Prelab Information

**Purpose** Explore the spread of a communicable disease using a simulation.

**Time** Approximately 45 minutes.

**Question** What is the effect of immunity on the rate at which a disease spreads?

**Hypothesis** If a higher percentage of people are immune to a disease, then the disease will spread more slowly, because fewer people will be able to contract it or pass it on.

**Variables** *Independent variable*: immunity rate

*Dependent variable*: number of people with the disease

**Summary** In this experiment, you will simulate the spread of a communicable disease using cups of liquids. This is a simulation of what happens when bodily fluids such as saliva, mucus, semen, or blood are exchanged between individuals in a population. At the beginning of each trial, one person is “infected.” In some trials, the infected person will be unknown. In other trials, a percentage of people will be immune. You will measure the number of people infected after four points of contact.

Safety

 Always wear safety goggles and a lab gown while performing an experiment.

 Wear rubber or nitrile gloves during this experiment.

 Behavior in the lab needs to be purposeful. Be careful not to spill the liquids.

 The liquid in Trial A might contain NaOH, which is alkaline and can cause severe burns. If this solution comes into contact with your eyes or skin, tell your teacher and follow his or her directions.

 The liquid in other trials might have food coloring, which can cause stains. Be careful not to spill.

 Report all accidents—no matter how big or small—to your teacher.

Materials

**Materials list:**

 White paper cups

 water

 1 cup of NaOH

 food coloring

 phenolphthalein indicator

Phenolphthalein is a chemical indicator that changes color based on the pH of the solution. The pH scale runs from 1 to 14. A pH value of less than 7 indicates an acid, a value of 7 indicates a neutral solution, and a value of more than 7 indicates a base. Phenolphthalein is a colorless indicator, but it turns pink at a pH of 8 or above. In this lab, phenolphthalein will be used to test for the “disease,” which is the base NaOH. People who are infected with the disease will start with a basic solution. When their solutions are mixed with other solutions that are neutral or also basic, the entire solution will change to a basic pH. Any solutions that carry the disease will be basic, so they will turn pink when a phenolphthalein indicator is added.

Trial Procedure

Before beginning, count the number of people in your class. Record this number in the space above the data table.

**Trial A (Blind): No Immunity**

**Step 1:** Obtain a cup. One person, unknown to everyone except the teacher, will have a cup of NaOH,

the “disease.” All others will have water in their cups.

**Step 2:** Make a point of contact with someone at random. One of you should put all of your solution into the other person’s cup. The other person will then mix the liquids and pour half of the solution back into the empty cup. The cups should now have an equal amount of the same liquid. If one of you had the “disease,” now both of you will. In the space below, write down the name of the person with whom you exchanged liquids.

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Step 3:** Repeat Step 2.

**Step 4:** Repeat Step 2.

**Step 5:** Repeat Step 2.

**Step 6:** Repeat Step 2.

**Step 7**: Repeat Step 2.

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Step 8:** Place one drop of phenolphthalein into your mixture. If the solution changes from clear to pink, then you have the disease. Count the total number of infected people and record that number in the data table. Compute and record the final percentage.

**Step 9:** Dispose of all liquids according to your teacher’s directions.

**Step 10:** As a class, work together to answer the following question: *Who was the first person to have the disease?* If you do not have enough data to identify the person, narrow down the field as much as possible and explain why you do not have enough data. Make sure to include your solution

to this question in the analysis and conclusion of your lab report.

Additional Trials

**Trial A:** Repeat Steps 1–7 of Trial A (Blind). This time, the person who begins with the disease will have a cup containing water and twenty drops of food coloring. This will allow you to watch the disease spread. Be sure to make points of contact with the same classmates as in Trial A.

**Trial B:** Repeat Trial A. This time, 25% of the class will be designated “immune.” If you are immune, do not exchange liquids at any point of contact. Be sure to make points of contact with the same classmates as in Trial A.

**Trial C:** Repeat Trial B. This time, 50% of the class will be designated “immune.” Be sure to make points of contact with the same classmates as in Trial A.

If your teacher has you do additional trials, make sure to record the data for each. If you write a lab report, make sure to analyze all data and draw appropriate conclusions. Data

Data

Record your data either in the space below or in your lab notebook.

Number of people in population (same for all trials): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Number of People Infected

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of Points of Contact** | **Trial A (Blind)**  **0 Immune** | **Trial A (Open)**  **0 Immune** | **Trial B**  **25% Immune** | **Trial C**  **50% Immune** |
| **0 (Initial)** | 1 | 1 | 1 | 1 |
| **1** | Hidden |  |  |  |
| **2** |  |  |  |
| **3** |  |  |  |
| **4** |  |  |  |
| **5** |  |  |  |
| **6** |  |  |  |
|  | | | | |
| **Final Percentage with Disease\*** |  |  |  |  |

|  |  |  |
| --- | --- | --- |
| \*Final percentage = | Final number infected | X 100% |
| Number of people in population |

Graph

Make a single graph showing the spread of the disease in trials A, B, and C. Use this graph to analyze the effect of immunity on the spread of disease.