NSF GK-12 Graduate Fellows Program
Award # DGE-0139171
University of North Carolina at Wilmington

Pandemics and Epidemics

<u>Activity Instructions</u>

by
Melissa Ernst, Department of Biological Sciences

Pandemic and Epidemic Investigation

Objectives being met:

2.01- Evaluate data related to population growth, along with problems and solutions: disease control

-This simulation assists in visualizing the affects of increased populations in contact with an infectious disease. The supplemental experiment of including 2 infectious hosts assists in demonstrating this occurrence as well.

2.03- Explain how changes in habitat may affect organisms

-Outbreaks of diseases often originate from disturbances of nature. Example: The flooding originating from Hurricane Floyd (1997) resulted in increased levels of pathogens within the waters of NC

3.02 Evaluate evolutionary theories and processes

-For those teachers choosing to discuss evolutionary changes in organisms: Discuss how mutations affect a population. Think about how a mutation in a virus (such as polio or smallpox) would affect the world. Talk about the influenza virus. Last year the US experienced a shortage of vaccinations. Why? Because the virus in question had mutated and a new vaccine had to be manufactured.

How and why do epidemics and pandemics spread so quickly?

Epidemic simulation:

Materials needed:

-One test tube for each student

Dixie cups can be substituted. A clear container is preferable so that everyone can see who is infected

-One pipette for each student

-Cornstarch diluted with water, milk, and iodine tincture **OR** flat, clear soda (ex: 7-Up) and purple cabbage juice

-Tap water

For those with access to acids and bases, a dilute solution of either can be used instead of clear soda- use the cabbage juice as the infection indicator.

***NIGHT BEFORE SIMULATION*:**

To make cabbage juice, cut purple cabbage into chunks. Add cabbage to a glass container of water and boil (metal pots have alkalines and will change the properties of the cabbage juice) until color has been extracted. Do not boil too long. Strain. Let cool. Store in an airtight container.

Note:

ADD JUST ENOUGH LIQUID TO EACH TEST TUBE SO THAT THE PIPETTE CAN TOUCH THE LIQUID. IF TOO MUCH LIQUID IS ADDED, THE SIMULATION WILL NOT WORK CORRECTLY DUE TO THE INCREASED DILUTION OF THE "INFECTION"!!

Setup:

Prior to starting the simulation, "infect" one test tube.

To do this:

If using cornstarch, make a solution of cornstarch and water until it has a milky appearance. Add this to one test tube. To the remaining test tubes, add milk diluted with water.

If using clear soda, add flat soda to one test tube. Use water in remaining test tubes.

Number test tubes with the exact number of students and remember which tube is "infected."

Simulation:

(Included is a story that can be read during the simulation. This is optional and may be chosen to facilitate the reading requirements required by the curriculum.)

-Have every student take one test tube and one pipette. Have them record the number of their test tube.
-Have students remove one pipette-full of their liquid. (Proper use of the pipette may need to be demonstrated prior to the simulation. This will ensure equal transfer of solutions.)
-Have students exchange their pipette full of liquid with someone sitting next to them. *Have them record the number of the test tube they exchanged with*. This will simulate contact with someone in the same region.
-Have students remove another pipette full of liquid. This time, have them exchange with someone farther away (if your room is setup in rows, have them exchange with someone 2 rows away). *Have them record the number of the test tube they exchanged with*. This will simulate contacting someone in a different state.

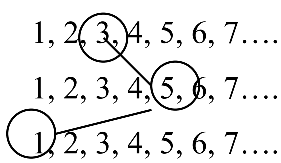
-Have students remove another pipette full. This time, exchange with someone on the opposite side of the room. *Have them record the number of the test tube they exchanged with*. This will simulate contact with someone in a different country (or continent).
-Once everyone has finished, add one pipette full of the indicator to each of the student's test tubes. Everyone "infected" with the "disease" will see a color change in his or her tube.

-Iodine will cause the starch to turn from brown to black
-Clear soda will cause the purple cabbage juice to turn pink (purple cabbage juice is a natural pH indicator and reacts with the acid in the soda)

-Write everyone's number on the board 3 times. Ex:

1, 2, 3, 4, 5, 6, 7….
1, 2, 3, 4, 5, 6, 7….
1, 2, 3, 4, 5, 6, 7….

