LErruonna C3–1: Pathology

<table>
<thead>
<tr>
<th>Instructional Time</th>
<th>5 days</th>
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<tbody>
<tr>
<td>Laboratory Time</td>
<td>3 days</td>
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<tr>
<td>NGSS Performance Expectations</td>
<td>HS-LS2-2</td>
</tr>
<tr>
<td>Common Core State Standard</td>
<td>CCSS.ELA-Literacy.RST.11-12.5</td>
</tr>
<tr>
<td>National AFNR Standards</td>
<td>AS.07.01.03.a, AS.07.01.03.b</td>
</tr>
<tr>
<td>Essential Question</td>
<td>What are the causes of a disease, its spreading, and a body’s response?</td>
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<tr>
<td>Student Learning Objectives</td>
<td>At the conclusion of this lesson, students will be able to:</td>
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<td>1. Describe the various types of animal pathogens and the diseases they cause.</td>
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<td></td>
<td>2. Illustrate how diseases are spread.</td>
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<td></td>
<td>3. Analyze animals’ immune responses to antigens.</td>
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</table>

ENGAGING Activities: Teacher

1. Prior to class, apply Glo Germ™ (or a comparable product) to a few objects, such as a Frisbee™ and a Nerf ball. Without informing the students about the reason why, have them play catch or pass the objects around the room. Afterward, inform them that the objects were infected with pathogens. Then, turn off all of the lights, and use a UV lamp to illuminate the Glo Germ™ around the room. Ask students to inspect their hands and surrounding surfaces. Generate a discussion regarding the transmission of pathogens. Ask them what they would recommend to minimize or prevent illness in livestock and pets.

2. Make forehead thermometers (or comparable) available to the students. Assign the “Body Temperature” activity.

ANSWER KEY for “Body Temperature”

Answers will vary per class on the first four questions. Question five (“Why might a veterinarian take note of an animal’s temperature?”) should have similar responses that should include:

- Normal temperatures indicate a healthy animal.
- Lower/higher temperatures reflect illness.
- High temperatures may need immediate action (medication and/or methods to cool down the animal).
After each group of students has completed the activity’s questions, discuss the answers to the questions. Lead a classroom discussion regarding the use of vital signs in monitoring animal health.

### Exploring Activities: Teacher

**Lesson description; materials needed / probing or clarifying questions; students think, plan, investigate, and then organize collected information; rubrics**

1. Ask the students to come up with questions that must be answered to demonstrate a mastery of animal pathology. List the questions provided for all to see. Lead a discussion during which the students group similar questions, and help them prioritize the questions in terms of which need to be answered first. Keep this list readily available, and refer to it as the lesson proceeds.

2. Assign the reading of the corresponding E-unit.

3. Have the students design a lab to expand their understanding of animal pathology. Suggested research topics include:
   - Animal illnesses and their impact on vital signs
   - Handwashing effectiveness (using Glo Germ™ to demonstrate)
   - Local biosecurity measures

4. Conduct the lab activity, “Effectiveness of Antiseptics, Disinfectants, and Antibiotics.”

### TEACHER NOTES for “Effectiveness of Antiseptics, Disinfectants, and Antibiotics”

**Helpful Hints:**

- The bacteria grown in this lab will come from soil. This is used to minimize the risk of growing pathogenic bacteria, but please ensure that students follow directions and use care when handling the materials. Make sure they wash their hands before and after the lab. Upon completion of the lab activity, a bleach solution should be used to soak (for at least two hours) the petri dishes and other items that come in contact with the bacteria. Non-glass items can be disposed of in the trash. Use a disinfectant to clean all surfaces utilized for this experiment.

- Prepared petri dishes (media plates) with agar can be ordered via Carolina Biological Supply or another similar source. Go to [https://www.carolina.com/prepared-biological-media/nutrient-agar-prepared-media-plates-100-x-15-mm-pack-of-10/821862.pr?question=agar+plates](https://www.carolina.com/prepared-biological-media/nutrient-agar-prepared-media-plates-100-x-15-mm-pack-of-10/821862.pr?question=agar+plates) to see pricing options. Alternatively, you can make your own agar plates using online guides. Try the instructions given on the SCIENCING website at [https://sciencing.com/make-agar-plates-5563283.html](https://sciencing.com/make-agar-plates-5563283.html).

