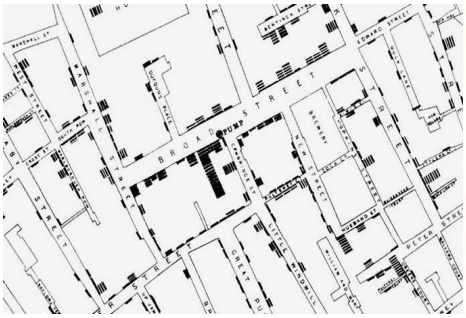
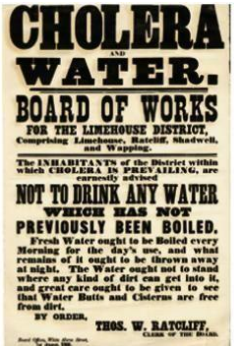
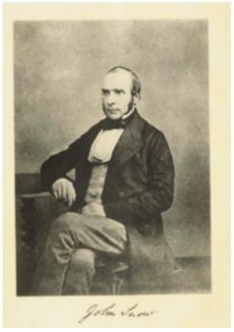
Studying How Diseases Spread

LaCuKnoS Language Booster







John Snow was a medical doctor in London in the 1800's. He is known as the "father of **epidemiology**." Epidemiology is the study of how diseases spread. Dr. Snow was worried about the cholera epidemics that killed many people in London during the 1840s. Cholera is an **infectious disease** that causes high fever, dehydration, and eventually death. At that time, doctors thought that cholera spread through the air. But John Snow had a different hypothesis. He thought that cholera probably spread through drinking contaminated water, but he had no evidence to prove this. The other doctors didn't believe him.

In 1854 there was another large cholera **outbreak** in London, and Dr. Snow developed a plan to test his hypothesis. He began to make observations of the home address of each person who died from the disease. He got a large map of London and marked the points of all the deaths on his map. It became clear that there was a central point around which nearly all of the deaths had occurred. Snow saw that there was a water pump at this location-- a pump where the victims probably obtained their water. To test his hypothesis, Snow convinced the mayor to remove the handle from the pump to prevent people from getting the water. He observed that the disease stopped spreading. This was the evidence that Dr. Snow needed to persuade the other doctors that his hypothesis was correct – the cholera disease was spread by drinking contaminated water.

Talk with a partner, then write your answers:

1. Write a sentence that describes in your own words the evidence that Dr. Snow used to support his hypothesis.

2. Choose one sentence from the language booster. Rewrite it in a simpler way so that a second grader could understand it.

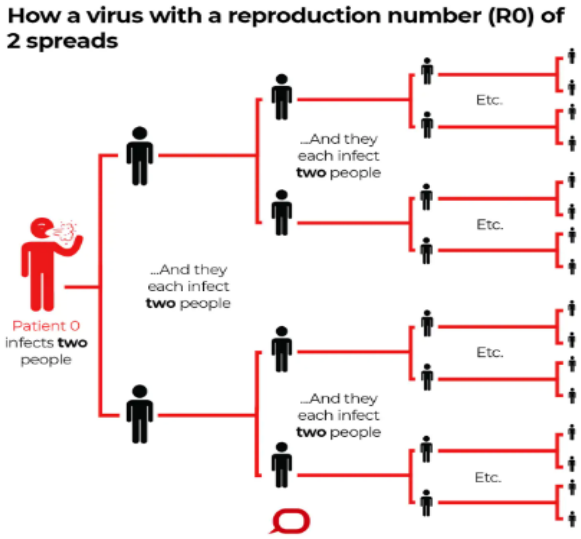
Spreading Infectious Disease
LaCuKnoS Science Investigation

In the following investigation you will use two simulations to study how disease spreads. First, you will use a computer simulation and then a hands-on simulation. After the second simulation you will play the role of epidemiologists and try to figure out who started the spread of the disease. Epidemiologists call this person **patient zero.**

Simulation #1: Computer Simulation (developed by EPIC learning)

In this activity, you will use a mathematical model to think about the spread of a virus. You will compare viruses with different **reproduction numbers** numerically and graphically. The reproduction number is a measure of how easily an illness can spread from one person to others. The higher the reproduction number, the more people are likely to become infected from one infected person. The figure below shows the spread of a virus with a reproduction number of 2. This means that on average, each infected person will infect two additional people. One of the reasons that the COVID-19 virus is so dangerous is because it

has had a high reproduction number, usually between 2-3 during most outbreaks.



Materials:

- You will need access to the internet for each small group to use the computer simulation

Procedure:

1. Go to the Google Spreadsheet at this link. The spreadsheet has been programmed to show a simulation of how a virus spreads under different conditions. This model can help us to understand how these conditions affect the rate of spread of an infectious disease like a virus.
2. Your group will decide on three numbers that will affect your model:
    a. the number of people initially infected;
    b. the reproduction number; and
    c. the number of rounds of spreading that you want the model to show.
3. Discuss the numbers you want to use and then enter them in the blue column called Situation 1. The blue line on the graph will show the results.
4. Your group can compare Situation 1 with different numbers using Situation 2 in the red column of the spreadsheet. Enter different numbers for people initially infected; the reproduction number; and the number of rounds of spreading in the red column.

