SIEMENS STEM DAY | Science Technology Engineering Math

GRADES 9–12

SIEMENS STEM DAY ACTIVITY

EPIDEMIOLOGY EMERGENCY

OBJECTIVES

Students will be able to:

- **Explore** the field of epidemiology and how and why some diseases can be spread very quickly, especially in populated areas.
- **Describe** the events and factors that allows disease to spread and become an outbreak.

THIS LESSON FOCUSES ON

Engineering Design Cycle

- Defining the Problem

21st Century Skills

- Collaboration
- Communication
- Critical Thinking

OVERVIEW

After learning about the field of epidemiology and what the term "patient zero" means, students will participate in a whole group simulation that shows how quickly infectious diseases can be spread and work as a class to determine patient zero.

STEM incorporates Science, Technology, Engineering, and Mathematics to focus on real-world issues and problems guided by the engineering design process. This type of instruction supports students in developing critical thinking, collaboration, reasoning, and creative skills to be competitive in the 21st-century workforce.

Each Siemens STEM Day classroom activity highlights one or more components of the engineering design cycle and an essential 21st-century skill.

MATERIALS

- Computers with internet access
- Plastic cups—one per student
- Droppers—one per student
- Water
- Sodium hydroxide and phenolphthalein (available from chemical suppliers or on http://amazon.com)
- **Outbreak Tracker**—one for display

HAVE YOU EVER WONDERED . . .

What allows diseases to spread and become an outbreak?

MAKE CONNECTIONS!

How does this connect to students?

Students probably have an idea about how quickly illness can spread around a school building, but what about illnesses that spread quickly throughout whole communities or cities? How do they start and how can they be stopped? Scientists study the outbreaks of harmful and often deadly diseases, piecing together clues and coming up with plans to stop illness and save lives.

How does this connect to careers?

Epidemiologists investigate patterns and causes of disease and injury in humans and plan and direct studies of public health problems to find ways to prevent and treat them if they arise. They collect and analyze data and use samples of blood or other bodily fluids to find the causes of diseases or other health problems.

Microbiologists study microorganisms such as bacteria, viruses, and parasites. They plan and conduct research projects, such as improving sterilization procedures or developing new drugs to combat infectious diseases, as well as perform laboratory experiments that are used in the diagnosis and treatment of illnesses caused by pathogens.

Community Health Educators collect data to develop and implement strategies to improve the health of individuals and communities.

How does this connect to our world?

Outbreaks of deadly pathogens, such as the Avian Flu Virus, Ebola, and HIV/AIDS have happened throughout history and continue today. Access to modern medicine, improvement in sanitation in developing countries, and education about how disease is spread will hopefully decrease the incidence of deadly disease outbreaks.

TEACHER PREPARATION

Before the session, prepare one plastic cup for each student. In **only one** of the cups, dissolve a sodium hydroxide (NaOH) tablet in water. This will create a clear colorless liquid. Fill each of the other cups to the same level with plain water. Mark the cup with the sodium hydroxide in a way that only the teacher can identify it. Prepare a dropper bottle with phenolphthalein indicator solution to be used at the end of the simulation.

BLUEPRINT FOR DISCOVERY

1. Introduce students to the concept of epidemics by showing the following video: https://youtu.be/DyY5fyxo4es
2. Explain the role of **epidemiologists** in finding ways to stop or contain an outbreak and trace the origins and spread of the disease.
3. Present students with the scenario of a fictional outbreak. They are each a citizen in the community that has been affected. Write or project the **Outbreak Tracker** on the board and write the name of each student in the table. Give each student a cup of liquid and a dropper.
4. Remind students that many diseases can be spread through bodily fluids, like saliva. The liquid in the cup represents this. Students will simulate sharing these bodily fluids, like they might if they coughed or sneezed on someone, by using a dropper to dispense some in another student's cup at various points in the simulation.
   Note: If time allows, shwo the following video with small groups of students as they finish: https://youtu.be/-K_boO2oceI
5. Direct students to find a partner and exchange a dropper of fluid. When each student has completed this, DAY 1 of the outbreak is over.
6. DAY 2 proceeds the same way as DAY 1. Again, each student will select a different person to exchange a dropper of fluid. When each student has completed this, DAY 2 of the outbreak is over.
7. Instruct students to add the names of the two people they exchanged droppers of fluids with in the columns labeled DAY 1 and DAY 2 beside their own name on the **Outbreak Tracker**.
8. Place a drop of phenolphthalein indicator solution to each student's cup. If the solution remains clear, they did not contract the disease. If the solution turns pink, they are "sick"!
9. On the **Outbreak Tracker**, highlight all the names of students who contracted the disease (whose solutions turned pink).
10. Explain to students that only one person was initially "infected," referred to in epidemiology as "**patient zero**." This person was the source of the outbreak.
11. Challenge students to figure out who patient zero is by looking at the **Outbreak Tracker**. If needed, explain that the best strategy is to look at who exchanged fluids with a sick person but is not sick him/herself.
12. After some initial guesses, reveal who patient zero is and trace the path of the spread as a class. Create a visual flowchart of the spread of the outbreak.

TAKE ACTION!

- Students can use the website https://www.thinglink.com to create an interactive poster or timeline of a specific disease or outbreak in history (i.e., Ebola, Typhoid fever (1900's), SARS, Avian Flu Virus (Bird Flu), H1N1 (swine flu), MERS (Middle East Respiratory Syndrome), HIV/AIDS, Plague, etc.)
- Students can build a model of the how a pathogen infects cells, creating a health awareness campaign that gives important tips to prevent the spread of a pathogen.

NATIONAL STANDARDS

Science	LS2.A: Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease.
Technology Education	**International Technology and Engineering Educators Association** III. Technology Operations and Concepts—Students demonstrate a sound understanding of technology concepts, systems and operations. Students: A. understand and use technology systems B. select and use applications effectively and productively **Computer Science Teachers Association** Collaboration (CL) Apply productivity/multimedia tools and peripherals to group collaboration and support learning throughout the curriculum. Collaboratively design, develop, publish and present products (e.g., videos, podcasts, websites) using technology resources that demonstrate and communicate curriculum concepts.
Health	1.12.1-3 Predict how healthy behaviors can affect health status. Describe the interrelationships of emotional, intellectual, physical, and social health. Analyze how environment and personal health are interrelated. 1.12.5 Propose ways to reduce or prevent injuries and health problems.

OUTBREAK TRACKER

Student Name	Day 1	Day 2