TATA CONSULTANCY SERVICES | Discovery EDUCATION

IGNITE MY FUTURE

THINK | SOLVE | CREATE | CONNECT

SUBJECTS

Science
Math

COMPUTATIONAL THINKING PRACTICE

Recognizing and Defining Computational Problems

COMPUTATIONAL THINKING STRATEGY

Collect Data, Analyze Data

MATERIALS

Centers for Disease Control and Prevention (CDC) FluView Interactive Map
*Note: May be printed for distribution or shown via projector

Printed copies of the CDC publication "How Vaccines Work"

Printed copies of the CDC blog post on the 2015 Disneyland Measles Outbreak

Designing Data student capture sheet

Outbreak student capture sheet

Computer with Internet access (optional)

Projector & presentation board
or whiteboard/chalkboard

LESSON TITLE

Outbreak

Guiding Question: How can technology improve our lives?

Ignite Curiosity

- What makes a virus spread?
- Can we use smartphones to identify viruses?
- What if computers could show us where a virus will spread even before it hits?
- How can we keep our friends and family safe from harmful viruses?

In this lesson, students will discover how scientists think like computers in order to combat virus outbreaks. Students will get firsthand experience with the computational thinking strategies of collecting and analyzing data by engaging with a real-world STEM problem: identifying and deterring a virus outbreak. In **THINK**, students act as public health analysts challenged by a mysterious virus outbreak. In order to combat the virus, they must research data published by the Centers for Disease Control and Prevention (CDC) to identify the virus and a vaccine to stop it in its tracks. In **SOLVE**, students utilize the computational thinking strategy of collecting data to construct questions designed to identify the virus. Students will learn the difference between qualitative and quantitative data and why each form of data is valuable to the research process. In **CREATE**, students will produce a flowchart using the qualitative and quantitative questions they designed. In **CONNECT**, students learn how doctors, public health professionals, scientists and bioengineers use computational thinking strategies like collecting and analyzing data to stop viruses in their tracks.

Students will be able to:

- **Analyze** maps to understand how viruses spread,
- **Understand** the importance of both quantitative and qualitative data, and
- **Create** a flowchart designed to identify and stop a spreading virus.

Students act as public health analysts challenged by a mysterious virus outbreak. In order to combat the virus, they must research data published by the Centers for Disease Control and Prevention (CDC).

1 **Read** the following scenario to students:
Imagine you are a public health analyst who studies virus outbreaks. A virus outbreak has begun at a local school, and reports indicate that it could spread quickly. As of now, patients are displaying symptoms that point to the virus being either measles or influenza, but medical professionals need your help to identify which virus it is and create a vaccine distribution plan. You and your teammates must design a flowchart that can be provided to medical professionals in the field that instructs them on the following:

- How to identify the virus (measles or influenza)
- How to assess the severity of the patient's condition
- How to treat the virus
- What vaccine to use to stop the spread of the virus
- How the vaccine should be dispersed

Pass out the article on the Disneyland Measles Outbreak. Instruct students to Think, Pair, Share to identify the following:

- What are the symptoms of measles?
- How did the virus spread?
- Who did the virus impact the most?
- How is/was the virus stopped?
- What is the role of vaccines in stopping the spread of this virus?

Have students investigate the patterns of the influenza (flu) virus during the 2016–2017 flu season using the CDC's interactive FluView dashboard. Instruct students to Think, Pair, Share with a different partner to identify the following:

- What are the symptoms of influenza?
- How did the virus spread?
- Who did the virus impact the most?
- How is/was the virus stopped?
- What is the role of vaccines in stopping the spread of this virus?

Distribute the CDC publication "How Vaccines Work" and guide students to read the descriptions and uses for different types of vaccines. Have students identify the ideal vaccine for stopping the spread of measles and the ideal vaccine for stopping the spread of influenza.

Teacher note: In multicellular organisms, the body is a system of multiple interacting subsystems. Viruses can only affect specific cells in your body. Influenza impacts the respiratory, digestive, and immune systems while measles predominantly impacts the respiratory and immune systems. Vaccinations allow the body to build up immunity to these viral infections by triggering our immune system with antibodies. The influenza virus changes rapidly, and new vaccines are continually developed. They provide protection against the flu virus. Measles, mumps, and rubella are prevented using one viral vaccine that induces immunity against all three viruses.

2 **Ask** students to brainstorm in groups a list of five questions they would use to find out information about whether the spreading virus is measles, as in the Disneyland example, or a strain of the influenza virus. Have each group write one of the five questions on the board or some other central location. They should have backup questions ready in case of duplicates. After each group has placed a question on the board, have students sort them into categories.

