Virus Tracker

Throughout the guide teaching tips are in red.

Activity Description and Estimated Class Time

This series of activities requires two 50-minute blocks. During the first session, students gather data about a simulated epidemic spreading through the class. During the second block, the class tries to find out who started the epidemic and explores the science behind the spread of diseases.

Objectives

Students will demonstrate their understanding of:

- differences between infectious and non-infectious diseases.
- ways infectious diseases can spread.
- ways infectious diseases can be prevented.
- ways data are used to look for patterns in the spread of a disease.

Correlations to North Carolina Science Standards

8.L.1 Understand the structure and hazards caused by agents of disease that effect living organisms.

8.L.1.1 Summarize the basic characteristics of viruses, bacteria, fungi and parasites relating to the spread, treatment and prevention of disease.

8.L.1.2 Explain the difference between epidemic and pandemic as it relates to the spread, treatment and prevention of disease.

Brief Science Background

Infectious diseases are caused by the growth and reproduction of disease-causing organisms (such as bacteria, viruses, or parasites) in a host. Infectious or "communicable" diseases spread to other organisms by some kind of contact with an infected person (carrier) or through animals such as ticks, fleas, or mosquitoes (vectors). Contact can include contact through the air (e.g. from coughing) or with objects an infected person has touched. When many people in a local area are infected, it is an epidemic. When a disease spreads around the world, it is a pandemic. In the US, the Centers for Disease Control (CDC) monitors disease and tries to prevent outbreaks. The CDC works with local health agencies to track diseases. It uses models to predict and reduce the spread of infection.

Materials

Digital Materials

- Video clips **http://www.pbs.org/wgbh/nova/sciencenow/3318/02.html**
  http://www.npr.org/templates/story/story.php?storyId=114075029
- **https://www.youtube.com/watch?v=6yV6uZSAeu8**

Materials for the Teacher

- vinegar
- rubber glove
- 1 dropper bottle of virus indicator solution (phenolphthalein)

Materials for the Whole Class

- 6 destination cards
- 8 dice
- 15 permanent markers
- infected saliva solution (sodium carbonate)
- clean tap water (or if indicator turns it pink, use distilled water)
- BLM-2 Class Exchange History Chart (ability to project)
- BLM-3 Virus Tracker Wrap-Up (ability to project)

Materials for individual students

1 food service tray containing:

- 3 empty 1 oz cups with lids
- BLM-1 Student Exchange Recording Sheet
- science notebook
- Microbe Cards (1 set per pair of students)

Preparation

Preparation (15 Minutes)

1. Place destination cards at 6 stations around the room.

2. Prepare 'original saliva' cups (prepare 1 set for each class).

a. With a permanent marker, number one cup for each student starting with 1 through the number of students in the class.
b. For a class of 15-35, fill two of the labeled cups ¾ full with infected saliva solution (sodium carbonate). For 8-14 students, fill one cup with "infected saliva solution." Record the numbers of the infected cups and keep that record to yourself.
c. Fill the rest of the labeled cups ¾ full with tap water. These are "uninfected."
d. Set aside 2 extra uninfected cups and 1 extra infected cup. Use these to replace any spills that happen before the first exchange (after the first exchange, a spill removes the student from the activity). When replacing spills, replace infected with infected and uninfected with uninfected. Mark the number of the spilled cup on its replacement.

3. Prepare one food service tray for each student to include 3 empty 1-oz cups and 3 lids.

Part 1 – Spreading the Virus (40-50 minutes)

Procedure

1. Explain that we will simulate a disease spreading through the school. A virus carried in saliva causes the disease. A tiny amount of saliva is enough to spread the disease. Ask students to respond to this prompt in their notebooks:

Notebook Prompt 1

List possible ways that saliva could transfer from one person to another, even in tiny amounts. After students write, discuss as a class. Examples might include:

- sharing drinks or food
- kissing or sexual contact
- shaking hands
- touching objects (doorknobs, drinking fountains, etc.) that an infected person had recently touched and then touching your mouth or eyes
- coughing or sneezing

2. Explain that we will simulate a day at school. Give each student a BLM-1 Student Exchange Recording Sheet. Ask them to use it to track what happens during the day.
3. Give each student a tray with 3 empty 1 oz cups and lids. Ask students to initial their cups and label their cups - one cup "morning," one cup "lunch," and one cup "after school" using a permanent marker.
4. To begin the simulation, each student must know where to make the first exchange. To find the morning destination, each student rolls a die and matches it to the key on the BLM-1 Student Exchange Recording Sheet. Record this location on the sheet. The destination key also shows the number of exchanges at each location.
5. Explain that you will receive cups of artificial saliva to exchange with classmates. Demonstrate an exchange as follows.
   a. Use 2 sample cups (cups not used in the real activity), labeled 7 and 10, half full with water.
   b. Pour all of the liquid from one cup into the other.
   c. Pour half the mixed liquid back into the empty cup so that both cups are half full.
   d. Show how both students record the name and cup # of the person exchanged with on the Student Exchange Recording Sheet.

