Transmission of Diseases

Text reference: Chapter 32, Section 32.1.

Time Required
- 50 minutes

Objectives
- Construct a model of disease transmission, using neutral and basic solutions.
- Observe the indicator color change that, in this lab, will stand for a test for a disease.
- Compare the results with class members.
- Interpret data to infer who the disease carriers in the model are.

Problem

In what way can a model be used to show how infectious disease is transmitted through a population?

Background

You have probably experienced a cold or flu and know what it's like to be sniffling and sneezing. It isn't just uncomfortable for *you*. When you sneeze, you can spread the viruses or bacteria if the airborne pathogens are carried in the aerosol droplets of the sneeze to the respiratory system of another person. More serious diseases like measles are also spread by casual contact from person to person. The rapid spread of diseases, known as epidemics, is of great concern to public health officials, who must learn how a disease is transmitted and attempt to control it. In this activity, you will simulate the transmission of disease in your classroom.

Recall that bacteria and viruses are causes of disease. Instead of real pathogens, you and your classmates will work with test tubes of solution that you will exchange with one another. A chemical test of the solutions will then identify which students are "carrying the disease." Think about how this process can simulate actual disease transmission.

Materials

- small stock bottle of solution (either neutral or dilute base)
- dropper
- small test tube
- small test-tube holder
- phenolphthalein indicator solution

Safety First!

In this lab, some of the solutions you will use may contain sodium hydroxide. Sodium hydroxide is a strong base and can burn the skin or damage clothes. Treat all lab solutions as if they were hazardous. Observe all precautions, especially the ones listed on the next page. If you see one or more safety icons beside a step in the procedure, refer to the list for its meaning.

- **CAUTION:** Wear your safety goggles. (All steps.)

- **CAUTION:** Wear your laboratory apron. (All steps.)
- **CAUTION:** Never taste any substances unless directed to by your teacher. (All steps.)

- **CAUTION:** Sodium hydroxide is a strong base and can burn the skin or damage clothes. If you spill any test solution on your skin or clothes, wash off the solution immediately with large volumes of water. Report the spill to your teacher as soon as possible. Follow your teacher's instructions for cleaning up any spill. (All steps.)

- **CAUTION:** Be careful of breakage when working with glassware. (All steps.)
- **NOTE:** Return or dispose of all materials according to the instructions of your teacher.

Procedure

1. Wear a laboratory apron and safety goggles. Your teacher will give you a numbered bottle of solution. Most solutions are neutral, and students having such solutions will represent healthy persons in the model. One or two people in the class will be given a bottle containing a dilute base, sodium hydroxide. The person or people will represent someone with an infection. **CAUTION:** *Do not let solutions touch your skin or clothing. If a spill occurs, flush the area with water and notify your teacher immediately.* Record the number of the bottle you were assigned in the space provided.

2. Use the dropper to transfer two droppersful of your solution into a test tube.
3. When your teacher gives the signal, begin the first round of transfers. Choose classmates at random. Use the dropper to transfer a dropperful of solution from your test tube to your classmate's test tube. At the same time, that classmate will give you a dropperful of his or her solution. Each student should trade solution with exactly one other student per trial. Record the name of the classmate in Data Table 1.
4. When your teacher signals you to do so, carry out a second round of transfers, repeating the process with a second classmate.
5. For the third round, repeat the process with a third classmate. Dispose of the dropper you have been using as instructed by your teacher.
6. Obtain the phenolphthalein indicator solution and, using its dropper, place two drops of phenolphthalein indicator

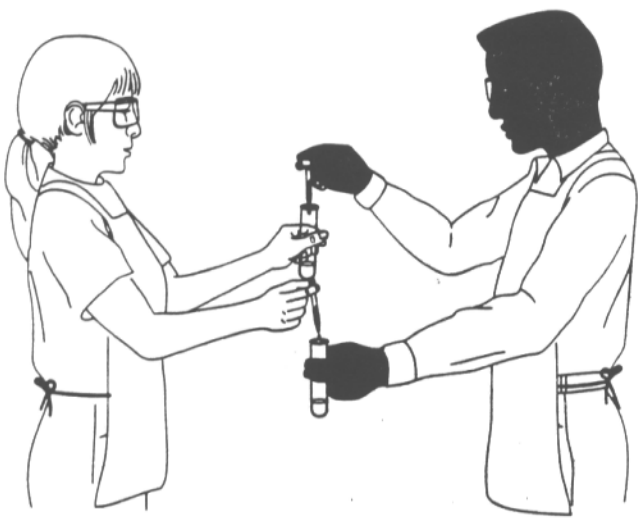
discuss possible outcomes if their transfers of solution were not done in discrete rounds. How would this affect the determination of a transmission route? How would this compare to "real-life" transmission of disease?

into your test tube. Record the color of the solution. Note that a neutral solution will remain colorless but a basic solution will turn pink.