5. Observe how the numbers and the graphs change. Discuss the following questions with your group and then write your answers.

a. What surprised you about the graphs as you changed the numbers in the model?

b. What happens to a viral outbreak when the Reproduction Number for the virus falls below 1?

c. In addition to what this model shows, what other characteristics of an infectious disease should we consider when comparing the severity or risk of an outbreak?

d. Do you think the reproduction number of a virus like COVID-19 will be the same in all communities and situations? Why or why not?

e. Are there things we can do to lower the reproduction number of an infectious disease?

Simulation #2 - Hands-on Simulation

In this activity, you will use a hands-on simulation to model how an infectious disease can spread. You will think like epidemiologists to determine who was patient zero in this simulation.

Materials (for students):

- Plastic test tube with liquid prepared by teacher for each participant
- Plastic dropper

WARNING: Do not drink the liquids in the test tube.

Procedure

1. Your teacher will give each person a test tube containing a small amount of liquid and a dropper.
2. Move around the room until your teacher says stop and find a partner.
3. Mix the liquid in your test tube with the liquid in your partner's test tube by using your dropper to transfer about half of your liquid to your partner's test tube. Then your partner transfers about half of the liquid in their tube back to you. Write the name of the person you shared with in the space below.
4. When your teacher tells you, circulate around the room again until your teacher says to stop. Find a new partner and repeat the sharing process in the same way as the first time. Record the name of the second person you shared with.
5. When your teacher tells you, circulate around the room one more time until your teacher says to stop. Find a third partner and repeat the same sharing process. Record the name of the third person you shared with and then return to your seat.

1st person I shared with: _____

2nd person I shared with: _____

3rd person I shared with: _____

6. Your teacher will come around and put a few drops of an indicator in your test tube. If you are infected in the simulation, the color of your liquid will change. This indicates whether the infection has spread to you or not.
7. Now your class is going to think like epidemiologists to come up with a strategy for determining who had the original contaminated liquid ("Patient Zero").
8. Talk together as a whole group about strategies that could be used to identify patient zero. Then go back in your small groups and draw a picture or diagram in the space below that can help you to figure out who patient zero was.
9. Be ready to share your group's ideas with the rest of the class.

Use the space below to draw a diagram to try to determine who was "patient zero."

Finally, your teacher will put another solution into a few of the "infected" tubes that turn the liquid clear again. Explain what this process represents in real epidemiology.

*The solution turning clear represents*_____.

Spreading Infectious Diseases
LaCuKnoS Investigation Summary
Using Models to Construct Explanations

How can a computer simulation help you explain how infectious diseases spread?	How can a hands-on simulation help you explain how infectious diseases spread?	What is one weakness of each of the simulations?

Use **your own words** to describe how your class worked to discover "patient zero."

Use **language an epidemiologist would use** to describe how your class tried to discover "patient zero."

Spreading Infectious Diseases
LaCuKnoS Concept Cards

Infectious Disease/
Enfermedad Infecciosa

An illness that can spread, directly or indirectly, from one individual to another, such as by bacteria, viruses, or fungi.

Enfermedad que se puede propagar, directa o indirectamente, de un individuo a otro, como por bacterias o virus.

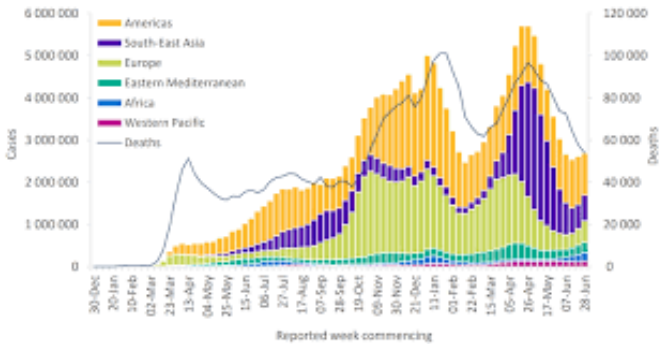
COVID-19 is an infectious disease that spreads easily from person to person.

Concept Card

Epidemiology/
Epidemiología

The study of how diseases spread in human populations and the factors influencing that spread (causes, risk factors).

El estudio de cómo se propagan las enfermedades en las poblaciones humanas y los factores que influyen en esa propagación (causas, factores de riesgo).



