# Unit Plan

# Infection: Modeling, Simulation, and Detection

Region 12 Elementary Curriculum / Grade 5 / Science

Week 30 - Week 39 | 3 Curriculum Developers | Last Updated: Jun 9, 2020 by DeBrito, Teresa

## Unit Overview

Sequence of topics/learning tasks

In this unit, epidemiologists look to answer, "How does the spread of germs help us understand infectious diseases?" First, students are presented with a problem where a large number of students at a school are sick. Students learn about transmission of disease through a simulation and compare communicable and non-communicable diseases. Students design, run, and analyze data from an experiment related to preventing the spread of germs. Student groups present ways to prevent the spread of infection using evidence from their experiments. Students investigate how the body protects us from these germs to keep us healthy. Bacteria and viruses are introduced as agents of disease, and students use information learned and patient symptoms to identify the disease agent causing a simulated disease outbreak. Using epidemiology practices, students deduce a likely source of an infection that is spreading through a fictional school.
Students then discover how modeling and simulation provide powerful insight into complex systems. As they engage in building their own simple computer models, they come to understand the indispensable role computers play in helping scientists study systems through modeling and simulation, and use this model to better explain the illness spreading in the school.

## College & Career Anchor Standards

Reading, Writing, Language, Listening, Speaking

## Standards

**NGSS: Science Performance Expectations**
**NGSS: Grade 5**
**5.Matter and Energy in Organisms and Ecosystems**

**Performance Expectations** Show Details

- [x] 5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
  Show Details

Interactive version of NGSS
NGSS Resources


**CSTA: Computer Science Standards (2017)**
**CSTA: 3–5**
**Algorithms & Programming**

**Variables**

- [x] 1B-AP-09 Create programs that use variables to store and modify data. (P5.2)

**Control**

- [x] 1B-AP-10 Create programs that include sequences, events, loops, and conditionals. (P5.2)

**Modularity**

- [x] 1B-AP-11 Decompose (break down) problems into smaller, manageable subproblems to facilitate the program development process. (P3.2)

**Program Development**

- [x] 1B-AP-13 Use an iterative process to plan the development of a program by including others' perspectives and considering user preferences. (P1.1, P5.1)
- [x] 1B-AP-15 Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended.(P6.1, P6.2)
- [x] 1B-AP-16 Take on varying roles, with teacher guidance, when collaborating with peers during the design, implementation, and review stages of program development. (P2.2)
- [x] 1B-AP-17 Describe choices made during program development using code comments, presentations, and demonstrations. (P7.2)

## Learning Targets

I can create a model that describes the movement of matter among organisms.
I can create programs that use variables to store and modify data.
I can create programs that include sequences, events, loops, and conditionals.
I can decompose (break down) problems into smaller parts to make programming easier.
I can use others' perspectives and considering user preferences when making a program.
I can test and debug (identify and fix) a program.
I can work together with a group during the steps of program development.
I can share my programming choices to improve other programs.

## Mathematical Practices / Universal Practices

## Science and Engineering Practice

## Essential Questions

1. How does the spread of germs help us understand infectious diseases?

## Enduring Understandings

1. Scientists ask and identify questions to gain knowledge or solve problems.
2. Scientists develop and use models to represent amounts, relationships, relative scales, and/or patterns in the natural and designed world(s).
3. Scientists plan and conduct investigations collaboratively to produce data that serves as evidence used to answer questions.
4. Scientists make predictions based on prior experiences.
5. Scientists make observations and/or collect data to construct evidence-based conclusions for natural phenomena.
6. Scientists keep and organize all of their work in a scientific notebook.
7. Scientists work collaboratively and communicate their findings with others.
8. The design process is a step by step method used to guide people in developing solutions to problems.
9. Infectious agents, such as bacteria and viruses, can cause illness and can spread from person to person.
10. The body protects and defends itself from infection.
11. Understanding how infectious disease spreads in a population helps medical professionals with prevention efforts.
12. Modeling and simulation allows scientists to test a digital model of a physical system with different parameters to

understand and predict how the system behaves in the real world.
13. Computers are essential tools for modeling and simulation because they can rapidly calculate and display information about a system.
14. Modularization, breaking problems into subproblems, and abstraction, ignoring details while focusing on common properties, are important steps to take when developing solutions with technology.
15. Computing is a collaborative activity that fosters creativity and requires communication and teamwork.
16. People use technology to create useful tools that help us understand the world better.
17. Computer programs do not need to be right the first time. Testing and fixing things is normal when programming.

## Concepts

what students need to know

- Recognize that germs can make a person sick.
- Recognize that bacteria and viruses are germs.
- Describe the various ways germs can be passed from person to person.
- Recognize that bacteria and viruses are microscopic in size and that they cannot be seen with the naked eye.
- Identify the ways that the body protects and defends itself against infection.
- Identify behaviors that promote good health.
- Organize and collaborate with group members by assigning roles and taking turns.
- Use parameters in a preprogrammed simulation to investigate the model system, its agents, and the effects of its parameters.
- Decompose a problem and use a predefined set of commands to write an algorithm that will solve the problem.
- Identify parts of a computational solution that can be abstracted and modularized so that they can be reused multiple times with different data.
- Use variables appropriately as part of a computational solution.
- Construct a class of objects with inherited properties and methods to create a variable number of agents in a program.
- Implement a loop when appropriate to make a program repeat a section of code until an ending condition is reached.
- Program actors to respond to both internal and external event triggers.
- Construct a computer program using age-appropriate tools to model a simple system and to simulate how it works.
- Demonstrate persistence in the cycle of testing, finding, and fixing problems in computer programs.

