Pandemic
High School Lesson Plan

Topic
Immunology

Grade Levels
9-12

Overview
QUEST *Pandemic* provides a glimpse into the world of studying contagious diseases. Over the course of this teaching unit, students will learn about viruses and bacteria and the illnesses they cause. They will also learn about the history of identifying viruses and bacteria, as well as some of the devastating results of early diseases before their causes were understood.

Introduction
Through the activities that follow, students will explore their understanding of disease, creating concept maps of their ideas. They will investigate infectious diseases and their causes as well as the human body's response to disease. Finally, students will examine their schools and homes for potential ways in which infectious diseases can be spread amongst students and their families, and they will explore ways in which to prevent this from happening.

Time Allotment
Five 45-minute class periods.

Accessing Prior Knowledge
Students should understand the general workings of the human body and its systems, particularly some information about the immune system. They should also have a basic understanding of human anatomy. It would be beneficial if students were familiar with what bacteria and viruses are.

Concepts to Clarify
Most high school students have a good understanding of the digestive, respiratory, and circulatory systems, but not the immune system. Many students think that all diseases are the same. They may think that all diseases are caused by germs, but they may not recognize the differences between bacteria and viruses. They may also think that all infections cause disease, not that disease occurs when an infection overpowers the body and causes a malfunction of tissue or organs. Additionally, some students may think that every disease acts the same way, and that all are equally virulent. Finally, some students may have difficulty expressing the difference between preventing a disease and curing a disease.

QUEST: Investigating Our World is a regional public television series seen on Maine Public Broadcasting Network, Vermont Public Television, and New Hampshire Public Television

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CONNECTIONS TO THE STANDARDS

National Science Education Standards	Benchmarks for Science Literacy	Maine Learning Results	New Hampshire Curriculum Framework	Vermont Learning Standards
Science in Personal and Social Perspectives: Personal and Community Health (9-12) F 1b: The severity of disease symptoms is dependent on many factors, such as human resistance and the virulence of the disease-producing organism. Many diseases can be prevented, controlled, or cured. Some diseases, such as cancer, result from specific body dysfunctions and cannot be transmitted.	The Human Organism: Basic Functions (9-12) 6 C1: The immune system is designed to protect against microscopic organisms and foreign substances that enter from outside the body and against some cancer cells that arise within.	Science and Technology: Cells (9-12) C 4: Explain how the human body protects itself from diseases and how the body might lose that ability.	Life Science 3d (Curriculum Standard): Students will demonstrate an increasing ability to understand fundamental structures, functions, and mechanisms of inheritance found in microorganisms, fungi, protists, plants, and animals. By the end of 10th grade, students will be able to: – Describe the life cycles of representative organisms that cause human diseases. – Describe the use of technology in the prevention, diagnosis, and treatment of disease, e.g., sanitation. medicines, organ transplants, and adequate food and water supplies.	The Human Body (9-12) 7.14.ccc: Analyze and describe how the health of human beings is affected by diseases passed through DNA, environmental factors, and activities that deliberately or inadvertently alter the equilibrium in ecosystems.

Materials Needed

- TV with VCR
- QUEST *Pandemic* video
- Computers with Internet access for student or teacher use (to download articles)
- Chart paper and markers
- Paper
- Colored Pencils
- Index Cards
- 1 copy per student of each of the following reproducible handouts:
  - Student Handout 1: QUEST *Pandemic* Viewing Guide
  - Student Handout 2: Infectious Disease Summary Sheet
  - Student Handout 3: The Human Body's Immune System
  - Student Handout 4: Mechanical Malfunction
  - Student Handout 5: Preventing Disease at Home
  - Student Handout 6: *QUEST* at Home: Pandemic of 1918: Local History

1. Introducing the Concepts

In the following "first-word" activity, students will use each letter in the word "disease" to start a sentence containing a fact about infectious diseases. The class will then share their ideas with each other. Next, students will work together to create a concept map. Finally, after viewing the QUEST *Pandemic* video, they will add any new ideas to their map.