-Have those infected circle their number and draw connecting lines to the people they exchanged with. Ex:



-Have the students work backwards to figure out who "initiated" the epidemic. Students may need some help with this form of deductive reasoning.

**Note: Sometimes the infection can only be traced back to 2 individuals. This is the result of whom the students exchange with. If the infection can only be traced back to 2, explain to the students that this demonstrates the difficulty pathologists face in epidemiological surveys*.

Presentation of data:

-Have students graph the number of infected and number of uninfected after each "swap." This will allow them to visualize the exponential increase in infections. One person coming in contact with many non-infected people results in a large number of infected people! (*This will especially be noted if the additional experiment, listed below, is done*.)

Additional suggestions:
-For more advanced classes, run the simulation again, starting with 2 "infected" tubes. This helps to reinforce how quickly and easily diseases can spread.

-Have the students research an epidemic to determine its origin and how it spreads. This could include a written story, mapping how the disease spread (from region to region, country to country), etc.

-Discuss how infection control originated and how it impacted the spread of diseases.

-Have the students complete a survey of cleanliness- how often do people wash their hands? Compile the class data and have them graph their results. Discuss the results. Do males or females wash their hands more? Mothers or fathers? Young or Old?

-For more advanced classes, engage the class in a discussion of recent threats of bioterrorism. What would this mean to the world? What are some actions the US can take to counteract any such attacks.

Teachers may choose to send a letter home to parents explaining the purpose behind this simulation. The students will, more than likely, connect the spread of epidemics and pandemics to that of sexually transmitted diseases. Some parents may choose to not have their child participate for such reasons.

Outbreak

The alarm clock rang and, at its sound, I sprang from my bed. Today was the start of a new journey- I had been assigned to a research team studying the outbreak of a new and extremely virulent disease in the jungles of South America. Villages were plagued by its presence and fatality from the symptoms was on the rise. Young and old, weak and strong were falling victim to its wrath- no one was spared. Our team of investigators had been summoned to collect data and attempt to find the source of the disease in hopes of finding a treatment. Would we be successful? Questions raced through my mind as I frantically finished packing for the 3 month sabbatical. Downstairs, the taxi honked furiously- I was running later than I thought! As I hurriedly fumbled down the stairs, the excitement of what the next few weeks would hold continued to mount. The flight left in 15 minutes- would we make it to the airport? Had I remembered my passport? Did I remember to unplug the iron? The taxi driver was rather polite as he heeded my urgency. He did, however, seem to be lacking in basic personal hygiene. As we reached the airport, he extended his hand to wish me well. Must I really return the favor? Reluctantly, I grasped his hand and gave a firm handshake (**stop here**: have the students complete their first exchange), thanked him for his services and rushed towards the check in counter. We had arrived at the airport in plenty of time and I was soon seated on the plane. Much to my dismay, a rather precocious 6-year old with a raging case of the common cold was seated beside me. I soon remembered how inquisitive little children can be. Continually leaning over my computer, asking "what's that"- would I get a moment's peace?! Suddenly the child stopped and reared her head back and let out an enormous sneeze- all over ME! (**stop reading**: Have students complete their second exchange). Frustrated beyond belief with the situation (especially with the importance of my journey weighing on my shoulders), I moved to a seat at the rear of the plane to conclude my flight in peace. Once on firm ground, I bustled through the international airport in Ecuador, South America. I soon found the convoy transporting all of the researchers to the depths of the Ecuadorian jungles. Several hours later, we arrived. The condition of the village was much worse than we had anticipated. Only a handful of villagers were healthy enough to care of the rest. In all, 64 of the 97 villagers were ill. 10 died the first night of our stay. We soon realized the urgency of our work. With the additional work of our team, the condition of the village soon stabilized but our search for answers was failing. What was causing this outbreak? One evening, a young man from the village and I sat pondering the condition of the village on the bank of a small stream. We told stories of our lives, laughed, and shared a canteen of a drink made by the men of the village (**stop here**: Have students complete their last exchange). What would come of this village and the dozens of others like it falling victim to this outbreak? I, unfortunately, would never get to find out the outcome of my effort….