

Teaching Materials on Infectious Diseases

MEDICAL MYSTERIES



Mission 3: Nemesis in Neuropolis

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MISSION BRIEFING: Contents

OVERVIEW

We hope that you and your students extend the ***MEDMYST*** adventures with the activities designed to cover related learning objectives. The activities described are intended for use both **before** and **after** students have "played" Missions of ***MEDMYST***. The files may be printed for classroom use **ONLY**. They consist of mini-labs that can be done with relatively little equipment or expense.

Rice University and the sponsoring agency cannot be responsible for any accidents or injuries that may result from: 1) the conduct of the activities without proper supervision, 2) the failure to follow the directions provided, or 3) the ignoring of cautions contained in the text.

Feel free to adapt these activities to your own classroom needs. Another resource that we suggest is the National Institutes of Health (NIH) web site at <http://www.nih.gov/>. It contains some excellent resources and teaching materials.

If you have specific questions, please contact us.

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***MISSION BRIEFING:* Mission Synopsis**

This synopsis is provided as an overview for TEACHERS. We advise teachers NOT to hand this out to the students prior to playing the adventure since much of the suspense will be eliminated.

The mission begins with Beta (chief science officer), Delta (robot scout), and the student sitting in a briefing room at the Neuropolis Center for Disease Control (NCDC). The NCDC is located at the On-line Reconstructor Base (ORB). A confidential message comes in from Dr. Xu at Neuropolis General Hospital. A young patient named Jeremy, who appears to have smallpox, puzzles Dr. Xu. This patient mystifies Dr. Xu because smallpox is a deadly infectious disease that was eradicated long ago. She is also worried about the spread of this disease and the reaction of the public once they find out that smallpox may have returned. She is especially worried about the reaction of the Areloch, a troublesome, survivalist group with an excessive fear of disease. Dr. Xu asks the Reconstructors to help investigate this mystery of how a disease which is suppose to have been eliminated has returned. Could it be bioterrorists?

The student is asked whether he or she wants to accompany Delta to Jeremy's apartment to look for clues on where he may have contracted the disease or go with Beta to the lab to determine if Jeremy does, indeed, have smallpox.

At the apartment, the student searches for the following clues in any order:

1. The passport of Jeremy's father, which indicates that he recently traveled to the Congo in Central Africa.
2. An e-mail from Jeremy to his mother describing the vacation he took with his father in the Congo which suggests Jeremy had been in contact with monkeys during the trip.
3. A PDA (hand-held device) with a NCDC travel alert for people visiting Central Africa which provides instructions on how to avoid contracting several diseases in the region including monkeypox, a disease similar to smallpox.
4. An electronic newspaper with an article describing groups who might be trying to get the smallpox virus to use against Neuropolis for bioterrorism.
5. An electronic album with vacation pictures of the Congo which provides no clues, but is just a fun object.

After the student finishes the search, he/she is prompted by Delta to compose an e-mail to Alpha, Leader of the Reconstructors, on what has been found. The e-mail is in the form of an interactive quiz.

At the lab, Beta is sitting at an electron microscope workstation. Suddenly, robo spiders appear and steal information from the microscope's computer. The player tries to disable the spiders by clicking on them; however, several manage to escape. Beta tells the student that a virus is causing Jeremy's illness. The student is asked to review the following viral information on the computer while she tries to find the escaped robo spiders:

1. An interactive diagram on the structure of a virus.
2. An interactive movie on the reproduction of viruses.

***MISSION BRIEFING:* Mission Synopsis**

Beta returns to the lab, having failed to catch the robospiders. She instructs the student to look at the viruses isolated from Jeremy's blisters through the electron microscope. The student is able to focus the microscope. Beta remarks that the viruses appear similar to the ones that cause smallpox and prompts the student to send Alpha an email reporting what has been learned thus far in the lab. The email is designed as a check for understanding.

The student and Delta meet with Alpha in the NCDC briefing room. Alpha has reviewed both of the email reports and needs the student's opinion on the course of action taken by Dr. Xu. He tells the student that Dr. Xu has quarantined the hospital and asks the student to draw a conclusion on whether this is a good decision based on what was learned from the apartment and the lab.

Suddenly, a news alert comes in on the briefing room's monitor. An angry mob of Areloch has appeared outside Neuropolis General Hospital. The news that a child has a contagious and unidentified pox has leaked to the media. Sedapa, a reporter for Cyber News Network (CyNN) is on the scene and interviews the Areloch's leader. The Areloch are convinced that the cities are the breeding ground for disease and that this mystery pox may lead to widespread deaths. Sedapa concludes the interview and signs off.

Later in the ORB lab, Beta reports that she has confirmed that Jeremy does not have smallpox by using DNA tests. She is still not certain which pox he has. Delta suggests that the disease could be monkeypox. To help get at the bottom of this mystery, Beta interviewed Mr. Kumar, Jeremy's father, for clues as to why he didn't become ill. The student reviews the interview, which reveals that Mr. Kumar had cowpox in childhood. Suddenly a robospider appears. The student dissects the spider to retrieve the information stolen from the ORB computers in the lab. The information is on Dr. Edward Jenner, who in 1796 discovered how to prevent people from getting smallpox by making them immune to it with a vaccine made with cowpox viruses. Additionally, there is an interactive animation on how the smallpox vaccine was made.

Alpha enters the lab to speak to Beta. She tells Alpha that Jeremy doesn't have smallpox and that they have uncovered a possible reason why Mr. Kumar didn't get Jeremy's pox disease. Beta asks the student to tell Alpha the reason. The student should conclude that Mr. Kumar's childhood case of cowpox could have made him immune to the mystery pox. Finally, Alpha asks the student what he/she recommends that the Reconstructors do next to solve the mystery and offers the student several scenarios on how to proceed. No matter which scenario is chosen, Alpha tells the student the pros and cons of that choice.