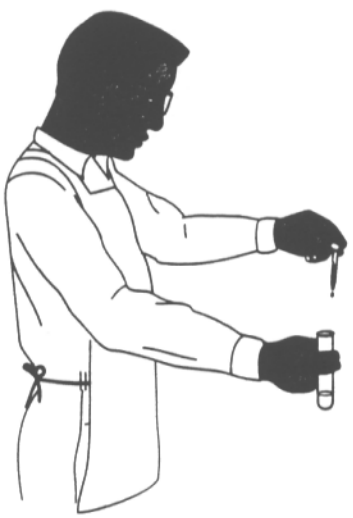
7. In Data Table 2, list the names of all the students who are "infected" (who have pink solutions). Then obtain from them the names of all their contacts, by round, and record their names.

8. After you have completed the data table, you must work backward to deduce the identity of the first "infected" students. To deduce their identities, start by crossing off the names of the uninfected students from Data Table 2. By deduction, identify the students who were infected in each round of contacts. That will allow you to reduce the list of infected students from the first contact to two, or four, students. Those two, or four, students should now test a sample from their stock bottles to identify which was the originally "infected" one.

9. Use these data to infer who must have transmitted the disease to whom. In the space provided, make a chart with student names and arrows to show the transmission route from one round to the next.



Use a dropper to transfer solution to another student's test tube. The other student also transfers solution to your test tube.



Add two drops of phenolphthalein indicator to find out whether your solution is basic – that is, whether you have been "infected."

Observations

Bottle Number ____

↙ Sample table

DATA TABLE 1: CONTACTS MADE IN EACH ROUND

Numbers of students contacted and their ID numbers in order

Color after indicator is added: _____

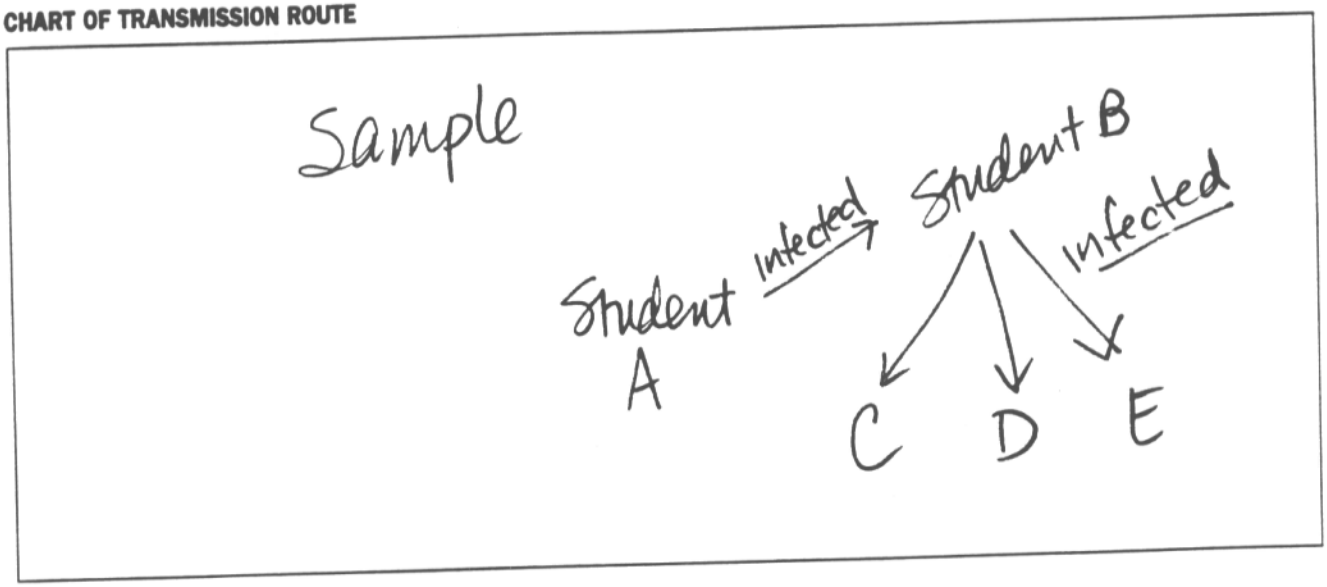
(A colorless-yellow result indicates "normal" neutral solution. A pink-colored result indicates "infected" basic solution.)

DATA TABLE 2: INFECTION CARRIERS

ID numbers of infected students / ID numbers of non-infected students

↑ sample table

CHART OF TRANSMISSION ROUTE



Analyses and Conclusions

1. Identify the students infected during Round 1.
2. Explain how the test in step 8 demonstrated which one was the original infected person.
3. What was the total number of students who became infected during the simulation? Determine the total possible number that could have been infected, assuming no infected student exchanged solutions with another infected student.
4. Describe what would have occurred if each student made more contacts per round.
5. If more people were infected per round, describe how that would have affected your ability to trace the transmission route back to one person.
6. Explain why health officials may ask an infected person for a list of his or her contacts.