- To create the soil solution, add about 1 teaspoon of soil to 1 cup of water. Stir it thoroughly. (Some soil will settle, which is fine.)

- The antiseptics, disinfectants, and antibiotics can be sourced from commonly used items in a medical supply kit, or you can have each student bring a specific substance to share from home. Alcohol, hydrogen peroxide, and store-brand disinfectants are fairly inexpensive. If using any materials in a spray form, make sure the students use paper folded into a triangle to shield the area they are spraying. If the substance gets into another area, it could alter the findings.
• If petri dishes are not stored upside down, condensation may form, drip onto the agar, and impact the activity.
• If you don’t have filter discs, substitute coffee filters. Use a hole puncher and scissors to mimic the discs.

**Anticipated Findings:**

Bacterial growth is apparent by white or cloudy areas. If the area around the disc is clear, the antiseptic, disinfectant, or antibiotic inhibited bacterial growth. The larger the clear area (zone of inhibition), the more effective the product. If bacterial growth was only slowed, the area might be lightly clouded. The control areas should have white or cloudy patches throughout with no zones of inhibition. Use a light source, if necessary, to view the zones of inhibition.

**Ideas for Additional Experiments:**

Students could replicate the experiment to test and compare additional antiseptics, disinfectants, or antibiotics. Replicating the experiment will also provide the opportunity to improve upon the processes and procedures used initially. Students could determine the most effective products/ingredients after the use of several different antibacterials.

A lab report is assigned in the next section. Assess the completed lab report for “Effectiveness of Antiseptics, Disinfectants, and Antibiotics” using the “Lab Report Scoring Rubric” provided, or modify the scoring rubric for your particular class.
## Lab Report Scoring Rubric

<table>
<thead>
<tr>
<th>Possible Points</th>
<th>Sections</th>
<th>Section Score</th>
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<tbody>
<tr>
<td>5</td>
<td>Title:</td>
<td></td>
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<tr>
<td></td>
<td>✓ The title is concise and appropriate.</td>
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<tr>
<td>10</td>
<td>Introduction:</td>
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<tr>
<td></td>
<td>✓ The research problem is defined.</td>
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<td></td>
<td>✓ The objectives and purpose of the lab are clearly explained.</td>
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<td></td>
<td>✓ The hypotheses are clearly stated (and logical).</td>
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<tr>
<td>20</td>
<td>Procedures or Methods:</td>
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<td></td>
<td>✓ The procedure of the lab is stated with sufficient clarity to allow its replication.</td>
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<tr>
<td>25</td>
<td>Findings or Results:</td>
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<td></td>
<td>✓ Data generated from the research is well presented.</td>
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<td></td>
<td>✓ Tables, graphs, or similar summary formats are used effectively.</td>
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<tr>
<td>15</td>
<td>Conclusions:</td>
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<td></td>
<td>✓ The meanings of the results are clearly explained and supported by the data collected.</td>
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<td></td>
<td>✓ Conclusions include results of the hypotheses initially stated for the study.</td>
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<td>10</td>
<td>Recommendations:</td>
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<td></td>
<td>✓ Suggestions are provided that would implement findings and/or further research.</td>
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<tr>
<td>5</td>
<td>References:</td>
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<tr>
<td></td>
<td>✓ Citations and references adhere to the proper format.</td>
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<tr>
<td>10</td>
<td>Presentation:</td>
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<tr>
<td></td>
<td>✓ Spelling and grammar are correct.</td>
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<td>✓ The overall appearance is attractive.</td>
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<td></td>
<td>✓ The report is clear and concise.</td>
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<td></td>
<td>✓ The report reflects thoughtful scientific inquiry.</td>
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<thead>
<tr>
<th>Total Score</th>
<th>F</th>
<th>D</th>
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<th>B</th>
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<td>60–69</td>
<td>70–79</td>
<td>80–89</td>
<td>90–100</td>
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</table>
### Key Terms Defined:

- **adaptive immunity**: a body’s defense mechanism for fighting unknown antigens
- **antibody**: a defensive protein produced to attack specific antigens
- **antiseptic**: a substance applied to the skin that kills or prevents the growth of pathogenic microbes
- **bacterium**: a one-celled microorganism that lacks a true nucleus
- **biosecurity**: a set of procedures for protection against harmful biological or biochemical agents
- **disinfectant**: a cleaning substance that destroys the microbial causes of disease
- **fungus**: a spore-forming organism that feeds on living matter
- **immunity**: the ability to resist a disease
- **infectious disease**: a type of disease that can be spread through the environment
- **innate immunity**: a natural, biological aversion or barrier to certain antigens
- **noninfectious disease**: a noncommunicable disease that cannot be spread through the environment
- **pathogen**: a disease-causing agent
- **protozoan**: a parasitic, single-celled microorganism that can only multiply within a host organism
- **species immunity**: the immunity of a specific species to a disease
- **vaccination (immunization)**: the act of providing an immunity to specific antigens, artificially
- **vaccine**: an artificially-produced, antigen-based substance designed for the body’s production of antibodies and immunity to a disease
- **virus**: a microorganism that can only multiply in living cells and is composed of RNA or DNA surrounded by a protein sheath

### Helpful Hints for “The Spread of Infectious Diseases”

- Separate students into groups for the second section of this activity.
  - Provide a plastic spoon for each student.
  - One ping pong ball should go to each group.
– Before handing out the spoons, create designated racing and relay areas (with obstacles). Otherwise, mayhem will surely ensue.

• You will need a bubble liquid and a bubble wand (or a set of small Nerf balls) for the third section of this activity. Make sure to stop creating bubbles or throwing Nerf balls after 30 seconds.
• Provide a box of tissues and antibacterial wipes for you and the students to wipe off with afterwards.
• Lead a discussion after each section of the activity. Discuss the spreading of the disease and its relation to the real-life pathology of animal diseases.

ELABORATING
Activities: Teacher

(Application and extensions; give students the opportunity to expand and solidify their understanding of the concept and/or apply it to real-world situations)

1 Assign the reading of a related Agricultural Career Profile (http://www.mycaert.com/career-profiles).

2 Assign the “Animal Disease Research” activity. Have students prepare a written report to support an oral report of their findings. Encourage the use of pictures, graphs, and other media.

EVALUATING
Activities: Teacher

(Summative assessment: scoring tools)

1 Assign the “Checking Your Knowledge” questions from the related E-unit, and grade the answers.

ANSWER KEY for “Checking Your Knowledge”

<table>
<thead>
<tr>
<th>Part One: Matching</th>
<th>Part Two: Completion</th>
<th>Part Three: True/False</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. d</td>
<td>1. active</td>
<td>1. F</td>
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<tr>
<td>2. j</td>
<td>2. Diseases</td>
<td>2. T</td>
</tr>
<tr>
<td>3. b</td>
<td>3. Pneumonia</td>
<td>3. F</td>
</tr>
<tr>
<td>4. f</td>
<td>4. protozoan</td>
<td>4. T</td>
</tr>
<tr>
<td>5. i</td>
<td>5. contagious</td>
<td>5. T</td>
</tr>
<tr>
<td>6. c</td>
<td>6. biosecurity</td>
<td>6. F</td>
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<td>7. e</td>
<td>7. Tetanus</td>
<td>7. T</td>
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<tr>
<td>8. a</td>
<td>8. isolation</td>
<td>8. F</td>
</tr>
<tr>
<td>9. g</td>
<td>9. susceptible host</td>
<td>9. F</td>
</tr>
<tr>
<td>10. h</td>
<td>10. New</td>
<td>10. T</td>
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</tbody>
</table>

2 Administer a written test to determine mastery of terms and concepts. A sample test has been provided in “Assessing What You’ve Learned.”
1. **How does an infectious disease differ from a noninfectious disease?**

   An infectious disease is a type of disease that can be spread through the environment. Infectious diseases are contagious, which means that they can be passed from one animal to another by direct or indirect contact. In contrast, a noninfectious disease is a noncommunicable disease that cannot be spread though the environment.