Three months later, Sedapa interviews Alpha. Vaccinating all of Jeremy's contacts has halted the monkeypox epidemic. And Jeremy has recovered. The episode ends with the Reconstructors taking a much-deserved break at the theme park, Roboland.

***MISSION BRIEFING:* Correlation with Standards**

National Science Education Content Standard Correlation Grades 5-8

Instructional Objectives “Nemesis in Neuropolis”	Science Content Standard
<ul style="list-style-type: none"> Apply the scientific method to the investigation of a mystery disease. Analyze and interpret epidemiological data and patient profiles to reach a hypothesis about a disease. 	<p><u>Science as Inquiry</u></p> <p>Content Standard A: All students should:</p> <ol style="list-style-type: none"> Develop abilities necessary to do scientific inquiry Understand about scientific inquiry
<ul style="list-style-type: none"> Identify the two major structures of a virus, and know their functions. Summarize the process of viral reproduction in a host cell. 	<p><u>Life Science</u></p> <p>Content Standard C: All students should develop an understanding of:</p> <ol style="list-style-type: none"> Structure and function in living systems Reproduction and heredity Regulation and behavior Population and ecosystems Diversity and adaptations of organisms
<ul style="list-style-type: none"> Associate the virus, <i>Variola major</i>, with the disease it causes – smallpox. Describe how smallpox vaccine is produced. Describe ways to prevent the spread of smallpox (quarantine, vaccine, health warnings, and previous illness). Identify the symptoms of smallpox. 	<p><u>Science in Personal and Social Perspectives</u></p> <p>Content Standard F: All students should develop understandings of:</p> <ol style="list-style-type: none"> Personal health Populations, resources, and environment Natural hazards Risks and benefits Science and technology in society
<ul style="list-style-type: none"> Associate Edward Jenner with the early development of the smallpox vaccine. Summarize the history of smallpox and its current status. 	<p><u>History and Nature of Science</u></p> <p>Content Standard G: All students should develop understandings of:</p> <ol style="list-style-type: none"> Science as a human endeavor Nature of science History of science
<ul style="list-style-type: none"> Summarize the storyline. 	

***MISSION BRIEFING:* Vocabulary Terms**

Vocabulary terms that are fundamental in understanding the concepts included in Mission Three are listed below. Teachers should alert the students to the ability to click on the hot-linked words in the game.

antibiotic - a drug that kills an infectious agent by inhibiting its growth. Antibiotics are effective against bacteria. Some antibiotics can be used to fight certain protozoa and fungi as well.

bioterrorism - the use of biological agents, such as pathogenic organisms or agricultural pests, for terrorist purposes.

electron microscope - a microscope that uses a beam of negatively-charged particles (electrons) to produce images of extremely small objects. With certain types of electron microscopes, objects as small as 0.2 nanometers can be seen. One nanometer is one billionth of a meter.

immunity - the body's defense mechanism that protects it against infectious agents.

monkeypox - a pox disease that presents with symptoms similar to smallpox but with a lower death rate. Although the disease can be spread from person to person, monkeypox is usually acquired by contact with the blood of or through the bite of an infected animal. From 1-10% of people who get monkeypox die from it.

nemesis - an extremely difficult opponent that inspires both fear and respect.

nucleic acid - a component of DNA which is the genetic material that contains instructions to make all organisms including viruses.

protein coat - outer layer of a virus which gives a virus its shape and helps it attach to a cell.

quarantine - to restrict the movement of people who may have been exposed to a contagious disease in order to prevent them from spreading it.

smallpox - an infectious disease caused by the smallpox virus whose symptoms include a rash of blisters (pocks) on the body. Smallpox is contagious and can easily spread directly from person to person or through the air. With the discovery of the smallpox vaccine, this disease was eliminated in the 20th century.

virus - a very small pathogen consisting of nucleic acid covered by a protein coat. A virus can only reproduce within a living cell.

vaccine - a substance made out of dead or weakened viruses or bacteria used to prevent a specific disease by producing an immune response in the body.

MISSION DEBRIEFING: Teacher Guide

TEACHER VERSION

TEACHER DIRECTIONS: Ask the students to fill in the **CLUE** column as they proceed through the mission.

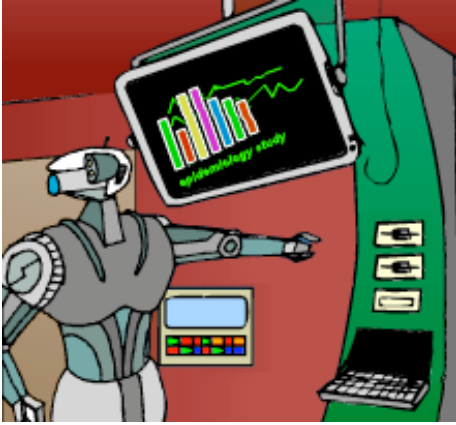
Question	Answer
When Dr. Xu is talking to Beta and Delta, she tells them that she thinks that a patient has smallpox. You then learn that smallpox is contagious . What does this mean?	It can easily be spread directly from person to person.
When searching the apartment with Delta, you find out that smallpox was eradicated in the 20 th century, but that smallpox could be used a weapon for _____.	bioterrorism
When searching the apartment with Delta, you find a Traveler's Alert that tells you, that to avoid getting monkeypox, you should limit your contact with what animals?	monkeys and squirrels
In the lab you see an interactive model of a virus. What is the part of the virus called that contains instructions to make other virus?	nucleic acid or DNA
In the lab, you see an interactive movie on viral reproduction. The process by which the virus obtains a new coating from the host cell's membrane is called: replication, docking, or release?	release
In the lab, you look at the viruses in Jeremy's blisters with Beta. His blister look similar to those a person would get from _____.	smallpox
When Alpha is in the lab he says that Dr. Xu has prevented anyone from entering or leaving the hospital. What is this called?	a quarantine
After the dissection of the robospider, information is released which tells you who created the first vaccine. Who was it?	Dr. Edward Jenner
In the information that is released from the robospider, you learn that a pathogen from mild disease can protect some one against smallpox. What is the name of this disease?	cowpox
After making the smallpox vaccine, you dip a special needle into the vaccine to vaccinate someone. What is the name of this needle?	bifurcated needle

MISSION DEBRIEFING Teacher Guide

Name _____ Class _____ Date _____

STUDENT INSTRUCTIONS: Record your observations by finding the clue that correctly matches each description. Write down the clues as you proceed through the mission.