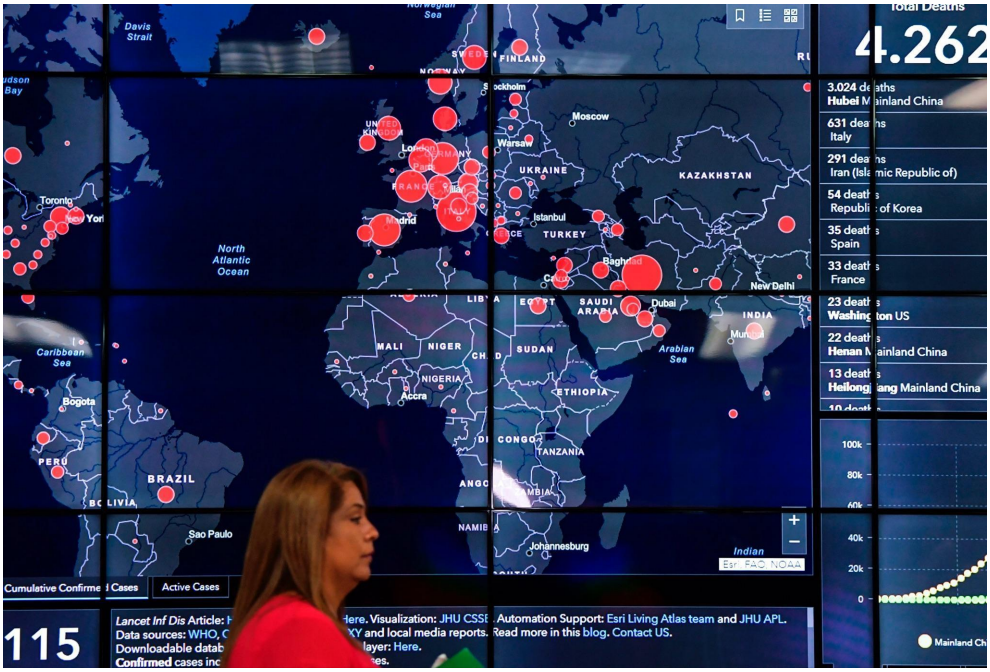
The number of students interested in studying epidemiology has increased over the past few years.

Concept Card

Outbreak/ Brote

The sudden start of something unwelcome such as a war or disease.

El inicio repentino de algo no deseado, como una guerra o una enfermedad.



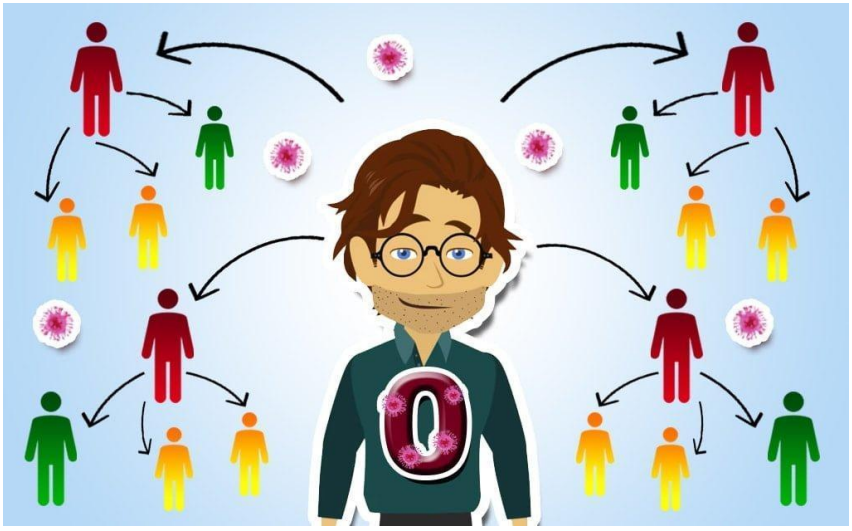
The first outbreak of the COVID-19 pandemic was in Wuhan, China.

Concept Card

Patient Zero/
Paciente Cero

The person identified as the first carrier of an infectious disease in an outbreak.

La persona identificada como el primer portador de una enfermedad infecciosa en un brote.



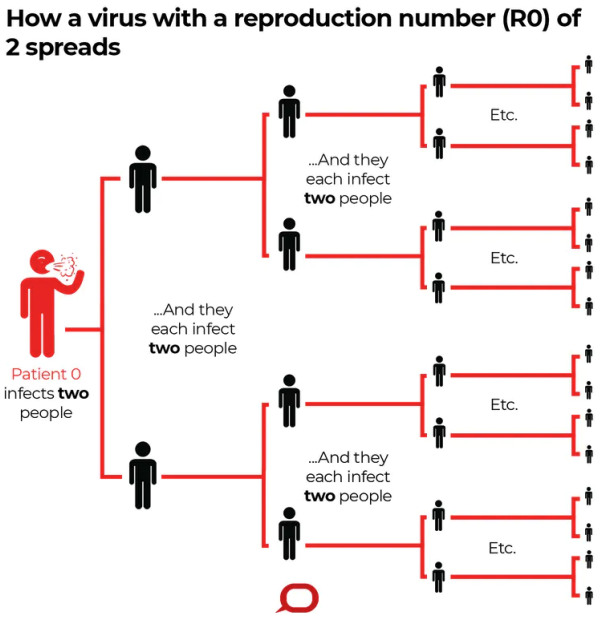
Our class used a simulation to learn how epidemiologists search for patient zero.

Concept Card

Reproduction Number / Número de reproducción

A number that describes how many people, on average, will get infected by one individual with an infectious disease.

Un número que describe cuántas personas, en promedio, serán infectadas por una persona con una enfermedad infecciosa.



The reproduction number for COVID-19 is probably between two and three.

Concept Card