TIP: Some students may have to make extra exchanges in order for all students to have an exchange at a given location. In other cases, students will not be able to make the designated number of exchanges. Either is OK.

6. Give each student a pre-numbered 'saliva' cup. Ask them to record its number on the Student Exchange Recording Sheet.

TIP: Students should think that the cups are given out at random, but give infected cups to students who can handle potential teasing about spreading a disease.

7. Ask students to remove the cups and lids from their trays and pour enough of their original saliva into the morning cup to half fill it. Cap the original cup and put it in the tray. Once a cup is capped and in the tray, it is not used again.
8. Tell students to take their morning cup to their morning destination, make exchanges, record them on the Student Exchange Recording Sheet, and return to their seat.
9. After all students exchange and return to their seats, ask them to transfer ½ of the 'morning' saliva into the 'lunch' cup so that each lunch cup is now about a quarter full, then cap the 'morning' cup and set it in the tray.

10. Have students determine their lunch location by rolling a die. If someone rolls a location they have already visited, roll again until they get a new place. Have everyone go to lunch destination, make exchanges, record them on Student Exchange Recording Sheet, and return to their seat.
11. After all students return to their seats, ask them to transfer ½ of the lunch saliva into the 'after school' cups so that each after school cup is about an eighth full, then cap the lunch cup and put it in the tray. When they are ready, they can roll a die to determine the 'after school' destination. As before, if someone rolls a destination they have already visited, roll again until they get a new destination. They will go to the after school destination, record the location, exchange with the number of people indicated, record who they exchanged with, and return to their seats.
12. This time, after students return to their seats, each tray will have three capped cups: original, morning, and lunch. Explain that we will check for infection by putting drops of virus indicator in the 'after school' cups. If the saliva turns pink, it has the virus. During the test, hold up cups for all to see. Test all cups. Wear rubber gloves and be sure that phenolphthalein does not contact students. Although numbers vary, 50% - 100% of the class will be infected. Ask everyone to record their disease status on the Student Exchange Recording Sheet. After testing, you can throw out after school cups but save all capped original, morning, and lunch cups.
13. Ask the class: For a disease to be this widespread, how many people do you think were infected at the start of the epidemic? After they speculate, tell them that only two students were originally infected and in the next class we will try to find out who they were.
14. Be sure that each student's tray with the three cups capped is put off to the side.

Part 2 – Whodunnit? (20-30 minutes)

Procedure

Procedure: The class identifies the originally infected people

1. Remind the class that two students had the virus at the beginning of the epidemic. Explain that our problem is to identify the two originally-infected students. Allow students a few minutes to try to solve this problem. **TIP: If almost everyone is infected, it is difficult to identify the two originally-infected students. However, spending time puzzling through the problem helps students to understand the challenges of finding the source of an epidemic.**
2. When the CDC sees these widespread epidemics, they investigate the recent history of infected people. We can do that by testing the lunch cups. Test all lunch cups.
3. Ask small groups to start working on the problem of finding the originally-infected students. **TIP: Students might get frustrated, but give them time to struggle.** After 5-10 minutes, stop the discussion. Ask for the following notebook entry:

   Notebook Prompt 2 - "What information would be most useful in identifying the originally infected people?"

   When writing is done, ask for answers. Accept all.

4. Explain that the history of exchanges for all students might show patterns in the spread of the virus. To do this, have all students record their exchange history on BLM-2 and project the completed chart for the whole class. Below is an example. In column 1 (original cup #1), a student exchanged with cup #s 13 and 2 in the morning, and 4, 19, and 28 at lunch, and 6 after school. If you prefer an Excel file of BLM-2 to record student exchange data on your own computer, go to **http://ciblearning.org/lesson-materials** and click on "Grade 8 Life Science Materials," and enter password **learn16$**

Original Cup #	1	2	3	4	5
Morning	13, 2				
Lunch	4,19,28				
After School	6				

5. While small groups are looking at the projected BLM-2, challenge them to identify the originally-infected people. Explain that the class will get only three tests of original cups. Ask each group to be ready to explain which three cups they want to test, and in what order. They will need to give the class evidence and reasoning to support their strategy. Project this challenge:

   Devise a strategy to find the originally infected people using only 3 tests of the original numbered cups. Prepare:

   - the three cup #s
   - the order of testing
   - the evidence and reasoning that supports this strategy

6. As groups decide which original cups they want to test, lead a class discussion to determine which one the whole class will test first. After the whole class agrees, test that original (numbered) cup and let the whole class see the result. Discuss results and get the class to agree on which cup to test next. Repeat as above, and continue until the originally-infected students are identified. **TIP: It might take more than 3 tests; do as many as you need. However, to focus the class effort, tell students that they will only get 3 tests.**

7. After determining the originally-infected people, ask each student to record on their sheet when, and by whom, they think they were infected and justify the prediction. Test each student's lunch and morning cup. Compare results to predictions.

8. Clean up. Pour contents of all cups into one container and neutralize with vinegar until the liquid is no longer pink. Pour down the drain. Discard all cups, lids and trays.