Question	Answer
When Dr. Xu is talking to Beta and Delta, she tells them that she thinks that a patient has smallpox. You then learn that smallpox is contagious . What does this mean?	
When searching the apartment with Delta, you find out that smallpox was eradicated in the 20 th century, but that smallpox could be used a weapon for _____.	
When searching the apartment with Delta, you find a Traveler’s Alert that tells you, that to avoid getting monkeypox, you should limit your contact with what animals?	
In the lab you see an interactive model of a virus. What is the part of the virus called that contains instructions to make other virus?	
In the lab, you see an interactive movie on viral reproduction. The process by which the virus obtains a new coating from the host cell’s membrane is called: replication, docking, or release?	
In the lab, you look at the viruses in Jeremy’s blisters with Beta. His blister look similar to those a person would get from _____.	
When Alpha is in the lab he says that Dr. Xu has prevented anyone from entering or leaving the hospital. What is this called?	
After the dissection of the robo-spider, information is released which tells you who created the first vaccine. Who was it?	
In the information that is released from the robo-spider, you learn that a pathogen from mild disease can protect some one against smallpox. What is the name of this disease?	
After making the smallpox vaccine, you dip a special needle into the vaccine to vaccinate someone. What is the name of this needle?	



Activity 1: OutBreak!: A Simulation

Through this simulation, students will experience tracing the spread of a pathogen through a population.

Background

Epidemiology works to uncover and explain the factors that determine disease frequency and distribution. In the field of infectious disease, epidemiologists identify infectious agents, determine how they are spread, who gets infected, and the results of infection. This is a difficult task because not only are there different infectious agents, but there are also different environments in which they live, methods by which they spread, methods of invasion into the host, and different host abilities to fight the infectious agent. The possibilities are endless.

In order to answer these questions, scientists, physicians, public health care workers, and countless others combine their skills to accurately and methodically study the spread of a disease through a population. This is important because it helps to prevent the spread of future infectious diseases and limits the emergence of mutations of the disease.

This activity simulates how a pathogen can spread among a population. Students will exchange paper with one another to simulate the epidemiology of tracking an infectious agent. After this activity, the students should have a better understanding of how infectious agents spread from person to person and ways to prevent outbreaks. It can be adapted to a variety of scenarios. For example, the infectious agent could be smallpox or HIV or another pathogen that is spread by human contact.

Outbreak!: A Simulation

Learning Objectives

The student will:

1. learn the importance of epidemiology.
2. trace the spread of a pathogen through a population

Teacher Preparation

Paper strips

1. Count the number of students in the class. Cut up enough filter paper into strips approximately 1 inch by 3 inches so that each student gets five strips of paper. Coffee filters purchased at the grocery store work fine as the filter paper. Ironing helps to flatten them out.
2. Group five strips together using a paper clip, staple, or some other method to keep the five strips together.
3. Randomly select one group of five strips and dip them into the saturated baking soda solution (directions below) for a few seconds. (The student who gets these strips will be “infected” and the agent of transmission.) For a really large class, (over 25) you may want to have more than one student receive the “infected strips.”
4. Allow the wet strips to dry on a clean surface. This should take about an hour or so.
5. Regroup the five “infected” strips and assemble in the same way as you did the other packets of five strips so that all the groups of five look alike.
6. If you want to know ahead of time which student picks the infected group of strips, then you can personally pass out the strips, taking note of who gets the “infected” packet.

Saturated baking soda solution for “infected” strips

1. Add a couple of tablespoons of baking soda to one cup of water.
2. Stir the baking soda so that it dissolves.
3. Keep adding baking soda until it does not fully dissolve and collects at the bottom of the cup. At that point the solution is saturated. Now dip five strips into the solution for a few seconds.

Red cabbage pH indicator

1. Cut a head of red cabbage in half. Cut half the cabbage into small pieces.
2. Place pieces of cabbage into a large pot and add enough water to cover the cabbage. 3. Bring the water to a boil and boil for 30 minutes (or less).
4. Drain off the cabbage pieces and allow the cabbage juice to cool. (You can store this solution in the refrigerator for a number of weeks.)
5. On the day of the simulation, place the cabbage juice in a jar in a central location to serve as the “microbe testing station.” Alternatively, you can pour small amounts of the cabbage juice into plastic test tubes or paper cups, so that student groups have their own testing station.

Note: The cabbage juice acts as an indicator solution that will turn green in the presence of a base (baking soda).

