



THE BIOTECHNOLOGY
EDUCATION COMPANY®

Edvo-Kit #

S-68

Edvo-Kit #S-68

What Is an Epidemic and How Does an Infection Spread?

Experiment Objective:

The objective of this experiment is to develop an understanding of the horizontal spread of an infection.

See page 3 for storage instructions.

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Experiment Components

Contents

- A Sodium Hydroxide Pellets
- B 1 N HCl
- C Color Indicator

- Test tubes and caps
- Large transfer pipets

Check (✓)

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Experiment #S-68 is designed for 10 groups.

Storage:
Store kit at room temperature

Requirements *(not included with kit)*

- Gloves
- Safety goggles
- Lab coats or protective clothing
- Distilled or Deionized Water
- Laboratory Glassware

All experiment components are intended for educational research only. They are not to be used for diagnostic or drug purposes, nor administered to or consumed by humans or animals.

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Background Information

HUMAN INFECTIOUS AGENTS

Human infectious agents are transmitted through populations by various means of contact. Infectious agents can be airborne, may be in the water we drink, the food we eat or transmitted through saliva or blood.

Water pollution is a major worldwide health problem. It is projected that 38% of deaths occur in children afflicted with severe diarrhea stemming from drinking contaminated water. Examples of infections include cholera, hepatitis, typhoid, and acute gastrointestinal illness. In the United States, chlorination was first incorporated into urban water treatment in the early 1900s, eliminating most infectious pathogens. However, an estimated 42 million Americans in rural areas today still rely on private, untreated wells for drinking water.

Contamination in food, such as meat, can occur by *Escherichia coli* (*E.coli*) O157:H7. Most strains of *E.coli* are harmless and actually live in the large intestines of humans where they aid in digestion. However, *E.coli* O157:H7 produces a potent toxin that can cause bloody diarrhea and in severe infections, kidney failure and death. Infections from this organism commonly are caused by inadequate cooking of meat. Likewise, *Salmonella* infections from chicken can also be a major problem if it is not stored and cooked properly.

The common cold and the more complicated infectious SARS (Severe Acute Respiratory Syndrome) can rapidly be transmitted rapidly among humans. These can be spread through contact by handshakes or by aerosols generated during sneezing or coughing. Other infectious agents, such as HIV, are transmitted by direct exposure to body fluids from infected persons.

Bacterial and viral infections have different incubation periods that can range from days to months, and in some cases, years. Quite often, infected individuals may not be aware that they are carriers of a disease, yet they have the ability to transmit the infection to others prior to becoming symptomatic. Examples include transmission of an infectious virus during a flu epidemic or in infections that can be deadly such as HIV.

Until recently, the detection of infectious agents occurred after the appearance of clinical symptoms. New diagnostic tests have been developed based on immunological antibody tests where an infected individual develops antibodies against the particular agent. The presence of antibodies is then detected by immunological tests.

It may take several weeks or months before antibodies appear in an infected individual. Using biotechnology-based tests that detect the nucleic acids (DNA or RNA) of the infecting agent, the presence and the amount can now be determined rapidly and much earlier in the infection cycle.

In this century, we are faced with the potential threat by individuals and groups who would use biological infectious agents to destroy our society and the freedoms we enjoy.



Background Information

Anthrax, plague, and smallpox are among the most likely bioweapons that would be used in a large-scale attack. Symptoms are similar to the flu or pneumonia. Also worrisome are the bubonic plague, botulism, tularemia and Ebola. Few vaccines currently exist to defend against these diseases and diagnosis is often difficult and slow. In order for any treatment to be effective, early detection is critical. To arm ourselves against such a potential threat, it is important that we learn to recognize and understand the mode in which infections can rapidly spread.

In this experiment, students will be provided with a tube representing his or her "self". A few (two to three) of the students will have the infecting agent while the remaining students will not have the infectious agent. Only the infecting agent turns pink in the presence of the indicator detecting solution.

Students will exchange their simulated fluids with other students. Records will be kept by students when the different exchanges occur to determine the source of the infection. Student(s) who do not succumb to the infection will also be identified. Students will obtain an understanding of how rapidly an infection will affect the entire classroom population.

Experiment Overview

EXPERIMENT OBJECTIVE:

The experiment objective is to develop an understanding of the horizontal spread of an infection.

LABORATORY SAFETY

1. Gloves and goggles should be worn routinely as good laboratory practice.
2. Exercise extreme caution when working with equipment that is used in conjunction with the heating and/or melting of reagents.
3. DO NOT MOUTH PIPET REAGENTS - USE PIPET PUMPS.
4. Exercise caution when using any electrical equipment in the laboratory.
5. Always wash hands thoroughly with soap and water after handling reagents or biological materials in the laboratory.



WORKING HYPOTHESIS

If an individual is infected with and carrying a disease, but unaware of it, then that individual may unknowingly transmit the infection to many others.

