

Our Body's Response to Infectious Diseases

**A Middle School Unit on Infectious Diseases
and the Immune System**

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OUR BODY'S RESPONSE TO INFECTIOUS DISEASES

OVERVIEW: This unit, written for grades 5 – 8, gives students an introduction to infectious diseases and the immune system. Part 1 on infectious diseases, starts with finding out what students already know by having them take a pretest and fill out a KWL chart. They will discover the source of the cholera epidemic that broke out in London in 1854, learn about scientific contributions made by Lister, Pasteur and Koch, be able to identify different types of pathogens that cause infectious diseases, explain how a pathogen can enter the body, explain how infectious diseases spread and be able to describe some strategies for staying healthy. Students will conduct two experiments, watch several demonstrations, listen to a guest speaker from the Infectious Disease Department and to a medical technologist from the Immunology Department at the University of Vermont's Medical Center, research an infectious disease and create a pathogen model.

Part 2 on the immune system covers the first, second and third line of defense used by the body to defend itself from pathogens. Students will conduct an experiment to understand how the skin acts as a barrier, participate in an activity showing how antigens and antibodies fit together, develop skits that show each of the body's lines of defense and design a poster with their group about how to stay healthy. The unit will end with a visit to the University of Vermont's Medical School.

RATIONALE: I feel that it is highly important for students to have a good understanding of how their bodies protect them from infectious diseases. To be able to do this, they must first understand how infectious diseases can affect them. With new viruses cropping up all the time and with over 22 million already dead from AIDS, it is essential to educate kids about these dangers. Students will be able to make healthier lifestyle choices if they have knowledge in these areas.

VERMONT STANDARDS AND EVIDENCES:

7.14 Human Body: Students demonstrate understanding of the human body – heredity, body systems, and individual development – and understand the impact of the environment on the human body. This is evident when students:

cc. Provide examples of how the health of human beings is affected by their genetic makeup and environmental factors (e.g., exposure to microbes, pollution)

2.2 Problem Solving Process: Students use reasoning strategies, knowledge, and common sense to solve complex problems related to all fields of knowledge. This is evident when students:

aa. Seek information from reliable sources, including knowledge, observation, and trying things out;

bb. Evaluate approaches for effectiveness and make adjustments;

cc. Consider, test, and justify more than one solution;

- dd. Find meaning in patterns and connections (underlying concepts);
- ee. Select and apply appropriate methods, tools and strategies;
- f. Implement an approach that addresses the problem being posed; and
- g. Use manipulative, sketches, webs, etc. to model problems.

3.5 Healthy Choices: Students make informed, healthy choices that positively affect the health, safety, and well-being of themselves and others.

- aa. Describe how lifestyle, pathogens, family history, and other risk factors are related to the cause of prevention of disease, injuries, pregnancy, and other health issues;
- bb. Explain the relationship between positive health behaviors and the prevention of injury, disease, alcohol, tobacco, and other drug use, and premature death, and develop a personal plan for health;
- cc. Demonstrate the ability to utilize resources from the home, school, and community that provide valid health information;

3.10 Teamwork: Students perform effectively on teams that set and achieve goals, conduct investigations, solve problems, and create solutions (e.g., by using consensus-building and cooperation to work toward group decisions).

3.11 Interactions: Student interact respectfully with others, including those with whom they have differences.

3.15 Career Choices: Students know about various careers. This is evident when students:
aa. Collect information about careers, and experience careers directly or indirectly through classroom work and community experiences such as job shadowing, working with a mentor, or performing community service.

GRADE EXPECTATIONS FOR VERMONT'S FRAMEWORK OF STANDARDS AND LEARNING OPPORTUNITIES:

HUMAN DISEASE

S5-6:42

Students demonstrate their understanding of the Patterns of Human Health/Disease by ...

-- Connecting the specialized function of white blood cells to their location in the circulatory system.

Science Concepts:

- a. White blood cells engulf invading microbes or produce antibodies that attack them.

TIME FRAME: 17 – one - hour classes

MATERIALS and EQUIPMENT: A list of basic supplies is included with each lab. Supporting worksheets and in-depth directions for selected activities are included in the appendix. A bibliography is listed at the end of the unit.

