Teacher Notes for Traveling Viruses Part I and II

Background:
You – or your students - may already be familiar with this disease transmission simulation. It is often used for HIV/AIDS education to demonstrate how we can unknowingly become exposed to diseases. Students will exchange a clear liquid from numbered cups. At least one cup will initially contain sodium carbonate, while the rest will contain water. The reaction of phenolphthalein (a colorless indicator) with sodium carbonate (a base) will turn the solution deep pink or red.

Part I simulates person-to-person disease transmission, like the flu or a cold. Part II takes this a step further to portray vector-borne transmission of West Nile virus.

Set Up:
Prepare sodium carbonate solution by mixing:
1 g sodium carbonate (kit provides enough for several batches)
100 ml distilled water

Prepare phenolphthalein solution by mixing:
0.1 g phenolphthalein (kit provides enough for several batches)
100 ml 95% (200 proof) ethyl alcohol (NOT provided in kit)

NOTE: If you don’t have access to a scale, we have worked out the following measuring spoon equivalencies:
1/4 teaspoon sodium carbonate
1/4 of 1/8 teaspoon phenolphthalein (sorry…best we can do!)

Procedure for Part I

1. Number one cup for each student. About 10% of students should receive sodium carbonate solution in their cups. For example, in a class of 25-30, fill all but about three cups with distilled water. Fill the three cups with sodium carbonate solution. Fill the cups about half to two-thirds full. Record the number/s of the cups that contain sodium carbonate.

2. Set out the cups with a pipette in each one. Have each student take a cup. This is a paired activity. If you have an uneven number of students, invite your principal, another teacher, aide, or include yourself.

3. As per the Student Guide, encourage your students to mingle and move around. After a minute or two, say “Exchange!” At that signal, students should put two droppers full into the cup of the person across from them.

4. Students MUST record the number of each person in proper sequence with whom they exchange! This is crucial if you are going to ask your class to trace the spread of the disease. Teachers have used the following methods of recording numbers accurately:
   - Have a chart already posted on the board or chart paper for students to fill in after each exchange.
• For younger or special needs students, have pre-numbered dots stuck to each cup. Students swap dots when they exchange, placing them from top to bottom on the side of the cup to keep track of the exchange order.
• Students keep a post-it note attached to the cup to record numbers.
• Teacher travels among the class and records each exchange on a sheet.
• For an uneven numbered group, one student is assigned to fill in the chart at each exchange.

5. Repeat the exchange a second time. Include a third if you have the time. Remind students they are not to exchange with the same person twice.

6. After the last exchange have students return to their seats. Move around the room and add a drop of phenolphthalein solution to each cup. Once you see who is disease positive, review the chart. Have the class brainstorm ideas to deduce which cup/s carried the infection first.

Procedure for Part II

1. Prepare another batch of solutions as needed. Depending on the number of students in the class, you may at least have enough of the indicator solution.

2. As in Part I, set up a numbered cup for each student, with 10% filled with sodium carbonate. **THESE CUPS WILL ONLY GO TO BIRDS.** The purpose of this activity is to illustrate how birds are the hosts for West Nile virus. If any mosquitoes become infected with the virus, they will have contracted it from a bird.

3. In this activity, not all students are the same type of organism: half are birds and half are mosquitoes. Feel free to play around with a different percentage! You may have advanced students who can calculate representative numbers of each population.

4. Read and familiarize yourself with the differences from Part I.
   • Only mosquitoes get a pipette, which simulates a proboscis.
   • Bird-to bird transmission of West Nile virus occurs but it is airborne. Birds infect each other in this way: In large reservoir host flocks, the virus is excreted in feces, which becomes dry, powdery, and easily inhaled.

5. Review the rules for exchange in this activity:
   • Mosquitoes may take fluid from birds
   • Birds may not take fluid from mosquitoes.
   • Mosquitoes may not exchange fluid with mosquitoes.
   • Birds may exchange fluid with birds.
   • Selected mosquitoes may exchange with the human as the last step.

6. Carry out the same amount of exchanges as in Part I. Remind students to carefully record cup numbers in proper sequence. Compare and contrast the transmission of a vector-borne disease to other types of transmission.
Traveling Viruses Part I

Purpose
To generate a discussion of how diseases can be transmitted.

Materials
For each student:
- Disposable cup of unknown liquid and eyedropper

Background
You saw television news stories about West Nile virus in Connecticut. This vector-borne disease arrived here in 1999 and spread quickly across the United States. Not all outbreaks of disease are caused by vectors.

