signs that pollution may also harm the circulatory system.

Paper thin blood vessels called capillaries line the alveoli collecting the oxygen and pollutants we breathe in. What effect does this now polluted blood have on the circulatory system? Initial experiments are showing that air pollutants may have an effect on the arterioles. Arterioles are blood vessels that distribute blood from the arteries to the capillaries. To regulate the flow of blood, the arterioles' flexible walls will continually dilate and constrict. Arterioles relax or dilate when a molecule called nitric oxide is released between healthy tissues. The arterioles ability to respond to nitric oxide is what scientists will use to measure the effect of air pollution on the circulatory system.

This study will examine the effects of air pollutants on the arterioles' ability to respond to nitric oxide in dogs. Dogs were chosen due to their keen sense of smell. Scientists are curious to see if air pollution will affect a dog's ability to track scents.

Proposed Experimental Procedure:

1. Thirty live dogs will be used for this study.
 - a. 25 dogs – experimental group
 - b. 1 dog – control group
2. The experimental group will be exposed to pollutant particles less than 2.5 micrometers in diameter (a size that can be inhaled deeply into the lungs) of oily soot.
3. The control group will be housed in a room equipped with a Bedford 2000 air filter. These filters are used in manufacturing clean rooms.
4. Both groups will be given daily care and feeding necessary for their comfort. Dogs will need to stay in their respective rooms for the duration of the study.
5. After 6 months, the back muscle (trapezius) of each dog will be injected with .2mg of nitric oxide. Ultrasound measurements will be taken of the arterioles' response to the nitric oxide.
6. If a difference in the dogs' muscle arteriole response is noted, then all dogs will be placed in the clean-air environment and tested again after 6 months. This added study would be to see if diminished arteriole responses can be reversed.
7. Once the study is finished, dogs will be returned to the lab's general population.

Inspired by *Science News*. "Inhaled Particles Damage Vascular Lining". December 4, 2004. pg. 365.

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Proposal Seven

High Fat Diet on the Brain

Abstract:

It is well known that a high fat diet has detrimental effects on the waistline as well as on a person's health. High fat diets are associated with increased risk for diabetes and cardiovascular diseases. Little is known, however, about the effects of fat on the brain. Preliminary studies indicate a possible correlation between a high fat diet and diminished memory and learning. Government regulators of school cafeterias expressed great interest in any experimental findings associated with diet and learning.

The focus of this study will be the hippocampus – the part of the brain associated with memory and learning. Mice will be used as the animal model for this study due to the well known fact that mice metabolize fat much like humans. Mice will be subdivided by gender due to recent research showing fat metabolism to be gender specific.

Proposed Experimental Procedure:

1. One hundred mice will be divided into the following subgroups
 - a. Experimental Group 1 – 50 male mice fed a high-fat chow with 45 percent of calories coming from fat
 - b. Experimental Group 2 – 25 female mice fed a high-fat chow with 45 percent of calories coming from fat
 - c. Control Group 1 – 15 male mice fed normal chow with 13.5 percent of calories coming from fat
 - d. Control Group 2 – 10 female mice fed normal chow with 13.5 percent of calories coming from fat
2. Mice will be weighed and measured to determine their baseline size and weight.
3. Mice will be fed their respective diets for 9 – 12 months. Besides diet, all other living conditions will be kept the same between groups. Mice will be cared for by the lab's animal technicians.
4. At the end of 12 months, mice will be trained and scored on how well they learn to avoid an electrically charged mat. Mice will also be scored on how well they remember their training. Testing will be conducted over a 2-week period.
5. Mice memory will further be tested by having each mouse work a maze. Mice will not be given food for a day to ensure that they are hungry during the test, and then placed in a maze with food at the end as an incentive.
6. During this two week period, all mice will be evaluated for changes in their weight to determine if the stress of training has an effect on their weight.
7. At the end of testing, mice will be sacrificed to examine the hippocampus. Tests will be run on the hippocampal cells to determine responsiveness to electrical stimuli. A strong hippocampal cell response will indicate cementation of new experiences into long-term memory. Direct hippocampus testing will give credence to the previous training tests.

Inspired by *Science News*. "High-fat diets slim down learning". November 6, 2004. pg. 302

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