GRADE LEVEL: 5 – 8 grade

LEARNING OBJECTIVES

Infectious Diseases:

Students will be able to:

- define infectious disease and give examples;
- identify the different types of pathogens that cause infectious diseases and give examples;
- explain the ways a pathogen can enter the body;
- explain how infectious diseases spread; and
- describe some strategies for staying healthy.

Immune System:

Students will be able to:

- describe how the body's first line of defense including barriers such as the skin, helps fight against pathogens;
- describe how the body's second line of defense, the innate immune system, helps fight infectious disease;
- describe how the body's third line of defense, the adaptive immune system, helps fight infectious diseases; and
- name the different types of white blood cells

PART 1: INFECTIOUS DISEASES

DAY 1

1. Students will take a pre-test on infectious diseases and the immune system. (Appendix A)
2. What do we know about diseases? Give each student a KWL chart (What I Know; What I Want to Know; and What I learned). Have students tell you what they know about diseases. Write down their ideas on the blackboard under the What I Know section of the chart while they write it down on their copy. Ask them what they would like to learn about disease and write that down under the What I Want to Know section of the chart. At the end of the unit go back and fill in the last column What I Learned with the students. (Appendix A)
3. Vocabulary words and readings from *Prentice Hall – Science Explorer – Human Biology and Health* will be assigned each day for homework. (Appendix A)
4. Activity: Poison Pump: Cholera Investigation. Students discover the source of the cholera epidemic that broke out in London in 1854 by using a series of clues and a neighborhood map of the infected area. (Appendix A)

DAY 2

1. Mini lecture on infectious diseases. This will include a definition for infectious disease, the causes of infectious diseases, and how they differ from noninfectious diseases. We will also discuss scientific contributions from Lister, Pasteur, and Koch. Each student will receive a timeline of important dates (Appendix B). Excerpts from *The Miracle of Immunity* by William Donnellan will be read aloud to the students.
2. Come up with a list of diseases with the students. Put the diseases in a chart with headings: Infectious Diseases and Chronic Disorders. Disease chart and a list of infectious diseases have been included in Appendix B.
3. Show pictures of the different types of pathogens that cause infectious diseases (bacteria, viruses, fungi, protozoa, and parasites) on power point. Images can be found at Google Images. Have students take notes. Resources can be found at <http://www.microbe.org> (Appendix B)

DAY 3

2. Show the Discovery Channel video on *Understanding Viruses*. Hand out questions to be answered while watching the video. When movie ends go over questions and discuss movie. (Appendix C).

DAY 4

1. Common Cold Virus: Demonstrations
 - a. Simulate a sneeze with a spray bottle. Notice how the fluid disperses in a large area. If the fluid contained a pathogen it, too, would disperse in a large area.
 - b. Simulate sneezing in your hand. Wet hand with water and then shake hands with other students. Those students go on to shake with additional students. Do not dry hands in between. If the pathogen was in the fluid sneezed out, how many students would be infected?
 - c. Place several drops of food coloring in a clear container of water to show how a pathogen can spread through water.

Discussion questions:

How does the common cold virus spread?

- Close contact with others that are infected (i.e., come in contact with fluid from someone coughing and sneezing or objects touched by someone infected with the cold virus)

How can we prevent spreading germs?

- cover your mouth when coughing or sneezing
- wash your hands after using the bathroom
- avoid sharing food, drinks and eating utensils

2. Read aloud article from *Science World* (Sept. 4, 2006) called "Bird Flu: The Facts You Need to Know." (Appendix D)

3. Make an overhead of the virus chart found on page 11 of the book called *Germ Killers* by Sally Morgan and explain how a virus reproduces in your body (Appendix D).
4. Give facts and information about the 1918 influenza outbreak.
5. Give students the following website so that they can track flu outbreaks across the United States at home on their own computer: fluwatch.com.