You and your classmates might have experienced such a disease outbreak. The flu, or influenza (its real name), spreads quickly in a closed area like a school. A student, unaware that the virus is multiplying within his body, brings it into the classroom. The flu virus escapes with a sneeze from the nose of its victim. It enters the bodies of nearby students. The disease takes a while to show up. During this incubation period, the disease organism grows in numbers. Finally it multiplies enough that symptoms appear, such as fever and aches. By this time, the disease has probably spread to infect even more people.

After a few weeks, the flu goes away. How did you get it? Did you touch a desktop, pen, book or backpack on which someone had coughed or sneezed? Did you touch an infected person directly? Did you share food or drink with a sick person? Were you in a closed room with an infected person?

This activity shows you how a disease can spread through a population. Imagine you are at a town meeting. You see people you know and stop to talk to them. One or more of them might be infected with the flu. They are contagious, but no one shows any symptoms yet. Do you have the flu? Will you get it?

Procedure
Caution: Some liquids in this activity are poisonous. Do not taste any of the materials or get any on your skin. If any liquid spills on you, wash it off immediately with plenty of cold water.

1. Choose any cup and eyedropper. On a piece of paper, record the number on your cup. Each cup and its content represent a person that might or might not have a disease.
2. Slowly walk around the room and occasionally stop to talk with someone at the meeting. Spend no more than five seconds talking to each person.
3. When the council president (your teacher) says “Exchange!” squirt two eyedroppers full of your liquid into the cup of the person you are talking with. Have that person do the same to your cup. Stir your mixture gently with the eyedropper.
4. Repeat steps 2 and 3 twice. Record the other person’s cup number for each exchange. Do not exchange with the same person again.
5. After the third exchange, take your seat. The council president will add a drop of indicator to your cup. If you are infected, the clear liquid will change to pink or red.

Conclusion
1. Compare and contrast the results of this activity to the transmission of a real disease.
2. Work together to make a chart that tracks the disease as it was transmitted. Try to use the chart to figure out the origin(s) of the disease.
Traveling Viruses Part II

Background

In Traveling Viruses Part I, you and your class were able to observe transmission of a disease from person to person (see Discovery Files: Vector-Borne Disease and Can I Catch It?). Now that you have seen one way a disease is transmitted, you can take a look at other ways pathogens get passed around.

West Nile virus is an example of a disease that is transmitted by a vector, the mosquito. Imagine a small pond somewhere in Connecticut. In the spring, this pond was the home for many larval mosquitoes. It is now early summer and lots of the mosquitoes have just emerged as adults. The pond also attracts birds that live nearby, including crows, jays, and robins. Several birds in the area became sick and died last fall.

Materials:
For each student “bird” and “mosquito”:
- Disposable cup of unknown liquid

For each student “mosquito”:
- eyedropper

Procedure:

Caution: Just as in Traveling Viruses Part I, some liquids used in this activity are poisonous. Do not taste any of the materials or get any on your face or skin. If any liquid accidentally spills on you, wash it off immediately with plenty of cold water.

1. For this simulation, half the class are mosquitoes and the other half are birds. Your teacher will assist you in dividing the class and handing out cups of liquid. Your teacher also will have a cup, and will be the only human in this simulation.

2. Every student gets a cup of unknown liquid. Only the mosquitoes get a dropper.

3. On a piece of paper, record the number on your cup. Each bird cup and its contents represents a possible host for West Nile virus. Each mosquito cup and its contents represents a possible vector for the disease.

4. Slowly walk around the room and occasionally stop in front of someone for a few moments. Spend no more than five seconds in front of each bird or mosquito.

5. When you hear a signal from the teacher, stay where you are. If you are not in front of anyone, just stand there and wait until the next round.

6. If you are in front of someone, follow these rules.
Mosquitoes:

If you are in front of another mosquito, do nothing.

If you are in front of a bird, take four droppers full of liquid from the bird and put them into your cup. Stir your cup gently with the eyedropper. Record the number of the bird’s cup on your paper.

Birds:

If you are in front of a mosquito, allow the mosquito to take four droppers full from your cup and put them into its cup.

If you are in front of another bird, very carefully pour a small amount from your cup into the other bird’s cup. Allow that bird to do the same to you. Both of you will gently swirl your cups to mix the liquid. Record each other’s numbers.

7. Repeat steps 4, 5, and 6 twice. Make sure you record a cup number for each exchange. Do not exchange with the same person twice.