Activity 1

Step 1

Begin by having each student write the word **DISEASE** on a piece of paper. Instruct them to use each letter in their word to start a sentence that contains a fact about diseases. This allows students to write what they know about diseases and for teachers to gauge their understanding.

Step 2

Once everyone has completed their sentences, have students work in teams and share their facts. Then, using chart paper, create a master list of facts about diseases as students read their sentences. Probe students' thinking about their sentences to guide them toward clarity and accurate facts.

Step 3

After all ideas have surfaced, distribute paper and colored pencils to the class. Have students work individually to create concept maps on infectious diseases. Instruct them to create one bubble for each

idea, and to add lines or arrows that show how the ideas are related. Stress the importance of students indicating on their maps how each idea relates to another. When their maps are complete, have students discuss their maps in their original teams. Tell them to add any new ideas to their maps in another color.

Step 4

Distribute copies of Student Handout 1 (QUEST *Pandemic* Viewing Guide). Tell students that they are to use this handout for note taking as they watch a video about infectious diseases. Review the questions on the handout with the class, clarifying as needed. Have each team discuss who will be responsible for answering each of the questions, making sure that this responsibility is evenly divided.

Step 5

Show the QUEST *Pandemic* video, reminding students to take notes. It may be necessary to pause the video periodically to allow students to write. Show the video from the start through the discussion about pigs and avian disease vectors, then to the section about the World War I troops returning from Europe.

Step 6

After showing the video, have each team discuss their answers to the questions on Student Handout 1. Allow time for team members to complete their information sheets. Then discuss the questions as a whole class. Finally, have students add or revise their concept maps based on the information presented in the video.

2. Exploring the Concepts

The next activity will help students clarify their thinking about the differences between infectious and noninfectious diseases and between viruses and bacteria.

Activity 2

Step 1

In teams, have students brainstorm a list of all the diseases they are aware of. Give each team a stack of index cards and ask them to put the name of one disease on each card. Then ask them to sort their cards into categories and identify the names of their categories. When they have finished, have teams share their card sets.

Step 2

If no one has specified the categories of infectious and noninfectious diseases, ask students to sort their cards again based on those categories. Then ask them to write a list of criteria indicating what determines a disease to be infectious versus noninfectious.

Step 3

Ask students to think back to the story about the troops that was in the *QUEST* video. Ask them to identify how the influenza could have spread from those who were sick to those who were healthy. During this discussion, clarify for students the difference between *infection* and *disease*. (An *infection* is when a disease-causing microorganism – a pathogen – enters the body. In many instances, the individual's immune system gets rid of the "invader" and the individual does not get sick. If, however, the person's body does not destroy the pathogen and it reproduces and spreads, it can cause damage to the cells and tissues of the body, thus causing *disease*.)

Step 4

Ask students if they can identify whether a disease is caused by a virus, a bacterium, or another type of pathogen. During this discussion, clarify their understanding of the differences between bacteria and viruses. If students know which agent causes one or more of the diseases listed on their cards, have them write this information on the appropriate cards.

Step 5

Next lead a discussion about how contagious an infectious agent (a virus or bacterium) may be, as well as how virulent it may be (how well it can survive the body's immune system attacks against it).

Have students take their cards that are currently grouped under the category of infectious diseases and have them arrange these cards in a continuum from those that are very contagious (spread easily from person to person) to those that are not.

Ask student to look at the cards listing diseases that are very contagious. Then have them arrange these cards in a continuum from virulent (reproducing quickly and causing symptoms that indicate the malfunctioning of tissues) to less virulent (having a small chance that even if it infects the body it will cause disease).

Step 6

Distribute copies of Student Handout 2 (Infectious Disease Summary Sheet). As homework, students should choose one of the infectious diseases listed on their cards and write a summary report on it following the guidelines on the handout. The Centers for Disease Control Web site has a Resources for Students page that contains valuable sources of information for student research: *http://www.cdc.gov/ncidod/student.htm*.