Material

A. Before class

1. filter paper (a coffee filters from the grocery will work just fine)
2. scissors
3. paperclips or stapler
4. baking soda
5. water
6. measuring cup
7. red cabbage
8. pot
9. jar or test tubes or paper cups

B. During class

1. *Distribution Record Sheet* and *Data Analysis Questions*
2. strips of paper
3. pen *or* pencil
4. indicator solution (cabbage juice)

Methods/Procedure

1. Discuss the concept of epidemiology and how epidemiologists track the spread of disease.
2. Invite the students to think of questions they need to answer in order to identify the source of an unknown infectious disease.
3. Explain the purpose of the Center for Disease Control and Prevention and local public health agencies and their efforts to determine how diseases spread.
4. Tell the students that they will be receiving five strips of paper that may represent an unknown pathogen (germ) that can be passed from person to person through methods such as touch or the exchange of bodily fluids.
5. Distribute the *Distribution Record Sheet*, *Data Analysis Questions*, and the strips of paper.
6. Instruct the students to write their initials or names on each of their five strips.
7. Begin the simulation by telling students to trade one strip with another student. On their *Distribution Record Sheet*, they should write down who they traded with, the name on the strip they gave away and the name of the strip they received.
8. **On the first trade, they have to give away one of their own strips.**
9. **On the following trades, they can give away any of the strips they have (their own or that of someone who has traded with them before), but give away only ONE strip per trade.**
10. As the teacher you decide how many trades or how long you want the trading to continue. There is enough space for eight trades on the *Distribution Record Sheet*, but you can have them trade as few as five times.
11. Once all trading has stopped, ask them to use the indicator solution (red cabbage juice to see who is holding the “infected” strips. **They should dip each strip one at a time because the color may bleed onto another strip. If the strip turns GREEN, it is one of the infected strips (i.e., it has been soaked in baking soda solution).**
12. Using their *Distribution Record Sheet*, they should be able to determine the path of transmission.

Extension Activities

- *Health*: Determine what characteristics can increase the likelihood of contracting an infectious disease.
- *Health*: Discuss what environmental factors can affect the spread of an infectious disease.
- *Language Arts*: Interview a scientist or physician working in the field of epidemiology. Ask them questions about the diseases they study, what they do at work, and what infectious diseases concern them.
- *Mathematics*: Calculate the morbidity rate of the epidemic in the class by dividing the number of cases of the disease (assuming it was fatal) by the total number of students (population at risk).

Standards

1. Science Content Standard A: All students should develop abilities necessary to do science.
2. Science Content Standard C: All students should develop understanding of the structure and function of living systems.
3. Science Content Standard F: All students should develop understanding of personal health.
4. Science Content Standard F: All students should develop understanding of science and technology in society.

Books

- DeSalle, R. (1999) Epidemic! New York: The New Press.
- Hoff, B.H. and Smith, C., III (2000) Mapping Epidemics: A Historical Atlas of Disease. New York: Franklin Watts.
- Stephen, B.H., et al. (2001) Designing Clinical Research: An Epidemiologic Approach. New York: Lippincott Williams & Wilkins Publishers.

Web sites

- Epidemiology Lessons for Middle and High School Students
<http://www.montclair.edu/detectives/index.shtml>
- Critical Thinking
<http://www.criticalthinking.com/>
- Historical Infectious Diseases
<http://www.rlc.dcccd.edu/MATHSCI/reynolds/history/history.htm/>
- History of Epidemics and Plagues
<http://uhavax.hartford.edu/BUGL/histepi.htm/>
- CDC-Teaching Material
<http://www.cdc.gov/excite/index.htm>
- Emerging Infectious Disease Journal
<http://www.cdc.gov/ncidod/EID/index.htm>

Name _____ Class _____ Date _____

OutBreak!: A Simulation

Data Analysis Questions

1. Who was the original source of the outbreak?

Answer should lead to the person whose filter paper strip turned green.

2. Were some people exposed to the infectious disease (pathogen) but not infected? Would this happen in an actual pathogen exposure?

Yes. Sometimes people can contract an infectious disease, but display no symptoms of the disease. They can still pass the disease to others (example- “Typhoid Mary”). Also in an actual exposure case, the health of a person’s immune system can affect if they get symptoms of the disease or not.

3. How many people in the class were exposed to the pathogen?

Answers will vary.

4. What factors might have increased the chance of exposure to the pathogen?

Location – closer to the “outbreak” pathogen.

Repeated exposure – you got more than one infected

Quantity of pathogen – all five infected strips were being traded

5. If you were an epidemiologist, and this was an actual pathogen, what kinds of things would you do to trace back the source of the disease?

- Verify that the pathogen that is involved is causing the disease.**
- Create a “case definition” to define what is included as a case.**
- Describe the outbreak with respect to time, place, and people.**
- Develop a hypothesis**
- Study and test the hypothesis (collect data)**
- Develop and implement control and prevention systems**
- Release the findings to the community**

***MISSION DEBRIEFING:* Student Activity Sheet**

Name _____ Class _____ Date _____

OutBreak!: A Simulation Distribution Record Sheet

Exchange Number	Name of person you exchanged with	Name on strip of paper you <u>received</u>	Name on strip of paper you <u>gave away</u>
1			
2			
3			
4			
5			
6			
7			
8			

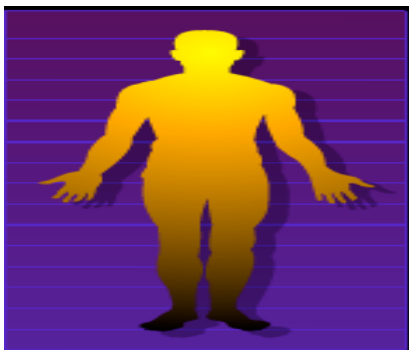
List below the names on the strips of paper that you ended up with after your final trade.

Name _____ Class _____ Date _____

OutBreak!: A Simulation

Data Analysis Questions

1. Who was the original source of the outbreak?
2. Were some people exposed to the infectious disease (pathogen) but not infected? Would this happen in an actual pathogen exposure?
3. How many people in the class were exposed to the pathogen?
4. What factors might have increased the chance of exposure to the pathogen?
5. If you were an epidemiologist, and this was an actual pathogen, what kinds of things would you do to trace back the source of the disease



ACTIVITY 2 Body Defenders

In this activity, the student will model specific and non-specific defenses against infectious organisms.