Lead students to consider the importance of qualitative and quantitative data using the following guiding questions:

- What kind of question formats do you usually see in a survey (multiple choice, text box, etc.)? What type of answer does each question format help you collect?
- What do we need to know about viruses in order to create a flowchart for medical professionals?
- How would you structure a question designed to capture how ill a patient feels?
- How would you structure a question designed to locate where people are infected with a virus?
- What is the importance of asking the right questions about virus outbreaks?
- When you hear the word quantitative, what comes to mind?
- When you hear the word qualitative, what comes to mind?

Students utilize the computational thinking strategy of collecting data to construct questions relating to the spread of the virus outbreak. Students will learn the difference between qualitative and quantitative data and why each form of data is valuable to the research process.

1 **Divide** students into groups or pairs. Instruct students to create a list of five quantitative questions and five qualitative questions that help determine what type of virus is spreading and how to treat it. Possible questions might be:

- Quantitative: How many times have you felt nauseous in the past week?
- Quantitative: How many of your friends and/or family members have felt sick in the past week?
- Qualitative: Can you describe your symptoms?
- Qualitative: Have you noticed any differences in your ears, nose, throat, or skin in the past week?

Distribute the Designing Data student capture sheet to guide students in formulating quantitative and qualitative questions to use in their flowchart.

Check In: Have students share their questions and write them in a central location.

2 **Select** several questions students have created. Work as a class to refine the questions in order to capture the type of information needed.

3 **Have students identify** relationships between the questions. Ask them to identify how some questions lead to others. Which questions need to be refined in order to be more specific? Which questions need to be more general? Rank questions in order of importance.

Students produce a flowchart that outlines a virus identification and treatment strategy.

1 **Distribute** the Outbreak student capture sheet and review the information with students before they begin.

2 **Explain** to students that they will use their questions to create a flowchart. The chart should be a one-page guide that professionals can use in the field to identify and treat the virus. It must address the following:

- How to identify the virus (measles or influenza)
- How to assess the severity of the patient's condition
- How to treat the virus
- What vaccine to use to stop the spread of the virus
- How the vaccine should be dispersed

3 **Tell** students that they can use the questions they designed on their Designing Data capture sheet to design the flowchart. Explain that these questions may have to be edited and refined to fit the intended purpose and gather the accurate information.

4 **Groups will share** the flowchart with the class and describe the format of their flowchart while the remaining students in the class complete peer assessments using the grading criteria from the Outbreak student capture sheet.

5 **Ask** students the following critical thinking questions:

- How could we use technology that a medical professional would likely have in the field (smartphones, etc.) to accomplish the work of our flowcharts?
- What are the benefits and drawbacks of a paper-based decision chart?
- How does this chart change depending on where the virus hits? How is it different in a city versus a rural area? How is it different in a hospital versus a school?
- What would you do if you were treating a virus in a remote location where it wasn't possible to purchase or distribute a vaccine?

Extension: Tell the students that they will participate in a town hall debate in which they will pitch a Vaccine Distribution Plan. All residents (students) will evaluate the plans being presented and participate in a debate to select a plan to implement. Students should use the criteria and constraints to assess the presentation, and they may also use the presentation criteria to support their debate points. Allow students to form groups according to which plan they will support and then determine debate statements to support an argument for that plan. Groups can take turns giving debate statements while the teacher monitors for fairness and timing. The class can vote to select one plan at the end. Instruct students to think about how a computer could have helped them decide on a plan to use rather than a vote or a debate. Have the class summarize by answering the following guiding questions:

- How do computers help us compile data?
- Why is the computational thinking strategy of analyzing data important?

Select one of the strategies listed below to help students answer these questions:

- **How do this problem and solution connect to me?**
- **How do this problem and solution connect to real-world careers?**
- **How do this problem and solution connect to our world?**

1. **Write** the three questions on PowerPoint or flip chart slides, and invite students to share out responses.
2. **Display** pieces of chart paper around the room, each with one question written on it. Ask students to write down their ideas related to the questions on each sheet.
3. **Assign** one of the questions to three different student groups to brainstorm or research and then share out responses.
4. **Invite** students to write down responses to each question on a sticky note, and collect them to create an affinity diagram of ideas.

How does this connect to students?

Students are likely to come into contact with many different viruses over their lifetimes. Viruses like measles and influenza can have a severe effect on populations, especially vulnerable communities like small children and the elderly. This lesson provides students with knowledge that they can use in their real lives to identify and treat viruses. It also helps students understand the importance of vaccines and the role they play in maintaining public health and safety.