3. Developing the Concepts

In the next activity, students will identify the human body's defense strategies. They will create flow charts that identify sources of infection and immune system responses, outlining which parts of the body's systems become involved as infections of various kinds occur.

Activity 3

Step 1

Distribute copies of Student Handout 3 (The Human Body's Immune System). Ask students to read the handout. Answer any questions they may have about their reading. Using their Infectious Disease Summary Sheet they completed for homework, have students work in teams to discuss how Handout 3 relates to the disease they researched. Have each team share their ideas with the whole class.

Step 2

Working in teams, students should diagram the body's response to infection in a flow chart. Have one team share its ideas and other teams add to it.

Step 3

Distribute copies of Student Handout 4 (Mechanical Malfunction). Ask students to read the story in Part 1 of the handout. Then have them proceed to Part 2, where they are directed to consider the story they have just read as an analogy. If any students are unclear about the meaning of the term analogy, take a few minutes now to explain and provide some examples.

Step 4

As directed in Part 2 of Student Handout 4, have students work individually to discover which sections of the reading in Part 1 are analogous to the description of the human body's immune system on Student Handout 3. Allow adequate time for all students to complete their charts on Student Handout 4.

Step 5

As a whole class, discuss what in this extended analogy students have found to be appropriate and what they feel is not a close match.

4. Synthesizing and Applying the Concepts

In the following activities, students will analyze various pathways for infection around their school and home. At school, working in teams, they will design a program to eliminate specific pathways and educate others to prevent the spread of infectious diseases. As homework they will plan with their families how to avoid spreading disease in their home and car.

Activity 4

Step 1

In class have students revisit the concept maps that they created in Activity 1. Instruct them to add, in another color, any new ideas they have learned about diseases. Indicate that their next task is going to be to inform their school about infectious diseases and how they can help prevent their spread in the school.

Step 2
As a class, try to identify which infectious diseases students think present the most serious problem at their school. List these diseases on chart paper or on the board.

Step 3
Next, have students work in their teams to identify how they think one of the diseases listed spreads between pupils at school.

Step 4
Have student teams share their ideas with the rest of the class. On the board or on chart paper, draw a map of the school. Have students come up and identify locations, such as drinking fountains, sinks, hallway contacts, or the salad bar, that are potential places for becoming infected. Mark each location separately with a different symbol for each disease.

Step 5
Using their background research and the other immune system information they have gathered on Student Handouts 1-4, have each team develop a flyer or poster along with a fact sheet on the disease they selected from Step 3 to distribute at school.

With the class, establish criteria for assessment of the posters and fact sheets. Also, be sure to determine how each member of the team will be scored. If possible, create a scoring guide that will allow students to score each other and themselves.

Step 6
Distribute copies of Student Handout 5 (Preventing Disease at Home). Review the contents of the handout with students and explain that they will be doing this activity with their families. Make sure that students understand they will be analyzing the occurrences of infectious diseases within their families and among their friends. They will examine their homes for potential pathways through which disease could be spread and determine a plan for changing people's habits in order to reduce the potential for spread of the disease. Assign a reasonable due date for completion of the activity.

Step 7
On the appointed day, have students share their findings with the rest of the class. Discuss similarities and differences in students' discoveries. How many disease pathways were found in common? How many similar/different habits did they find that needed to be changed? If possible, share the findings with the school nurse and principal asking them to select ones for posting or distributing in the school.

5. Extending the Concepts

QUEST at Home

Use this activity for a homework or extra credit assignment. Distribute copies of Student Handout 6 (Pandemic of 1918: Local History). Review the contents of the handout with students. Assign a due date.

Community Connections

Many communities have public health departments. These agencies can be responsible for things such as treatment of water and sewage; they may also house public health professionals who distribute vaccines. With students, arrange a visit with one of your public health officials to learn more about how they protect the health of the community.

Immunology is the study of the human immune system. There are many diseases that scientists and doctors are now studying in an effort to discover cures or to prevent their spread. If possible, visit a hospital, health clinic, or lab with your students to learn what doctors and other health professionals might be working on in the field of immunology.