Background

The immune system deploys different types of defenses in protecting the body against disease-causing organisms. One type is non-specific, affecting a wide variety of pathogens. Key non-specific defenders are the phagocytes. Latin for “cell-eater”, phagocytes are white blood cells that travel around the circulatory system gobbling up and digesting debris, pathogens, infected or worn out cells. Some phagocytes migrate to the lungs and certain other organs where they enlarge into macrophages (“big eaters”). Each of these cells is capable of consuming more than 100 bacteria before dying from the effect of the enormous pathogen meal.

In addition to the non-specific defenses, the immune system has the ability to target a particular pathogen. One of these specific defense mechanisms is the antibody-mediated response, which uses phagocytes, as well as B-cells and helper T-cells. B-cells are white blood cells that mature in the bone marrow, and helper T-cells develop in the thymus. After a phagocyte digests a pathogen, it displays antigens from the infectious organism on its surface. Antigens are chemicals that elicit an immune response. In this case, they stimulate helper T-cells to instruct B-cells to make antibodies. The antibodies bind to the antigens, and phagocytes engulf and destroy these complexes. Phagocytes are not the only cells that can “present” antigen to T-cells. B-cells can also display antigens to helper T-cells. The T-cell then instructs the B-cell to make antibodies.

Body Defenders is based on activities developed by Tory Brady for The Exploratorium in San Francisco, California.

Learning Objectives

The student will:

1. Comprehend the role of the immune system in detecting and eliminating pathogens.
2. Act out non-specific and specific defenses against infection.

Materials

1. A piece of colored paper or cloth
2. Antigen and antibody template sheets (student version)
3. Colored railroad board or poster board
4. Scissors
5. Large plastic garbage bag

Procedure

Non-specific Defense

1. Tell the class they will be acting out a phagocyte, a white blood cell that is part of the body's immune system.
2. Have the students form a circle, holding hands, facing out. This represents the outer, hydrophilic layer of the phagocyte's bilayer cell membrane.
3. Take 3 or 4 students and have them form a smaller, inner-facing circle within the cell, representing a lysosome full of digestive enzymes (lysozymes).
4. The teacher will act out the role of a pathogen—bacteria or virus—which will be ingested by the phagocyte. He or she holds a piece of colored paper or cloth to represent the pathogen's antigen.
5. As the pathogen nears the phagocyte, the students in that area of the membrane “engulf” it by forming a circle around the pathogen without letting go of their joined hands.
6. After the circle of students encloses the pathogen, they quickly break off from the outer circle and head towards the center. The outer circle reconnects. The pathogen is now **INSIDE** the white blood cell, but it cannot damage the phagocyte because the pathogen is surrounded by cell membrane (the small group of students that broke off from the outer circle).
7. Instruct the lysosome to migrate over to the encircled pathogen and fuse with it (have the lysosome circle join hands with the circle encapsulating the pathogen). The teacher should scream in agony and say that the lysozymes (digestive enzymes) are digesting him or her.
8. Next, the lysosome with the dead pathogen inside migrates to the cell membrane and joins with it. The pathogen is dumped out, but as it leaves, the pathogen gives the antigen to one of the students making up the cell membrane. Note: the presentation of the antigen on the cell membrane is the trigger that stimulates helper T-cells to alert the B-cells to make antibodies.

Specific Defense

1. Prior to class, use the teacher version of the antibody templates sheets to create student versions. These sheets **SHOULD NOT** have a number on them. The number identifies which antigen binds to the antibody.

MISSION DEBRIEFING Teacher Guide

2. Describe the specific defense process and then divide the students into two groups—antigens and antibodies.
3. Have students cut Y-shaped antibodies out of one color of railroad board or poster board using the template sheets. Note: there are different shaped receptors at the ends of the Y, although the rest of the shape is the same from one antibody to another.
4. Instruct the other group to cut antigens out of different colors. Note: the protruding shape on the antigen is the epitope, or marker that complements the antibody's receptors.
5. Each student should have at least 2 antigens or antibodies.
6. Have students go around the classroom holding up their antigens. When an antibody recognizes a marker (epitope) on an antigen, he/she binds with it, and that antigen is inactivated.
7. Some antibodies will bind with two antigens at their two receptor ends, and these antigens may also be bound by other antibodies at other marker sites on the antigen. This creates an antibody/antigen "chain of agglutination". Phagocytes are attracted to these complexes and engulf them. A student with the garbage bag acts as a phagocyte and gathers up the antigen/antibody complexes.

Extension Activities

- *Visual Arts:* Create models of different types of immune system cells.
- *Science:* Research how the immune system can cause autoimmune diseases.
- *Language Arts:* Create a story from the perspective of the immune system as it battles a disease.

Standards

National Science Standards, Grades 5-8

- Science Content Standard C: Students should develop understanding of structure and function in living systems.
- Science Content Standard F: Students should develop understanding of personal health

National Health Standards, Grades 6-8

- Standard 1: Students will comprehend concepts related to health promotion and disease prevention to enhance health.