Virus Tracker Wrap-Up (20 minutes)

Lead a class discussion about an infectious disease spreading through the school of 900 students. Imagine that 24 students have symptoms of this highly contagious disease that causes coughing and sneezing. Of the 24 who are infected, 20 are at school and are actively mixing with many other students. The other four are at home.

1. If no preventive measures are taken in the next few days, how many of the 900 students would you expect to get sick and why?
2. After three days, many students are already infected. You are the principal. Rank the preventive measures listed below in order of effectiveness (most effective at the top) and explain your rankings. Project these options from BLM-3:

   a. Add hand sanitizers in each classroom.

   b. Cancel the school dance and football game.

   c. Any student with symptoms would be sent home until the symptoms are gone.

   d. Cancel school for three days.

   e. Ask students to wash hands throughout the school day.

TIP: There is no correct ranking. Use this opportunity to lead a discussion about prevention and treatment.

3. Afterward, project BLM-3 Virus Tracker Wrap-up to introduce and define the terms epidemic and pandemic. Ask students to speculate which definition applies to the class simulation.
4. To better understand an actual pandemic, watch the following NOVA video: **https://www.youtube.com/watch?v=6yV6uZSAeu8**
5. To address microorganisms that cause epidemics and pandemics, explain that only a small portion of microorganisms cause disease. Define the terms "pathogen" and "host." A host is any organism (including a human being) that gets infected, whether or not the infection causes disease. A pathogen is an infectious agent that causes disease in a host. Explain that different disease organisms spread in slightly different ways. Give each pair of students a set of microbe cards, and ask them to find examples of each of the following that are pathogens:

   - a virus
   - a bacterium
   - a fungus
   - a parasite (such as Giardia, a protist)

Answer Key:

The following microbe cards are considered pathogens:

2. Virus: Ebola (Hemorrhagic Fever)

3. Virus: Human Immunodeficiency Virus (HIV)

4. Protist: Giardia lamblia (intestinal parasite)

7. Virus: Influenza A (respiratory flu)

10. Bacteria: Borrelia burgdorferi (Lyme Disease)

11. Bacteria: Streptococcus pneumoniae (pneumonia)

13. Bacteria: Treponema pallidum (syphilis)

17. Fungi: Tricophyton rubrum (athlete's foot)

Name_____Original sample #_____Date_____

Morning exchanges:

Location_____ # of exchanges_____

Name and number _____

Name and number _____

Name and number _____

Lunch exchanges:

Location_____ # of exchanges_____

Name and number _____

Name and number _____

Name and number _____

After school exchanges:

Location_____ # of exchanges_____

Name and number _____

Name and number _____

Name and number _____

Disease Status after school day: _____

I think I became infected during the _____ **exchange**

I was infected by_____

Destination Key

Die number	Destination	# of Exchanges
1	cafeteria	3
2	concession stand	2
3	homeroom	2
4	gymnasium	2
5	library	1
6	principal's office	1

Class Exchange History Chart

original cup #	morning	lunch	after school
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			

An infectious disease is spreading through the school of 900 students. Imagine that 24 students have symptoms of this highly contagious disease that causes coughing and sneezing. Of the 24 who are infected, 20 are at school and are actively mixing with many other students. The other four are at home.

1. If no preventive measures are taken in the next few days, how many of the 900 students would you expect to get sick and why?

2. After three days, many students are already infected. You are the principal. Rank the preventive measures listed below in order of effectiveness (most effective at the top) and explain your rankings.
    a. Add hand sanitizers in each classroom.
    b. Cancel the school dance and football game.
    c. Any student with symptoms would be sent home until the symptoms are gone.
    d. Cancel school for three days.
    e. Ask students to wash hands throughout the school day.

An **epidemic** is a widespread occurrence of an infectious disease in a community at a particular time.

A **pandemic** is an epidemic of infectious disease that has spread through human populations across a large region; for instance multiple continents, or even worldwide.

Student Misconceptions About Disease

Agents that spread infectious disease are invisible to the naked eye. Invisible things (such as atoms, molecules, and cells) are abstract for students. As a result, students often hold these wrong ideas:

- All microorganisms cause disease.

  Most microbes are either harmless or helpful. Those that cause disease are rare.

- Germs, bacteria, and viruses are all the same thing.

  Bacteria, viruses, and parasites are different kinds of organisms. A "germ" is any microorganism.

- There are different diseases but not different kinds of germ.

  Different kinds of germs cause different diseases.

- Infectious and non-infectious diseases are the same.

  Infectious diseases are passed from person to person. You cannot catch non-infectious diseases from another person.

- Prevention and cure of disease are the same thing.

  Preventing a disease keeps people from getting it. Curing a disease makes a sick person well. Prevention does not stop a disease from coming back; it just prevents it for now.

- People catch colds by getting cold and wet, not from a pathogen

  Being cold does not cause colds. Viruses cause colds. Being chilled for a long time could weaken someone enough to make them susceptible, but not give them a cold.