Health clinics have been established in many communities to supply vital health services. They often have volunteer opportunities, particularly for special events like kindergarten health screenings, vaccination days, blood pressure days, and so on. Explore such opportunities with your students and encourage them to become involved.

School nurses play an important role in maintaining health at school. Some school nurses may also help with health classes as well. With your students, spend some time with your school nurse to learn about the job requirements of this important professional and how such a position benefits the school.

Career Opportunities

Health Practitioners: These are individuals with varying degrees of education in medicine. Training programs range from two years to eight years for nurses to physician assistants and doctors. All have direct responsibilities for patients.

Lab Technicians: These individuals can do jobs from taking x-rays and cat scans to testing blood samples. They work to provide additional information to the healthcare professionals to help them diagnose or treat patients.

Medical Researcher: Trained as doctors or technicians, these individuals spend their careers doing research on health issues. They can work for the World Health Organization, the National Center for Disease Control, or a private pharmaceutical company. Some are researchers and professors at universities.

Resources

Phylogeny of Life
This site offers an overview of the classification of organisms and information on viruses.
http://www.ucmp.berkeley.edu/exhibit/phylogeny.html

Kingdoms of Life
http://www.palaeos.com/kingdoms/kingdoms.htm#five_kingdoms

National Center for Infectious Diseases: Resources for Students
This is a great Web site for background information on any infectious disease.
http://www.cdc.gov/ncidod/students.htm

National Institutes of Health: Curriculum for High School
Emerging and Re-emerging Infectious Diseases, Grades 9-12
http://science-education.nih.gov/customers.nsf/hsdiseases?openform

Biozone Health and Disease
This site has a good set of links to many topics, including SARS or HIV.
http://www.biozone.co.uk/biolinks/Health-and-Disease.html

World Health Organization
Emerging health issues around the world are covered here.
http://www.who.int/en

QUEST *Pandemic*
Viewing Guide

Directions: While watching the *QUEST* video on infectious diseases, take notes to answer the following questions:

1. What was one of the first diseases that spread throughout the world and killed nearly 100 million people?

2. What is the term for the unusual entity or thing (which can be considered both living and nonliving) that caused the pandemic?

3. How does this entity reproduce?

4. What is a common disease caused by this entity?

5. Is there anything that can be taken as medication to fight this entity?

6. What conditions made the influenza epidemic that occurred during World War I so dangerous?

7. What factors about the reproduction of this entity make it so dangerous?

8. What is the difference between antigen drift and antigen shift?

9. What are two domestic species of animals that can carry diseases capable of spreading to humans?

Infectious Disease Summary Sheet

Infectious disease: _____

What kind of infectious agent causes this disease?

_____ Bacterium _____ Virus

_____ Other _____

_____

How does this infectious agent spread in the body? _____

_____

_____

What are the symptoms of this disease? _____

_____

_____

How does it spread between people? _____

_____

_____

What can be done to prevent this disease? _____

_____

_____

What can be done to cure this disease? _____

_____

_____

The Human Body's Immune System

The human body has two types of responses to prevent infectious disease. Some responses are considered *nonspecific* mechanisms that work to prevent infection and disease. Other responses are *specific* to particular types of pathogens (disease-producing agents).

Non-specific responses can be divided into (1) physiological barriers and (2) biochemical responses. For example, many infections occur primarily through natural openings in the body such as the mouth, nose, and mouth. Each of these openings contains defense systems, such as tears in the eyes, mucous in the nose, and saliva in the mouth. The skin can also be a source of infection. However, the physical environment on the skin is not conducive to the survival of viruses and bacteria. Skin is dry, hard to penetrate, has a high pH, and is often high in salts.

If a pathogen is able to penetrate the body's physiological barriers and enters the blood stream, another set of responses occurs which are biochemical in nature. A substance called *lysozyme*, which is an enzyme in blood, sweat, and some tissue fluid, can break down the invading bacteria. In addition, *phagocytic cells* in the blood can detect, track, engulf, and destroy the bacteria or the cells that viruses might have invaded in order to reproduce and spread.