2. **Why is the early detection of an animal’s illness so important?**

   Early detection and isolation will help to prevent, or at least minimize, the spread of disease, since contagious diseases can be spread from simple contact, water and food sources, or shared facilities. Additionally, early detection and treatment can lead to a quicker recovery. Late detection increases the likelihood of a larger loss in profitability, since the disease can result in death, a reduction in productivity, or an increased use of medicine.

3. **Describe the disease triangle.**

   Infectious diseases are spread through the environment. It takes three components to create the perfect situation for a pathogen to infect an animal. This is referred to as the disease triangle and includes a susceptible host, the presence of a pathogen (causal agent), and favorable environmental conditions.

4. **What types of practices are included in biosecurity measures, and why are they important?**

   **New Animals:**
   - New animals should be isolated (quarantined), for the first 30 days to monitor their health status.
   - If they are immediately commingled with the other animals, any pathogens become a group problem.

   **Visitors:**
   - Visitors should have restricted access to the property.
   - Farmers who visit have been exposed to other animals. Visitors who travel to other countries may have come in contact with diseases that are exotic to the United States. Therefore, visitors should have clean clothes and boots, and they should utilize shower-in/shower-out procedures before entering or exiting a facility.
   - Other unwelcome guests, such as rodents, birds, or other wildlife can also carry pathogens. Feed containers and livestock facilities should be inaccessible to other animals.
   - Proper cleanliness and disinfection can help reduce rodent populations.

   **Importance:**
   - Biosecurity is a set of procedures for protection against harmful biological or biochemical agents. The use of biosecurity reduces the likelihood that a pathogen will be carried from place to place by people, clothing, animals, equipment, or vehicles.
5. **What are innate and adaptive immunity? Include the three types of innate immunity and the two categories of adaptive immunity.**

Innate immunity is a natural, biological aversion or barrier to certain antigens. Also referred to as natural immunity, this is when an animal’s immunity to a specific disease is inherited genetically, as from a parent. Species immunity, breed resistance, and individual resistance are the three types of natural immunity.

Adaptive immunity is a body’s defense mechanism for fighting unknown antigens. In adaptive immunity, animals establish immunity to a specific disease through exposure, and then their bodies produce their own antibodies to fight off the disease. Also referred to as acquired immunity, adaptive immunity can be further divided into two categories, passive and active.
Body Temperature

Instructions: With a partner, use the provided thermometers to read and record your body temperatures. Record the data on the classroom’s whiteboard. After all classmates have recorded their data on the whiteboard, work with your partner to answer the following questions.

1. What are the lowest and highest temperatures recorded?

2. What are the mean, median, and mode of the body temperatures of your classmates? [NOTE: The mean is the average. The median is the middle number. The mode is the number that occurs most often.]

3. Do any of your classmates’ temperatures fall outside of the normal range (97.7°F to 99.5°F)? What may be the cause of this abnormality?

4. What can you infer from the data as a whole?

5. Why might a veterinarian take note of an animal’s temperature?
Effectiveness of Antiseptics, Disinfectants, and Antibiotics

PURPOSE

The purpose of this activity is to test the effectiveness of common antiseptics, disinfectants, and antibiotics upon the growth of bacteria.

OBJECTIVE

Identify the antiseptics, disinfectants, and antibiotics that are most effective in impeding the growth of bacteria by measuring zones of inhibition on bacterial culture plates.

MATERIALS

- antibacterials (minimum of 2 each): antiseptics, disinfectants, and antibiotics
- beakers or cups (8 or more to hold each liquid material)
- cotton swabs
- disposable gloves
- distilled water
- filter discs (paper)
- forceps (or tweezers)
- incubator
- isopropyl alcohol
- markers
- masking tape
- paper towels
- pipette (or eyedropper)
- prepared petri dishes with agar and lids (3 per group)
- ruler (with millimeters)
- soil solution
PROCEDURE

1. Follow the instructions carefully, and use exceptional care as you will be handling bacterial cultures. Use disposable gloves, and wash your hands before and after the lab. Use masking tape and a marker to label each beaker (or cup) for the liquid inside. These beakers should include distilled water, alcohol for disinfecting your forceps, and two of each antibacterial subset.