DAY 5

1. Introduce research project: Infectious Disease Fact Sheet and Pathogen Model. (Appendix E). Each student will create a fact sheet about an infectious disease, which addresses the following areas: description of the disease/symptoms; what causes the disease; distribution worldwide; treatment; vaccine availability; recent research; and 3 interesting facts. They will also create a styrofoam model of the pathogen causing the disease.

2. Spend the day in the computer lab working on research project.

DAY 6

1. Guest speaker from Infectious Disease Department at the Medical School (Beth Kirkpatrick)

Homework: Animal Disease Carriers Worksheet (Appendix F). A computer is necessary to complete this assignment.

DAY 7

1. Lab: How Viruses Travel (Kit by Neo/Sci) Students will simulate the transmission of a virus through a population. They will identify the index case and calculate the percent of infection. Students will also calculate the rate at which the infection spreads. (Appendix G)

2. Six ways that pathogens can spread will be discussed.

- contact with animals (vectors)
- water
- air
- body fluids (sexual contact)
- food
- contact with a dirty object (i.e., nail)
- contact with humans

3. Read aloud *The Case of the Unsuspecting Murderer* (Adapted from *A Walking Killer Called Mary* by Mark Sufrin, Chicago Tribune). The story is about Typhoid Mary. (Appendix G)

3. KWL for the topic of AIDS (Appendix A)

4. Students will complete a worksheet during a discussion on AIDS. Additional topics include: worldwide distribution of AIDS, available treatments and recent research (Appendix G).

DAY 8

1. Guest speaker (Cheryl): Medical technologist from the UVM Medical School's Department of Immunology (Job description; educational background; research discussion; lab demonstration; help with classroom lab listed below)
2. Classroom Lab: Observing the Action of Antibacterial Soap and Bar Soap on Microorganisms Lab. Students will determine the effect of two types of soap on the growth of microorganisms. Questions, sketches, and a circle graph will be completed after students get their lab results in a week. (Appendix H)

Alternative activity appropriate for younger students: Caught Dirty-Handed (American Society for Microbiology) (Appendix H)

PART 2: THE IMMUNE SYSTEM

DAY 9

1. Mini lecture and note taking on the first line of defense: skin, saliva and tears, mucous membrane and stomach acids and enzymes. (Appendix I)
2. Read aloud an article from *Science World* (Sept. 4, 2006) called "Picky Eater." It is a short essay on how a cow licks the inside of its nose to clean out bacteria-laden mucus (Appendix I)
3. The Skin as Barrier Lab - Students will investigate how skin protects you from infectious disease. Lab results will be checked daily for one week (Appendix I).

DAY 10

1. Lecture with transparency explaining how the innate immune system works. (Appendix J)
2. Look at lab results: Observing the action of Antibacterial Soap and Bar Soap on Microorganisms. Students will make observations; determine if they have proved or disproved their hypothesis; and complete lab questions; sketch results; and construct a circle graph for homework.

DAY 11

1. Lecture with transparency explaining how the adaptive immune system works. (Appendix K)
2. Power point showing T cells, B cells, and other related information.
3. Antigens and Antibodies Activity
Materials Needed: handout: Matching Antigens and Antibodies puzzle pieces that fit together; colored paper; and a glue stick

This activity will help students understand how each antibody is designed to attack and bind to one specific antigen. An antibody recognizes an antigen by its shape and molds itself to fit that shape. (Appendix K)

DAY 12

1. Skits assignments: Class will be divided into groups. Group 1 will act out the body's first line of defense - barriers. Group two will act out the body's second line of defense – pathogen – destroying white blood cells (macrophages). Group three will act out the body's second line of defense – the inflammatory response. Group four will act out the body's third line of defense – B cells. Group five will act out the body's third line of defense – T cells. Students will be required to wear simple costumes and large name tags. A long piece of red butcher block/bulletin board paper will be taped to the floor. This will represent the blood stream and act as the stage. At the completion of each mini skit, all the groups will work together to demonstrate a total immune response. Students will have one day in class and two evenings at home to complete their skit. Additional time during study hall will also be given.

DAY 13

1. Group discussion on how to stay healthy.
2. Make group poster showing how to stay healthy. Posters will be hung around the school.
3. Read aloud *Germ Zappers* by Fran Balkwill and Mic Rolph.