LABORATORY NOTEBOOKS:

Scientists document everything that happens during an experiment, including experimental conditions, thoughts and observations while conducting the experiment, and, of course, any data collected. Today, you'll be documenting your experiment in a laboratory notebook or on a separate worksheet.

Before starting the Experiment:

- Carefully read the introduction and the protocol. Use this information to form a hypothesis for this experiment.
- Predict the results of your experiment.

During the Experiment:

- Record your observations.

After the Experiment:

- Interpret the results – does your data support or contradict your hypothesis?
- If you repeated this experiment, what would you change? Revise your hypothesis to reflect this change.

Experiment Procedure

1. Your teacher will provide you with a plastic transfer pipet, three empty tubes and a tube with 5 ml of a solution with a number on it to serve as your code. This solution represents your simulated biological "self". The liquid can be a simulation of saliva, blood or any other body fluid. Label the tube as "self" in addition to a code, which is equivalent to your social security number.
2. Label the other three tubes with the code and dispense 1.0 ml (20 drops) using the plastic transfer pipet of your biological fluid into each of the three empty tubes.
3. Randomly select a student to be "contact 1" and accept 1 ml of their solution from one of their 3 tubes which is to be added to your tube labeled "self". (At this point you will not be aware if he or she is a carrier of the infection).
4. In return, exchange your simulated biological fluid with contact 1 by adding 1 ml of your solution from one of your 3 tubes to their tube labeled "self".
5. Register the code of your contact 1 tube in your notebook.
6. Repeat for a second time (steps 3, 4 and 5) by randomly selecting a second student.
7. Repeat for a third time (steps 3, 4 and 5) by randomly selecting a third student.
8. At the end of this experiment you should have the same volume that you started with. However, the composition will be very different. One part will be your "self" and three or four parts will be fluids added by three other students with whom you exchanged "biological" fluids.

Note that the proportions for the infecting agents are exaggerated to facilitate and to dramatize the transmission of an infection.

9. Record your code and the three other contacts in Table A. You should record your code and the codes of the three simulated contacts you made. It is possible that one or more of the students or perhaps you yourself were the carrier of the infection. Your Teacher knows the identity of the carrier(s) and it's up to you to determine who it is.
10. The teacher will add one drop of Phenol red to your tube. If your solution does not turn pink then you have not been infected.
11. If your solution turns pink you or one of your contacts is a carrier of the disease. Proceed to step 12.
12. The teacher will help you group with students who also have a pink color.
 - a. How many groups have a pink color
 - b. What percentage of the student groups does that cover?
 - c. Who are the suspected carriers (they would be common among the groups whose fluid turned pink)?

Each student group should receive:

- One tube of "carrier" or "non-carrier" solution
- Tube rack with 3 empty tubes
- One large transfer pipet
- Lab marker



Study Questions

1. Do all people who come in contact with an infected person acquire or contract an infection?
2. What body fluids can harbor infections?
3. What is an example of an infectious agent that is transmitted by blood? (i.e. HIV which causes AIDS).
4. What is an example of an infectious agent that is transmitted by saliva? (i.e. Epstein Barr virus which causes mononucleosis also known as the kissing disease).

Instructor's Guide

PRE-LAB PREPARATIONS

1. Prepare a NaOH stock solution by completely dissolving the NaOH pellets (component A) in 10 ml distilled or deionized water.
2. Prepare the "infected" or "carrier" solution by adding 1 ml of the NaOH stock solution to 9 ml distilled or deionized water. Dispense 5 ml of this solution to one or two unlabeled tubes and assign them to one or two students or student groups.
3. Prepare the "uninfected" or "non-carrier" solution by diluting the HCl solution (component B) in 500 ml distilled or deionized water. Dispense 5 ml of this solution to eight or nine unlabeled tubes and assign them to eight or nine students or student groups.
4. Instruct students to use extreme caution when working with these chemicals. Students should wear gloves, safety goggles, and protective clothing.
5. Assemble the following materials for each student group:
 - One tube of "carrier" or "non-carrier" solution*
 - Tube rack with 3 empty tubes
 - One large transfer pipet
 - Lab marker

Use extreme caution when working with NaOH and HCl. Always add acid to water, slowly and carefully. Wear Safety goggles, gloves, and protective clothing. Work in a fume hood or well ventilated area.

Assign the "carrier" and "non-carrier" solutions to the students or student groups and make a note of who gets each sample type. Do not inform the students of their sample type.

OPTIONAL EXPERIMENT

Have one or more students with a negative sample "abstain" from exchanging fluids with the other students to show that the infection cannot be spread without exchanging fluids.

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InstaStain® Blue stain is safe and non-toxic, but will stain skin and clothing. Students should wear gloves and handle with care.

**Please refer to the kit
insert for the Answers to
Study Questions**