8. After the third exchange, take your seat.

9. The human will then take an evening walk, at the exact time the mosquitoes are active. Three mosquitoes will be allowed to “bite” the human and put one dropper of liquid from their cups into the human’s cup.

10. Your teacher will then use a drop of indicator solution to see if the mosquitoes passed West Nile virus to the human. Once you know whether the human is infected, the teacher will add indicator solution to everyone’s cup.

**Conclusion:**

1. Compare and contrast the transmission of a vector-borne disease to other types of disease transmission.

2. Work together to make a chart that tracks the disease. Use the chart to find the origin of West Nile virus for this group of organisms.
Discovery File
Bacteria and Viruses

Your body is made of about 100 trillion cells!

The cells in your body are quite complex. Most have a nucleus and many special parts.

Bacteria are much simpler. A bacterium is made of only one cell but has no nucleus. And bacteria are small. Each is about 1/100th the size of a human cell.

Bacteria are like fish swimming in the ocean of your body. As they swim about, they eat and reproduce. And, wow, do they reproduce! One bacterium can become millions in just a few hours.

Viruses are completely different.

A virus is not really alive. It is just a particle of DNA or RNA with a special cover over it. When a virus comes in contact with a living cell, it attaches to it. The virus injects its DNA or RNA into the cell. The virus DNA or RNA takes over and uses the cell to make more viruses.

Eventually the cell dies and bursts open spewing millions of new viruses into the body of its victim. Each new virus particle can infect another cell.

This bacterium is only one cell, but it can grow and reproduce. The plural of bacterium is bacteria.

This is the West Nile Virus. Viruses have no living parts and must take over living cells to grow.
You are seated at a basketball game. The person next to you is sniffling, sneezing and coughing after every play.

Will you catch her cold?

The next day at school, you ask your friend for a pencil. Before he hands it to you, he wipes his runny nose with his hand...**the same hand he uses to give you the pencil!**

Is it too late? Will the pathogen on the pencil be passed to you? Will you catch his cold?

There are infectious diseases all around us, but knowing how diseases are spread can reduce or prevent your risk of infection.

Infectious diseases are spread in five basic ways: contact, air, food, water, and vectors.

**Contact**

Contact transmission itself happens in different ways:

*Direct contact* happens when a disease is spread from person to person or from an animal to a person by physical contact. This can happen with the exchange of body fluids (blood, saliva, etc.) or a playful scratch from your pet cat.

*Indirect contact* happens when the disease pathogens go from person to object to person. For example, your friend’s cold pathogens can pass to you on that pencil. Hand washing can help reduce the risk of infections spread by indirect contact.

Every contact transmission is either *direct* or *indirect*, but is also either *vertical* or *horizontal*.

*Vertical transmission* happens when the pathogens are passed from a mother to her offspring before birth.

*Horizontal transmission* occurs after birth.

**Air**

Some infectious diseases can spread through the air. A sneeze or cough can carry pathogen-laden droplets up to three feet away. If you are close enough, you can inhale the sneezed or coughed pathogens through your nose or mouth.
Some pathogens become airborne without being carried on droplets. The common cold, flu, TB and SARS can all be spread through the air this way. Small rooms with closed doors and windows and crowded indoor areas help the transmission of these airborne pathogens.

### Water and Food

Many disease-causing pathogens can live and breed in water. If you drink contaminated water you will probably get sick. This is a serious problem in the poorest places on earth where people lack good sanitation or the sewage treatment they need to keep their water clean.

Boiling water can help prevent water-borne diseases. Thorough cooking can help prevent food-borne diseases.

### Vectors

Some pathogens rely on other living things called vectors to carry them from host to host. Insects (mosquitoes) and arachnids (ticks) are common vectors. Birds and mammals often serve as hosts but they can be disease vectors too.

With West Nile virus, the vector is a mosquito. When a disease-carrying mosquito bites you, pathogens in its body can enter you. The deer tick—*Ixodes scapularis*—is a vector that carries Lyme disease.

You can reduce the risk of getting vector-borne diseases. Experts recommend avoiding *hot zones* during peak seasons and the use of insect repellant.

<table>
<thead>
<tr>
<th>Nickname</th>
<th>Real name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flu</td>
<td>influenza</td>
</tr>
<tr>
<td>TB</td>
<td>tuberculosis</td>
</tr>
<tr>
<td>SARS</td>
<td>Severe Acute Respiratory Syndrome</td>
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**Some diseases have nicknames. What are their real names?**