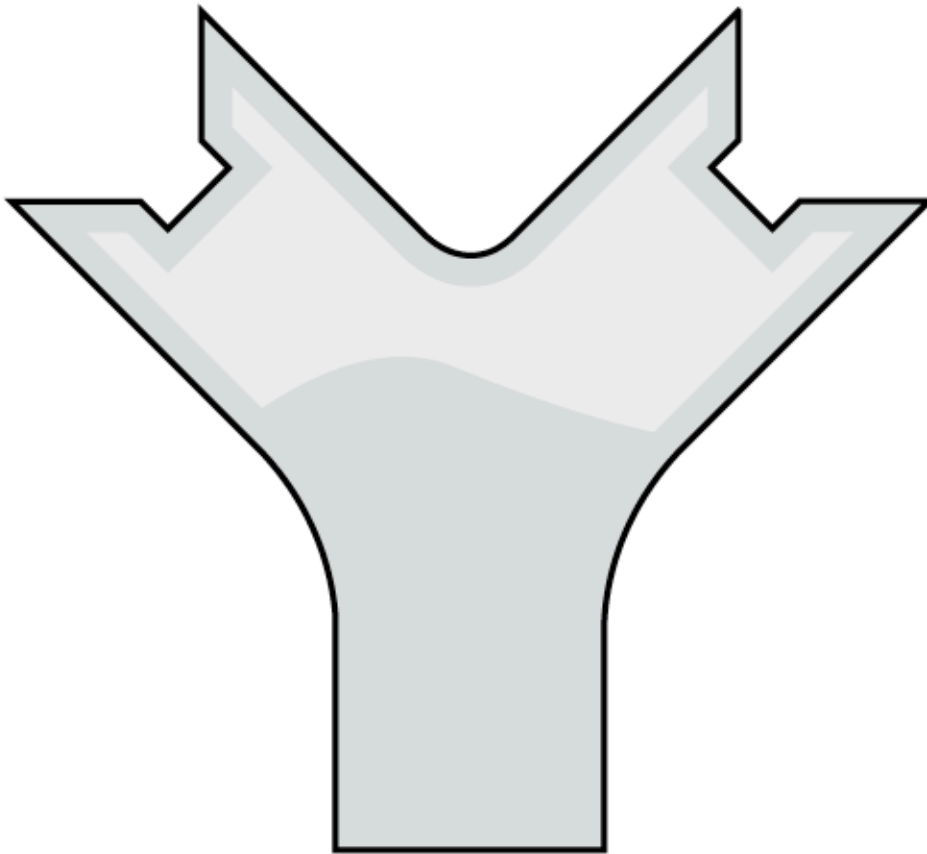
Web Sites

- About.Com: Understanding the Immune System
<http://thyroid.about.com/library/immune/blimm10.htm?terms=monocyte+and%20macrophage>
- The National Institute of Allergy and Infectious Diseases: The Immune System
<http://www.niaid.nih.gov/final/immun/immun.htm>
- Wikipedia: Macrophage
<http://en.wikipedia.org/wiki/Macrophage>

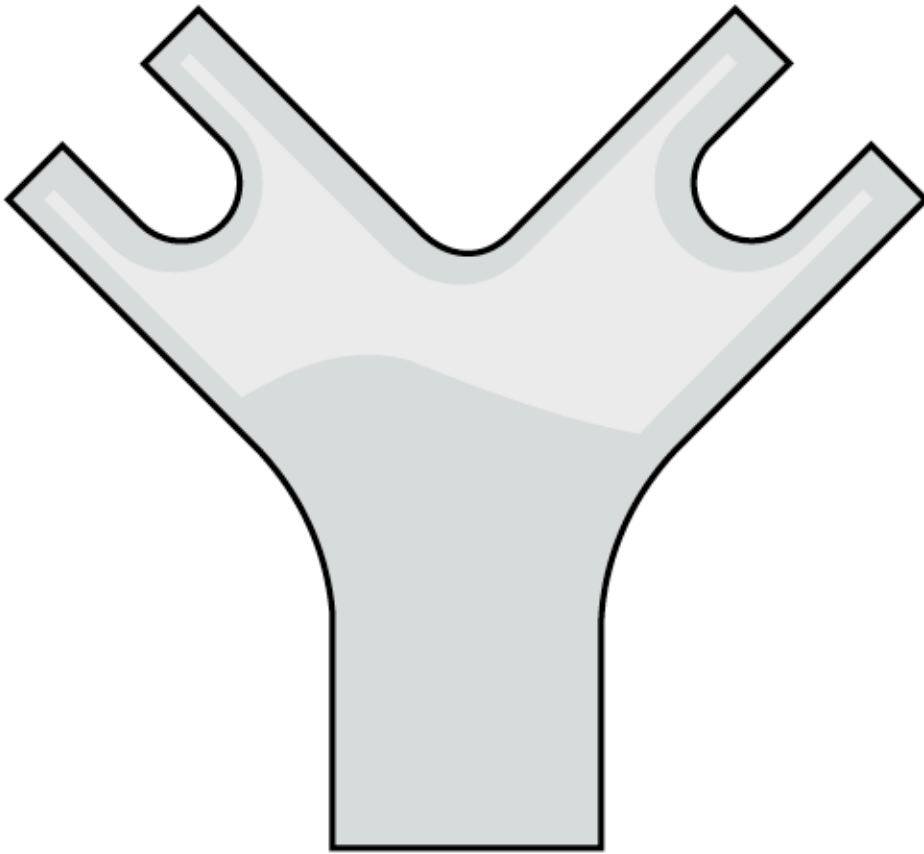
Curriculum Guides

Emerging and Re-emerging Infectious Diseases. National Institutes of Health Curriculum Supplement Series Grades 9-12. Publication No. 99-4645, 1999.