DAY 14

1. Present skits.
2. Work on posters.

DAY 15

1. Infectious Disease Fact Sheet and Pathogen Model presentations.
2. Test review. Students will be given a grid with a review question in each grid block. Students will circulate around the classroom looking for someone who can answer one of the questions on the grid. The person who can answer the question will write the answer in the block along with their initials. The first person to have their grid completed will receive a homework pass. (Appendix L)

DAY 16

1. Poster presentations.
2. Unit test. Same as pretest. (Appendix M)

DAY 17

1. Field trip to UVM Medical School. Students will be divided into small groups and will rotate through the following areas:

- Flow cytometry
- Cheryl's lab (separating white blood cells from red cells and plasma; looking at cells through microscopes
- Confocal machine
- Electron microscope
- Laser capture microdissector
- Mice dissection and discussion of how mice are used in research
- DNA analysis facility

Our Body's Response to Infectious Diseases Vocabulary List

1. epidemic
2. symptom
3. contagious
4. pandemic
5. infectious disease
6. microorganism
7. pathogen
8. microbe
9. virus
10. sterilize

11. vaccine

12. eradicate

13. bacteria/bacterium

14. protozoan

15. helminths (parasitic worms)

16. fungus

17. vector

18. immune system

19. immunity

20. phagocytes

21. macrophages

22. T cells

23. B cells

24. lymphocytes

25. antibody

26. antigen

27. mast cells

28. interferon

29. histamine

30. autoimmune disease

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NAME OF PATHOGEN _____



Sketch of the Pathogen

NAME OF PATHOGEN CAUSING THE DISEASE: _____

TYPE OF PATHOGEN: _____

DESCRIPTION OF DISEASE SYMPTOMS: _____

WORLDWIDE DISTRIBUTION: _____

AVAILABLE TREATMENTS: _____

VACCINE AVAILABILITY: _____

RECENT RESEARCH: _____

THREE INTERESTING FACTS:

1. _____

2. _____

3. _____

REFERENCE: _____

STUDENT NAME: _____

Infectious Disease Fact Sheet Assignment

1. Research your disease. Do a rough draft of your fact sheet. At the top of your rough draft draw a picture of the pathogen causing your disease (i.e., virus, bacterium, fungus, protozoan, or parasite) using a pencil. Conference with someone to insure you have included the necessary information and have corrected any editing errors. Have the person you conference with sign the top right hand corner of your rough draft. Signed rough drafts will be counted as a homework grade. Do a final copy of the fact sheet in your neatest writing. Draw a final copy of your pathogen include color by using crayons or colored pencils. No markers.

2. Make a model of your pathogen. Be creative. You can choose to use a variety of materials including Styrofoam, pushpins, pipe cleaners, yarn, paper with flour and water, wood, cloth, cardboard, paint, etc.

65% of your grade is from the fact sheet the other 35% of your grade is from your pathogen models.

PATHOGEN GRADE SHEET

CRITERIA	POSSIBLE POINTS	POINTS EARNED
Name of pathogen	3	
Type of pathogen	2	
Symptoms	10	
Worldwide distribution	5	
Available treatments	5	
Recent Research	5	
First interesting fact	5	
Second interesting fact	5	
Third interesting fact	5	
Reference	3	
Student name	2	
Pathogen drawing	5	
Pathogen model	35	
Neatness – fact sheet	10	
Total	100	

COMMENTS:

Excellent Fact Sheet	Excellent Pathogen Model
Did not follow directions	More effort needed
More information needed	Your work needs to be edited
Model needs to be neater	Fact sheet needs to be neater

Immune System Skits

Divide the class into several large groups. Have each group develop a skit incorporating the following topics: first line of defense; second line of defense; helper T cell; killer T cell; suppressor T cell; antibodies; and pathogen. Have students make or bring in simple costumes depicting their role in the skit. Use the Immune Skit grade sheet to evaluate each skit.