If these responses do not overcome the invader, the body initiates a second response. Two types of cells are developed for this purpose. (1) *T-cells*, often called killer cells, develop in the thymus gland in the throat. These cells attack the pathogen cells and destroy them. They can also stimulate more production of the phagocytic cells. (2) *B-cells* develop in the bone marrow. These produce antibodies, which attach to the invading pathogen. A signal is then sent to produce more phagocytic cells to destroy the invader.

Mechanical Malfunction

Part 1.

Directions: Read the story below.

Rafael was working in the plant one night. He came in every night at 11:00 P.M. and cleaned up after the day shift. There was only a skeleton crew on at night, watching the machines as they produced the CD players. Rafael had just started working here. It was a good job; the manufacturing process was very clean, so the job was not hard.

Rafael began on the third floor and worked his way down. He was on the second floor when he came upon an area that was under construction. A new production line was being built; he saw the orange cones. He was amazed to peer down and actually see the clean room down below, where the CD readers were manufactured. Rafael continued his sweeping around the cones, not reflecting on the small particles of dust that floated down through the hole in the floor. He finished his work and headed home as the morning shift came in to start work.

Tonya, a first-shift worker, was just putting on her white lab coat and looking in at her production line. She was a college intern who was working as a production supervisor. Tonya spent eight hours a day watching three production lines that were making parts for the company's CD players. It was her job to be sure that all the manufactured parts matched the company's quality criteria. She had to inspect the new parts every hour and test them for specific criteria.

Tonya prepared to take her first sample from the production line. She intended to test the part against the first criterion. She usually did this quite casually, since the parts always matched the criteria; in fact, Tonya often felt that her job was useless. But she knew that the process had to occur, and if she did it quickly, she could get back to working on her college homework.

Tonya took a part off the line and made her first measurement. She was surprised. It was off by 2mm. This seemed like a small amount, but in the world of manufacturing, it was too big a variation. She measured again. Her first measurement had been correct. The part was off by 2 mm. Tonya took another part off the same line and measured it. It, too, was off by 2 mm. She knew the protocol. She needed to call the mechanic on the floor to check the machining. But, to do this, Tonya would have to shut down the line. She knew that if she shut down the line, the company would begin losing money because of the drop in production. Tonya did not want to do that for no good cause. Yet, she also did not want to produce parts that could not be used; that would also cause the company to lose money. She took her third sample and measured. Yes, it, too, was off by 2 mm. Tonya flicked the switch.

She saw the floor mechanic, Sam, coming toward her production line. He did not look happy. He was busy trying to string new wires to put in the new production system. Sam and Tonya discussed her problem. He smiled and told her that she had done the right thing. He would check the machine's adjustments. Sam suggested that she look through the parts that had come off the line and pull out all of the bad ones. They were stacked in boxes on a flat near the door, ready to be moved to their next assembly site. Tonya opened one box after another, measuring the parts. Each box was marked with a time. It was not until she got to the boxes containing parts that had been completed early in the morning that she found one that was the correct size. Tonya went to tell the mechanic.

Sam had been working hard to find the problem, but he was unable to identify what was throwing the machine off. Tonya said that protocol indicated she should call the engineer if they could not get the line operating properly. Sam asked her to wait, and he turned the machine back on. Some wisps of smoke puffed off one of the machines.

"Maybe that will clean it off," Sam said. They watched as the first part came off the line. No, it still measured 2 mm off. Sam flicked the machine back off, smiled, and waved as he walked back to his other project. This signaled Tonya that she should go ahead and call the engineer. According to protocol, she should first call the electrical engineer to be certain it was not a malfunction in the machine's computer.

Tonya called Jen. Jen would try to adjust the program directly to get rid of the fault and bring the measurement back in line. Tonya liked working with Jen, since she hoped perhaps to be an electrical engineer herself one day. Jen came and tested the program. Unfortunately, the problem was not in the computer or the software. Next it would be the mechanical engineer's turn to check the system; it must be something in the machine itself that had gone wrong.