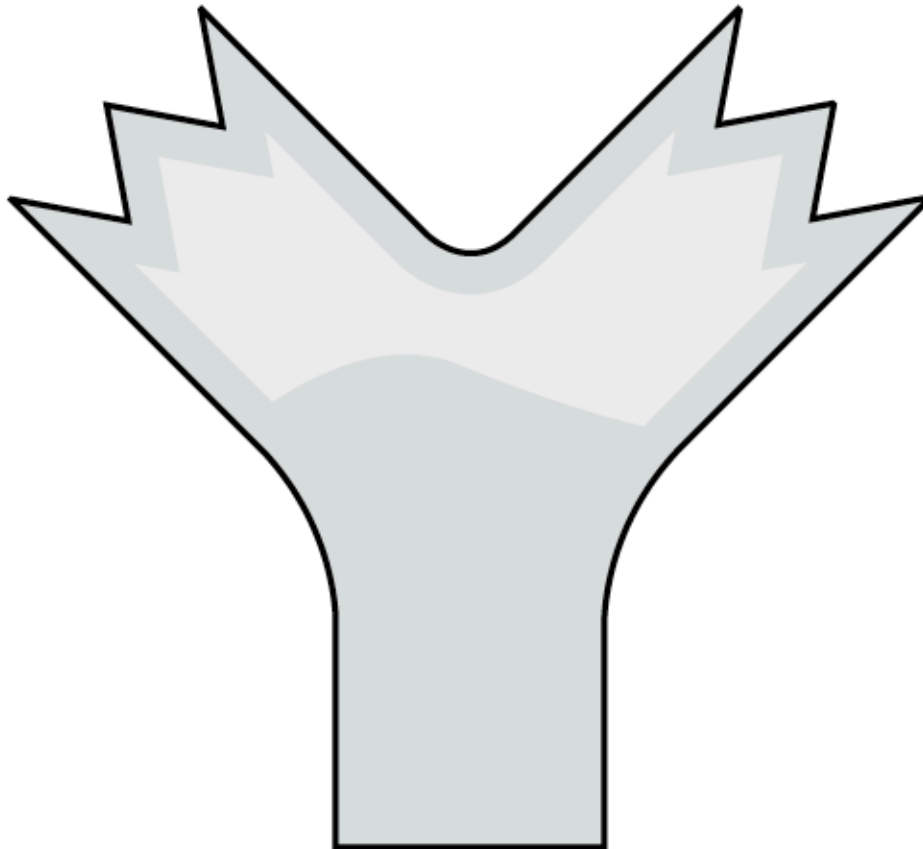
**Antibody 1 Template
Teacher Version**



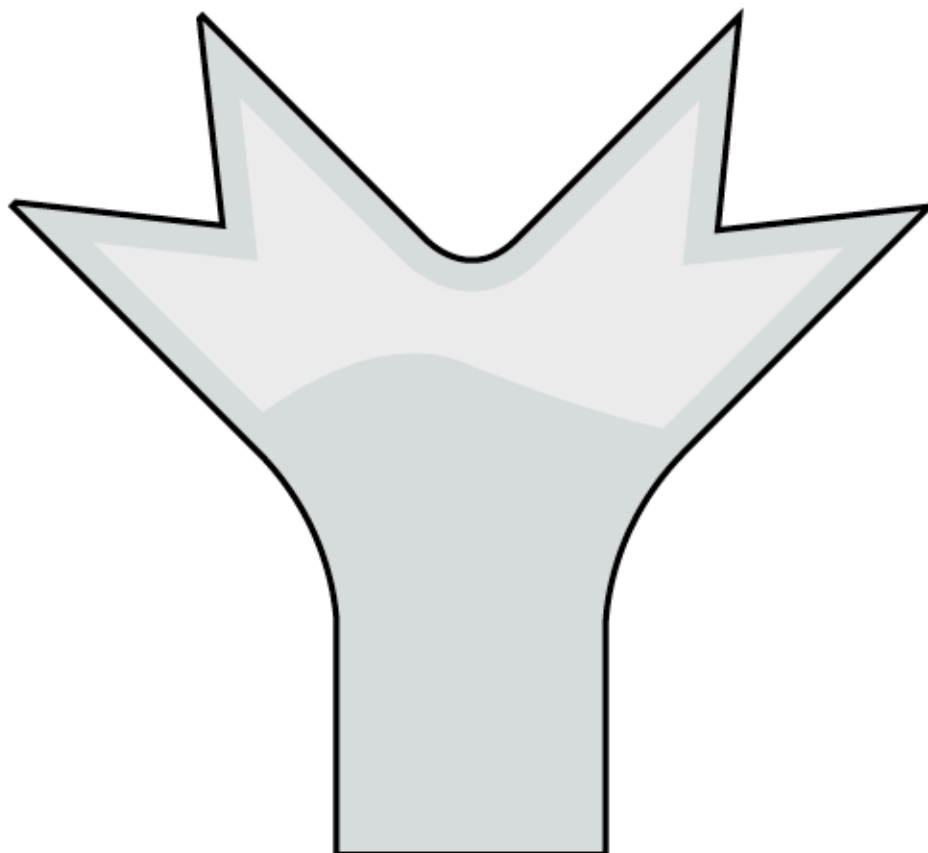
**Antibody 2 Template
Teacher Version**



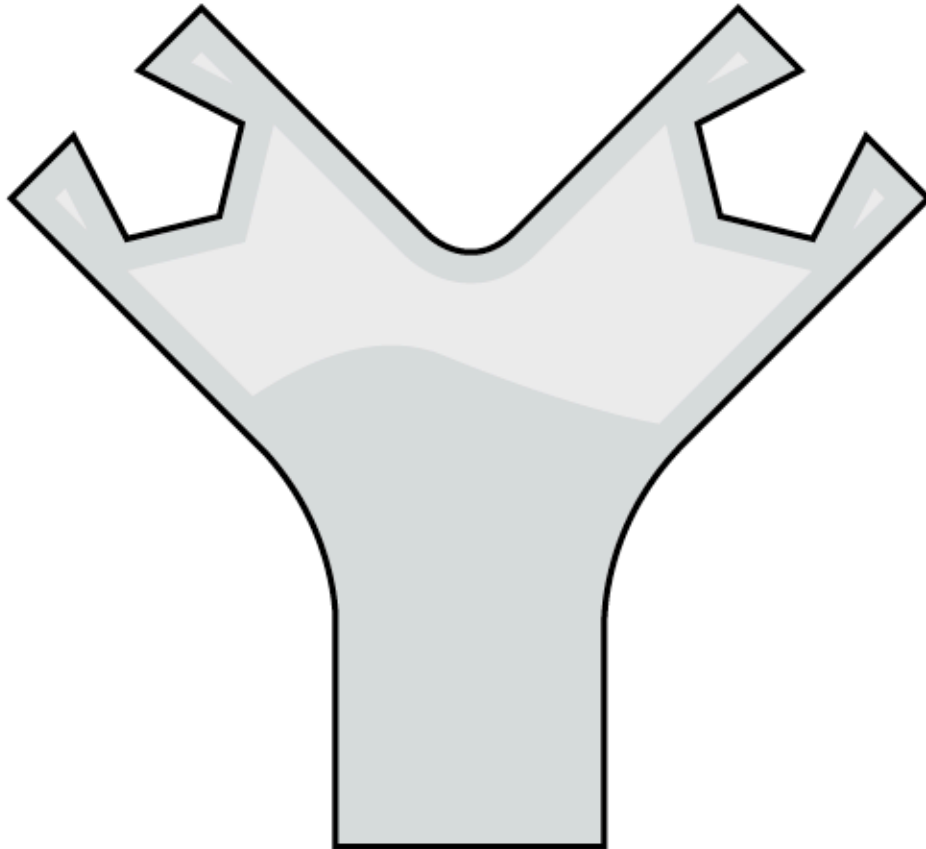
