Viral Infection!

Introduction

Use this extraordinary classroom activity to provoke discussion of an important social and health issue. Designed to simulate the transmission of a virus, the activity is based on a simple chemical reaction involving a sudden and obvious color change.

Concepts

- Disease transmission
- Viral infection
- Acid–base indicator

Background

Viruses spread from one host to another by a variety of methods such as contaminated water, body fluids or bites from an infected animal. The transfer of viruses through a body fluid, such as saliva, blood, or mucus, is a frequent occurrence in schools. For example, a sneeze or bloody nose are both capable of spreading viruses. In order to simulate viral transmission in this activity, one culture tube will contain a basic solution while the remainder of the culture tubes contain deionized or distilled water. Each student will exchange his solution with three other students to mimic the transfer of the virus through a population. Phenolphthalein indicator solution will then be added to quickly identify which students have become infected with the simulated virus either by direct infection from a carrier, or by indirect infection from contact with another student who was infected by the carrier.

Materials

Phenolphthalein indicator solution, 0.5%, 5 mL
Sodium hydroxide solution, 0.2 M, 5 mL
Water, distilled or deionized
Culture tubes, 16 × 125 mm, 30
Graduated pipets, 31
Index cards, 30
Marker
Paper towels
Test tube racks or other small containers to hold two culture tubes without tipping, 15

Safety Precautions

Sodium hydroxide solutions are corrosive to skin and eyes. Wear chemical splash goggles, chemical-resistant gloves, and chemical-resistant apron. Phenolphthalein indicator solution contains alcohol and is flammable; avoid heat and open flames. Wash hands thoroughly with soap and water before leaving the laboratory and follow all laboratory safety guidelines. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

Procedure

1. Use a marker to number a clean, dry culture tube and graduated pipet for each student in the class.
2. Randomly pick one culture tube to be the "carrier." Note the number of this tube in an inconspicuous place.
3. Fill all but the "carrier" tube with 5 mL of deionized water.
4. Fill the "carrier" tube with 5 mL 0.2 M sodium hydroxide.
5. Place each numbered graduated pipet into its respective culture tube.
6. Allow students to choose a culture tube with a pipet, along with an index card. Each student should write down the number of his or her culture tube on the index card.
7. Each student should find a partner. Remind students to follow appropriate safety precautions since the solution inside the culture tubes may irritate their skin or eyes. The students should not be holding the culture tubes as they transfer the solution—place them in a test tube rack or other small container.
8. Using the graduated pipet, the student should withdraw about half of the solution and transfer it to their partner's culture tube. Record the partner's name and culture tube number on the index card.
9. Using the graduated pipet, mix the contents of the culture tube by carefully stirring with the pipet.
10. Each student repeats steps 7–9 two more times while moving throughout the classroom. Students should not exchange

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fluids with the same person twice.

11. After three transfers, students should place two drops of phenolphthalein indicator solution into their culture tube and stir the solution with their own graduated pipet. If the solution remains clear or turns yellow, the solution is negative for the "virus." If the solution turns red or pink, the solution is positive for the "virus."
12. Epidemiologists frequently have to determine the original carrier for epidemic viral infections. In order to do this, have all "negative" students write the numbers of their culture tubes on the board before returning to their seats.
13. Students should cross out the numbers of the "negative" students on their index cards, since none of these students could have been the original "carrier."
14. Make a list of the remaining "positive" possible carriers on the board. Have any "negative" students who exchanged solution with a positive student raise their hand. Cross out the numbers of these positive students from the possible list and add their numbers to the negative list. Have students do the same on their index cards.
15. Typically this procedure will leave one or two students as the original carrier. If there are two remaining, one was the original carrier and one was the first infected student. Announce the number of the original carrier to the class.
16. Discuss the implications of the simulation. Possible discussion points include—

    a. Is it possible to tell who the original carrier was before the phenolphthalein indicator is added? Would it be possible to tell if the person were infected with a cold? What about hepatitis?

    b. If more exchanges were allowed after the phenolphthalein had been added, would you have exchanged with someone who carried a potentially fatal virus like HIV or HPV?

    c. Why is bed rest recommended for people infected with a "bad" cold or the flu?

    d. If the simulation had involved every person at the school, would it have been more or less difficult to trace the original carrier?

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. Collect the "body fluid" solution into one waste container. If the phenolphthalein solution in the waste container is colorless or yellow, the solution may be disposed of down the drain with excess water following Flinn Suggested Disposal Method #26b. If the phenolphthalein in the waste container is pink or red, add a few drops of an acid, such as 3 M hydrochloric acid, stir the solution with a glass stirring rod and note the color. Continue to add acid, a few drops at a time, until the solution just turns colorless or yellow. Flush the neutralized solution down the drain with excess water.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Evidence, models, and explanation
Constancy, change, and measurement
Content Standards: Grades 5–8
Content Standard A: Science as Inquiry
Content Standard C: Life Science, diversity and adaptations of organisms
Content Standard F: Science in Personal and Social Perspectives; personal health; risks and benefits
Content Standards: Grades 9–12
Content Standard A: Science as Inquiry
Content Standard C: Life Science, biological evolution, interdependence of organisms; behavior of organisms
Content Standard F: Science in Personal and Social Perspectives; personal and community health

Tips

- Culture tubes should be thoroughly cleaned to remove all traces of sodium hydroxide and phenolphthalein, which will otherwise interfere with the results if the exercise is repeated.
- Phenolphthalein is an acid–base indicator that reacts with the basic sodium hydroxide solution "virus" to form a red or pink color.
- Allow students to determine the epidemiology procedure needed to create a student-centered activity.
- The number of exchanges each participant conducts and the number of tubes initially infected will determine the ulti mate rate of infection. For class sizes of 30 or less, one carrier with three exchanges per student will provide a dramatic result. For larger classes, you may want to add a second carrier. For smaller classes, reduce the number of exchanges to two. It is important that participants circulate throughout the room or between groups following each exchange.
- Students should be cautioned at the onset to exchange fluids carefully and avoid spillage. Spills should be absorbed on damp paper towels immediately.
- It is possible for the pipet to fall into the test tube. The student should not attempt to retrieve it with bare fingers or by tipping the tube. The instructor should retrieve the pipet using either forceps or a gloved hand.
- With students milling about, it is important to prevent horseplay in the lab—pipets should never be used by participants to "squirt" each other. The possibility of eye contact with dilute sodium hydroxide must be strictly avoided.

Materials for *Viral Infection!* are available from Flinn Scientific, Inc.

Catalog No.	Description
P0115	Phenolphthalein Indicator Solution, 0.5%, 100 mL
S0244	Sodium Hydroxide, 0.2 M, 500 mL
GP7038	Test Tubes without Rims, Disposable, 16 × 125 mm, pkg. of 250
AP1516	Beral-Type Pipets, Graduated, pkg. of 500
AB1210	AIDS—Transfer of Body Fluids Kit

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.