NAME: _____

IMMUNE SKIT GRADE SHEET

Criteria (what needs to be included in the skit)	Possible Points	Self Assessment
1 st Line of Defense	5	
2 nd Line of Defense	5	
Helper T Cells	5	
Killer T Cells	5	
Suppressor T Cells	5	
B Cells	5	
Antibodies	5	
Pathogen (virus or bacteria)	5	
Participation (Use the rubric below to determine your individual points)	30	
Props (5 points each) - creative - able to tell what was represented - everyone had a prop	15	
Script (5 points each) - included all of the above - easy to understand - flowed together	15	
TOTAL	100	

RUBRIC FOR PARTICIPATION

0 points – did not meet the standard	10 points – almost met the standard	20 points – meet the standard	30 points – exceeded the standard
I did not take my role seriously; I laughed and fooled around; I did not understand my part; contributed very little.	I put some effort into my role; I paid attention but I was not very enthusiastic; I contributed some to the script and prop ideas.	I took my role seriously; I worked on all aspects of the skit; I cooperated with my group and contributed my equal share to the script and prop ideas.	I put a lot of effort and enthusiasm into my role; I worked hard on all aspects of the skit; I cooperated with my group and helped others; I contributed a lot to the final product.

Observing the affect of antibacterial soap on the growth of microorganisms found on the skin of an apple

Problem: Does antibacterial soap affect the growth of microorganisms found on the skin of an apple?

Hypothesis:

Materials:

2 apples
2 Petri dishes with sterile nutrient agar
rubber gloves
grease pencil
transparent grid cut into a circle the size of the Petri dish
paper towels

Procedure:

1. Each group will receive two apples and two Petri dishes containing nutrient sterile agar. Lids need to be kept on.
2. Using a grease pencil, label the top lid of one dish “antibacterial soap”. Label the top lid of the second dish “no soap”. Write the group name and date on both lid tops.

NOTE: Be sure to keep the lids on while labeling.

3. Handle both apples with dirty hands until some of the dirt from your hands has been transferred to the apples' skin. Place them on a clean paper towel.
4. Wash your hands and put rubber gloves on.
5. Wash one apple with antibacterial soap and dry with a paper towel. Take the lid off of the Petri dish marked "antibacterial soap". Then roll the clean apple completely across the Petri dish. Put the lid back on.
6. Pick up the dirty apple and roll it completely across the Petri dish marked "no soap". Put the lid back on.
6. Incubate the Petri dishes for one week at room temperature.
7. At the end of the week make observations and analyze your results.

Observations:

1. After one week, what did you observe in the Petri dish marked "antibacterial soap"?
2. After one week, what did you observe in the dish marked "no soap"?

Analysis:

1. Using the transparent grid, count the number of squares showing growth of microorganisms. What percent of the total number of squares shows growth of microorganisms? Report your results on the class data chart on the blackboard. Copy the completed class data chart onto the data chart handout.

2. What was the class average (mean) for squares showing growth with antibacterial soap? What was the class average (mean) for squares showing growth with no soap? Make a circle graph showing your data. Don't forget a title and labels.

On a separate piece of paper, include a sketch of the growth with your findings.

Conclusion:

1. What effect did the antibacterial soap have on the growth of microorganisms?

2. Was your hypothesis correct? Why or why not?

3. Explain why you should wash fruit and vegetables before eating them.

4. List three things that you have learned from doing this lab.

Name: _____

Data Chart for observing the affect of antibacterial soap on the growth of microorganisms found on the skin of an apple

CLASS GROUPS	% of squares showing growth with ANTIBACTERIAL SOAP	% of squares showing growth with NO SOAP
Group 1		
Group 2		
Group 3		
Group 4		
Group 5		
Group 6		
Class Mean (average)		

Can the skin of an apple act as a barrier?

Problem: Does an apple's skin act as a barrier against microorganisms

Hypothesis:

Materials:

4 Ziploc baggies numbered 1 – 4 with a sharpie

4 apples

1 rotting apple

Q-tips

Toothpicks

Rubbing alcohol

Paper towels

Procedure:

1. Wash your hands with antibacterial soap.
2. Wash four apples with antibacterial soap. Dry them with a paper towel.
3. Place one apple using your paper towel in Ziploc bag #1
4. Puncture the rotting apple with a toothpick. Draw the tip of the toothpick down the side of the second apple. Do not break the skin of the apple. Repeat this several times. Using a paper towel place the apple into Ziploc #2.