**Antibody 3 Template
Teacher Version**



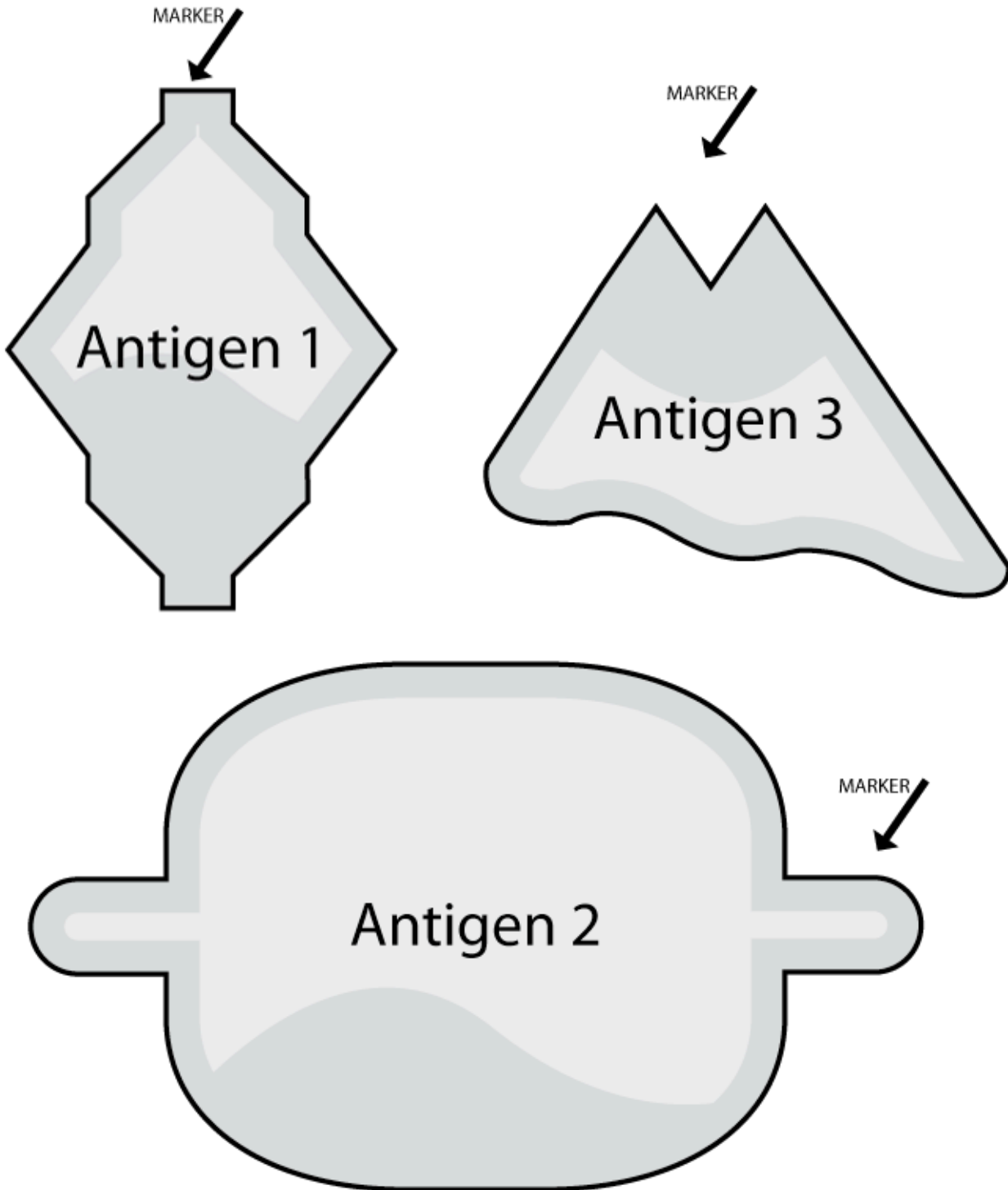
**Antibody 4 Template
Teacher Version**



**Antibody 5 Template
Teacher Version**



Antigen Templates



Antigen Templates