2. Split into groups per teacher instructions. As a group, develop hypotheses for the outcome of this experiment. Record your hypotheses in the area provided.

3. Each group of students should acquire three petri dishes with agar.

4. On the bottom of each petri dish, divide the plate into thirds with your marker. Label one area with a “C” for control, another area with a “#1” for an antibacterial, and the final area with a “#2” for a different antibacterial. You will use one type of antibacterial per dish, but two different options of that antibacterial. Write “Antiseptics” on the bottom of one petri dish, “Disinfectants” on another, and “Antibiotics” on the third petri dish. [EXAMPLE: In the Antiseptics dish, you might be using povidone iodine in area #1 and hydrogen peroxide in area #2. You wouldn’t use Lysol®, because it’s a disinfectant.]

5. Open a petri dish, and add 2 drops of the soil solution to the center of the dish. Using a clean cotton swab, gently spread the soil solution uniformly across the entire culture plate. Repeat for the other two petri dishes. The moist soil provides bacteria that can grow on the agar. The agar solidifies, allowing you to later turn the dishes upside down.

6. Using clean forceps, pick up a single filter disc by the edge, and dip it in and out of a beaker (or cup) of distilled water. Allow the excess liquid to drain off, and then place the disc in the center of section C of the first petri dish. Press the disc against the surface of the soil/agar mixture with your forceps to ensure good contact. Repeat this step for the 2nd and 3rd dishes. Clean your forceps with alcohol, drying them thoroughly with a paper towel.

7. Pick up one filter disc by the edge using clean forceps, and dip it in and out of one of your antiseptic beakers. Allow the excess liquid to drain off, and then place it in the center of area #1 (in the Antiseptics dish). Press the disc against the surface of the soil/agar mixture with your forceps to ensure good contact. Clean your forceps with alcohol, drying them thoroughly with a paper towel. Repeat this step with the next antiseptic in area #2. Record the names of the antiseptics used in each area in the chart provided. Again, clean your forceps with alcohol, drying them thoroughly with a paper towel.

8. Follow the step above with the Disinfectants and Antibiotics dishes, using the appropriate substances for each dish.

9. Place a lid on the petri dish. Using masking tape, place tape all the way around the outer edge of the petri dish to seal the lid. Do not place any tape across the top or bottom of the dish (you need to see the labels and bacterial growth). Write your group name and dish name (such as The Pathology Pack: Antibiotics) on the tape for easy identification.
10. Place each of your dishes upside down (lid on the bottom and agar on top) in the incubator or another designated warm place. [Check with your teacher if the liquid/agar mixture is not firm enough to turn upside down.]

11. After at least two days, you will examine the bacterial growth that occurred (without opening the dish lids). The control areas in each of the petri dishes should show relatively uniform bacterial growth over the surface area.

12. If the antiseptic, disinfectant, or antibiotic that your group tested was effective, then zones of inhibition (bacteria-free zones) should be well defined. Generally, bacterial surfaces will look white or cloudy.

13. Measure the diameter of the zones of inhibition (this includes the discs) for each labeled area of the petri dishes. Record your results in millimeters. [NOTE: Areas of bacterial growth should be white and/or cloudy, but might present differently. Consult your instructor if you have questions.]