Brian arrived with his tool bag. He seemed to have a million tools for fixing everything from inner parts of the computer to the larger metal stamping machines. As he walked into the room, he glanced up at the ceiling. He could look up to the floor above, where Sam was now working. Brian yelled up to Sam, "Where's the cloth to cover that hole so particles don't drop into this machine?" Sam grinned and pulled the cloth over the space.

Brian was smart. He immediately climbed up over the machines in the production line to see if any sawdust or bits of wire might have drifted into it. Sure enough, it looked as if Sam had been trimming wires; a few small pieces lay on top of the machines. They were tiny, but Brian explained to Tonya that when making parts like these, there is very little room for error. One tiny wire caught in the machinery could throw off the mechanics. Brian followed the production line until he found the machine that made the specific cut that was off. He traced the precision movements made by the machine. He located the one spot that could possibly affect the cut. He would need to spray some solvent that could disintegrate the piece of wire caught inside; then he would recoat the rod with fresh lubricant.

It did not take Brian long with his precision tools and sprays. He started the machine back up. He looked confident as Tonya removed the first manufactured part. It was still off, but this time by only 1 mm. Brian told her that the lubricant was just settling and that she should check the third part off the line. Tonya removed it, and sure enough, its measurement was perfect. She went on and measured the next three. All matched; she was back in production.

Part 2

An analogy is a comparison of things that may first appear dissimilar. For example, comparing the human brain to a high-speed computer is an analogy; comparing the human thyroid gland to a thermostat is another.

The story you have just read in Part 1 of this handout might also be considered an extended analogy to the human body's immune system. Review the Mechanical Malfunction story above. Then compare it with the description of the human immune system on Student Handout 3. Identify any roles of the immune system's defenses that are similar to the workers' roles described in the Mechanical Malfunction story. Make your analogies by completing the chart below.

Human Body's Immune System	Mechanical Malfunction Analogy	Pathogen
Physiological Barriers		
Phagocytic Cells		
Lysozyme		
T-Cells		
B-Cells		

As a follow-up, list the ways in which you find this extended analogy accurate. Then list the ways in which you do not find it accurate.

Accurate	Inaccurate

Preventing Disease at Home

1. Share with family members your concept map on disease and the disease summary sheet for one of the infectious diseases studied during class. Explain what you have learned about how infectious diseases spread.

2. Discuss which of the infectious diseases seems to be the most frequent problem for your family. Talk about how this disease may spread from one family member to another. Note at least three ways.

3. Take a walk through your home and check your family vehicles to see if you can identify places where you might be getting infected. Identify at least three.

4. Make a plan to change some family habits during cold and flu season. Discuss how this will decrease your chances of spreading viruses and bacteria among family members. List three ways your family can reduce the spread of diseases in your home and car.

Pandemic of 1918: Local History

You're on a Quest!

Explore how your town might have been affected by the Influenza Pandemic of 1918 discussed in QUEST *Pandemic*. Remember many individuals died in New England during that pandemic.

1. Ask members of your family if anyone in your family died during the 1918 Pandemic. You can also ask friends of your family who might remember.

2. Ask older members of your family and/or community if they remember how your town was impacted. For example, theaters were closed, people were arrested for spitting, and some people wore masks during the pandemic.

3. One of the best sets of historic records in any community is in the local cemetery. Family histories can be traced and disasters are recorded through multiple deaths in the same year. If you can, visit one of your local cemeteries. If you are unfamiliar with where it is located, ask at your historic society or town hall. When going, you may want to record the names and dates from the headstones. Take some note paper and perhaps a camera. You may also want to make a charcoal rubbing of some of the headstones you see.

Walk through the cemetery looking for gravestones dated October 1918. These individuals (along with some dated September 1918 and November 1918) are likely to be flu victims, not the fallen of World War I. Do you recognize any names?

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