How does this connect to careers?

Epidemiologists investigate causes and patterns in diseases. They research, educate, and present on how to reduce the risks of viruses, diseases, and other health hazards.

Health Educators teach people how to identify and treat viruses. They also lead programs that promote health and wellness. They often work in schools, hospitals, and patient care facilities.

Public Health Analysts work for institutions like the Centers for Disease Control and Prevention (CDC) and use quantitative and qualitative data methods to work with public health programs.

How does this connect to our world?

The computational thinking strategies of collecting and analyzing data are useful in virtually every career field. When it comes to identifying and stopping the spread of disease, technologies like deep learning and artificial intelligence are helping researchers to identify genetic defects in patients' DNA before they cause any harm.

National Standards

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations ▪ Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (MS-LS1-1)	**LS1.A: Structure and Function** ▪ In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.	**Patterns** ▪ Patterns can be used to identify cause-and-effect relationships. (MS-LS4-2) ▪ Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-1) (MS-LS4-3)

COMMON CORE STATE STANDARDS CONNECTIONS

ELA/Literacy

- **WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-5) (MS-LS1-6)

Mathematics:

- **6.SP.B.4** Summarize numerical data sets in relation to their context. (MS-LS1-4) (MS-LS1-5)

K-12 COMPUTER SCIENCE FRAMEWORK

Practice 3: Recognizing and Defining Computational Problems

- The ability to recognize appropriate and worthwhile opportunities to apply computation is a skill that develops over time and is central to computing. Solving a problem with a computational approach requires defining the problem, breaking it down into parts, and evaluating each part to determine whether a computational solution is appropriate.

By the end of Grade 12, students should be able to:

- Identify complex, interdisciplinary, real-world problems that can be solved computationally.
- Decompose complex real-world problems into manageable sub-problems that could integrate existing solutions or procedures.
- Evaluate whether it is appropriate and feasible to solve a problem computationally.

Designing Data

Before you build your questions, identify five pieces of information that you want to learn about the virus:

1.
2.
3.
4.
5.

Types of Data

Quantitative Data – Data that are expressed numerically. These data are specific and measurable.
Examples of quantitative survey questions:

- How many times have you felt nauseous in the past week?
- How many of your friends and/or family members have felt sick in the past week?

If you want to collect quantitative data, use these question types:

- Checkbox, multiple choice, rating scale with numbers

Qualitative Data – Data about details or qualities that cannot be specifically measured.
Examples of qualitative survey questions:

- Can you describe your symptoms?
- Have you noticed any differences in your ears, nose, throat, or skin in the past week?

If you want to collect qualitative data, use these question types:

- Text box, free response, rating scale with adjectives

Write five quantitative and five qualitative questions to identify the virus:

Quantitative Survey Questions

Question Type:	Quantitative Question 1:
Question Type:	Quantitative Question 2:
Question Type:	Quantitative Question 3:
Question Type:	Quantitative Question 4:
Question Type:	Quantitative Question 5:

Qualitative Survey Questions

Question Type:	Quantitative Question 1:
Question Type:	Quantitative Question 2:
Question Type:	Quantitative Question 3:
Question Type:	Quantitative Question 4:
Question Type:	Quantitative Question 5:

Do your questions help you gain information about the five things you wanted to learn about the virus? Why or why not?

Outbreak

You are part of the Emergency Virus Team for your state. A virus has begun to spread. It needs to be identified, and then a vaccine must be distributed.

Objective: Construct a flowchart with quantitative and qualitative questions for health professionals in the impacted areas to identify and treat the virus.

While designing your flowchart, your team must adhere to the following criteria and constraints:

- The flowchart must include a minimum of 10 quantitative and 10 qualitative questions.
- The flowchart should help identify whether the virus is measles or influenza.
- The flowchart must lead to answers that identify how the virus is spreading.
- The flowchart must include decisions on which vaccine should be used to stop the spread of the virus.
- The flowchart must include medical and safety issues that must be considered while distributing the vaccine.

Your team will create a decision flowchart. The flowchart will be graded on the following:

Organization	Content	Flowchart
The information is presented in a clear manner and logical sequence.	Definitions and content are accurately described in detail. The plan adheres to all criteria and constraints.	The flowchart includes 5–10 viruses that can cause an outbreak. A minimum of 10 quantitative and 10 qualitative survey questions are included. Decisions are included for each of the following: ▪ Virus type ▪ Virus location and high-risk areas ▪ Where to distribute the vaccine ▪ Medical and safety issues