5. Puncture the rotting apple again using a new toothpick. Use the tip of the toothpick to slice through the skin of a third apple. Repeat this several times. Using a paper towel place the apple into Ziploc #3
6. Repeat step 4 using the fourth apple. Then dab the areas that were sliced with a Q-tip soaked in alcohol. Using a paper towel place the apple into Ziploc#4.
7. Store the bags for 5 days in a warm, dark place.
8. Throw the rotted apple away and wash your hands.
9. Observe daily for five days without opening the Ziploc bags. Record your observations and return the bags to their storage place.

Observations: Use the attached chart to record your observations

Analysis:

1. How did the appearance of the four apples compare after five days?
2. What caused the apples to appear differently after five days?

Conclusion:

1. Was your hypothesis correct? Why or why not?
2. How do the apples represent real life situations? Be sure to include the rotting apple in your discussion.
3. Explain why cuts on your skin should be cleaned and bandaged?
4. List three things that you have learned from doing this lab.

NOTE: This lab was adapted from Lab: The Skin as a Barrier found on page 168-169. Prentice Hall – Science Explorer – Human Biology and Health

Name: _____

Data Chart for The Skin as a Barrier Lab

Date	Apple 1 (no contact with toothpick)	Apple 2 (contact with rotting apple, unbroken skin)	Apple 3 (contact with rotting apple, sliced skin)	Apple 4 (contact with rotting apple, sliced skin dabbed with alcohol)
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				

NAME: _____

DATE: _____

The Skin As A Barrier Lab

Problem: How does skin act as a barrier to pathogens?

Hypothesis:

Materials: (per group of 4 students)

4 Ziploc bags
4 apples
1 cotton swab
permanent marker
paper towels
3 toothpicks
rubbing alcohol
1 rotting apple to be used with each group

Procedure:

- 1 Wash your hands before starting.
- 2 Label the four Ziploc bags 1, 2, 3, and 4.
3. Wash the four apples with water and dry them with a paper towel.
4. Place one apple in Ziploc bag #1 and close it.
5. Insert a toothpick in the rotting apple and then take it out. Gently rub the tip of the toothpick down the side of one apple without breaking the skin. Repeat this three more times with the same apple, but along a different side. Then place the apple in Ziploc bag #2 and close it.
6. Insert a new toothpick in the rotting apple and then take it out. Use the tip to make a long scratch down the side of the third apple breaking the skin. Repeat this three more times with the same apple, but along a different side. Place the apple in Ziploc bag #3 and close it.
7. Repeat step #6 with the fourth apple. However, before you place the apple in the bag, dip a cotton swab in rubbing alcohol, and swab the scratches. Place the apple in Ziploc bag #4 and close it.
8. Store the bags for a week in a warm, dark place.
9. Wash your hands after touching the rotting apple.
10. Every day for a week, remove the apples from their storage place, and observe them without opening the bags. Record your observations and return the bags to their storage place.

Observations:

Use the attached chart to record your observations.

Analysis:

1. Describe each apple in detail after one week.
2. How did the appearance of the four apples compare?
3. What caused the apples to appear differently after one week?

Conclusion:

1. What conclusions can you draw from this experiment?
2. Was your hypothesis correct? Why or why not?
3. How does this experiment show why routine cuts and scrapes should be cleaned and bandaged?
4. List two things that you have learned from doing this lab.

NOTE: This lab was adapted from Lab: The Skin as a Barrier found on page 168 – 169.
Prentice Hall – Science Explorer – Human Biology and Health

Name: _____

Data Chart for The Skin as a Barrier Lab

Date	Apple 1 (no contact with toothpick)	Apple 2 (contact with rotting apple, unbroken skin)	Apple 3 (contact with rotting apple, sliced skin)	Apple 4 (contact with rotting apple, sliced skin dabbed with alcohol)
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				