Hypotheses:

Results:

<table>
<thead>
<tr>
<th>Antiseptics Petri Dish</th>
<th>Zone of Inhibition (mm)</th>
<th>Other Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#1 Antiseptic Name:</td>
<td></td>
<td></td>
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<tr>
<td>#2 Antiseptic Name:</td>
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</tr>
<tr>
<td>Disinfectants Petri Dish</td>
<td>Zone of Inhibition (mm)</td>
<td>Other Notes</td>
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<tr>
<td>Control</td>
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<tr>
<td>#1 Disinfectant Name:</td>
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<tr>
<td>#2 Disinfectant Name:</td>
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<table>
<thead>
<tr>
<th>Antibiotics Petri Dish</th>
<th>Zone of Inhibition (mm)</th>
<th>Other Notes</th>
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<td>Control</td>
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<tr>
<td>#1 Antibiotic Name:</td>
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<tr>
<td>#2 Antibiotic Name:</td>
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</table>

Record a summary and explanation of the findings. Include reasons your hypotheses were correct or incorrect.
The Spread of Infectious Diseases

Instructions: Follow the exercises in Parts 1, 2, and 3 to visualize the transmissible abilities of a disease. The instructor will provide you with any necessary equipment.

Part 1: Direct Contact

Wander around the room while shaking hands with other students for 30 seconds. One student will have been secretly selected by the instructor as a carrier of a contagious disease. This student will give a two-pump squeeze to the hand of other participants during the handshakes. If your hand is pumped twice, make sure you pump twice when shaking the next person’s hand.

After 30 seconds, raise your hand if you received a two-pump handshake. Look around the room. How many others have a hand up? How does this demonstration relate to public interactions? Have a class discussion with the teacher regarding how this applies to animals and the techniques available for disease prevention when animals have direct contact.

Part 2: Indirect Contact

Divide into groups. Designate a race course, perhaps around the classroom or from end to end. Make sure to involve obstacles that you have to walk around, over, or under. While holding a spoon with a ping pong ball, your group will race in a relay.

Each group will go separately and be timed. Follow the outlined course. With your group spread along the course, the first person will walk carefully (with a ball on their spoon) from the beginning spot to the next group member. Once the next teammate is reached, the ball is transferred to that teammate’s spoon. If the ball falls, you can pick it up, but you are considered infected and must walk slowly through the rest of the course. Once the ball reaches the last teammate, all others will shift back one spot on the course. The ball will then need to be transferred back through teammates in the same manner until it reaches the beginning mark again. Write down the time on the board, deducting 10 seconds for every “infected” person on the team. The fastest time (minus deductions) wins.

In this activity, only the person who touched the ball got sick. If the ball is the pathogen, what happens when it was dropped and picked up by another person? How quickly could a disease spread through indirect contact on a bus, a train, or in a public bathroom? Have a class discussion with the teacher regarding how this applies to animals and the techniques available for disease prevention in areas where animals have indirect contact. Discuss the differences between direct and indirect contact.
Part 3: Airborne Contact

In this demonstration, your teacher will blow bubbles or throw Nerf balls toward the class. Each time a bubble or ball lands on a student, that student will have become infected with an airborne pathogen. After 30 seconds, if you were infected, raise your hand.

Look around the room. How many others have a hand up? How does this demonstration relate to airborne diseases? Have a class discussion with the teacher regarding how this applies to animals and the techniques available for disease prevention when animals are dealing with airborne pathogens. Discuss the differences between direct, indirect, and airborne contact with pathogens.
Animal Disease Research

Instructions: Identify an animal disease that interests you. It might be a disease that is prevalent locally or familiar to you. Research the disease, and prepare a report. Be sure to provide answers to the following questions in your report.

1. What is the causal agent (pathogen or antigen) of the animal disease?
2. What species are the primary hosts of the disease?
3. What are the symptoms of the disease?
4. What environmental conditions favor the causal agent?
5. Explain the disease cycle, including contagious periods if it is infectious.
6. How does the disease spread?
7. How can the disease be managed?
8. What is the potential for an economic loss to a producer from the spreading of this disease?
Assessing What You’ve Learned

ESSAY QUESTIONS

Instructions: Provide a detailed explanation of the processes or principles in answering the following.

1. How does an infectious disease differ from a noninfectious disease?
2. Why is the early detection of an animal’s illness so important?
3. Describe the disease triangle.
4. What types of practices are included in biosecurity measures, and why are they important?
5. What are innate and adaptive immunity? Include the three types of innate immunity and the two categories of adaptive immunity.