## Skills

what students need to do. Include (DOK).

DEVELOP models
CREATE programs
DECOMPOSE problems strategically
PLAN programs
CONSIDER alternate perspectives
TEST programs
DEBUG programs
COLLABORATE with peers
DESIGN programs
IMPLEMENT programs
REVIEW programs
DESCRIBE choices

## 21st Century Skills

## Learner Outcomes

## Interdisciplinary/Career Connections

## Assessments

include: interim & summative assessments, and performance tasks

Infection Detection CheckForUnderstanding.pdf

Infection ModelingCheckForUnderstanding.docx

## Research\Expansion Opportunities

include collaboration with peers

## Rubrics & Artifacts

**Rubrics:**

See attached Science and Engineering Practice Rubrics

**Artifacts:**

See attached Unit Outlines and Artifacts

3-5 Sci. and Eng. Practices Rubrics

Unit Outlines:Artifacts

Unit Outlines:Artifacts

## Essential Vocabulary

| | |
|---|---|
| germ | infection |
| communicable disease | contagious |
| scientists | patient zero |
| experiment | scientific inquiry process |
| immune system | microorganisms |
| bacteria | test |
| viruses | models |
| infected | computer models |
| susceptible | agent |
| simulation | parameter |
| animation | tilt |
| x-y coordinate | stage |
| code | pair programming |
| loop | driver |
| variables | navigator |
| solutions | events |
| modeling | recover |

## Technology/Tools/Resources

Tynker

## Learning Plan

with formative assessments

*Unit Introduction Structure:*
The unit begins with the viewing of an **unit phenomenon**. Using the (Question Formulation Technique), students generate target questions for the unit/lesson. Students collect and share information throughout the experiences toward answering the question they raised with evidence and a more complete scientific explanation, using vocabulary and concepts learned throughout the lesson(s).
Questions raised through the Question Formulation Technique are posted, and one **overarching Essential Question** is chosen. This question is posted on top of a classroom chart (paper copy and online unit summary document (please place a copy of this file in the unit Phenomenon Outline Folder)) as a location where information from the unit can be posted to be later referenced at the end of the unit while crafting a complete response to the unit EQ.
**Unit Phenomenon** :
Many kids at school are sick/introduction story
**Potential Unit Essential Questions:**
How does the spread of germs help us understand infectious diseases?
*Session Structure:*
Phenomenon Questioning Routine : Students set up their notebooks with a section for what they notice, followed immediately by questions they have raised (using the Question Formulation Technique). They fill this section while viewing the **engaging phenomenon** for the lesson. (students practice raising questions and not answering...yet).These generated questions are shared, and patterns and big ideas are discussed from the questions raised. These patterns and big ideas are then condensed into one lesson target question (or essential question) and this question is posted on the target board.
Exploration Activity Routine: Students then set up the next section in their notebook to collect evidence they gather during the **exploration activity.**
If students are designing/conducting an investigation**,** they set up their notebooks to include Materials, Procedure, Data (sample page below).
Explain Routine: Students use the specific collected evidence and generalize science concepts in a Claim, Evidence, Reason format to provide an answer to the target question raised earlier
Elaborate Routine: Students take their understanding from the lesson and consider how to apply it to the unit essential question and add this insight to the classroom charts (paper copy and online unit summary document. Students can further extend their understanding to other novel situations outlined in the specific lesson plans.

Session 1:
Students complete the **Engaging Phenomenon** routine outlined above with: Seven Up game to spread germs described in lesson
*Look for: questions related to source of the germs and how they spread*
Students complete the **Exploration Activity** routine outlined above with:
Students have passed around "glow germs" and the class will discuss to determine patient zero
Students use the **Explain r**outine to answer the target question.
*Look for: Students use evidence to explain,* How could the disease have been prevented from spreading?

## Instructional Strategies

- whole group modeling/discussing
- individual student exploration to make sense of learning via modeling/journaling/reflecting
- sharing thinking with table partners
- whole-group sharing
- supported individual development of scientific concepts via one-to-one feedback
- whole class discussion
- follow along modeling
- off-line algorithm practice and creation
- paired programming
- plain-language coding
- testing programs to debug and improve
- design process to identify a problem, inform solution, design a model, build and test

Students complete the **Elaborate** routine outlined above and can **Extend** by: What information will you need to determine more information about the outbreak at school?
Supporting resource: PLTW ID Activity 1: Germs, Germs Everywhere

Session 2:
Students complete the **Engaging Phenomenon** routine outlined above with:: Hand Scrub
*Look for: questions related to why the routine is so specific and detailed/ reasons behind various steps*
Students complete the **Exploration Activity** routine outlined above with:
students design and perform an experiment to collect and then analyze data to draw conclusions about best hand washing/soap techniques
Students use the **Explain r**outine to answer the target question.
*Look for: Students use evidence to explain,* Why do doctors scrub with such a clear technique?
Students complete the **Elaborate** routine outlined above and can **Extend** by: How could we improve our experiment to test parts of the hand washing routine we observed?
Supporting resource: PLTW ID Activity 2: Preventing the Spread

Session 3:
Students complete the **Engaging Phenomenon** routine outlined above with: White Blood Cell Chases Bacteria
*Look for: questions related to how the cell moves and what it is doing to contain the bacteria*
Students complete the **Exploration Activity** routine outlined above with: investigate the lines of defense your body uses to keep you healthy
Students use the **Explain r**outine to answer the target question.
*Look for: Students use evidence to explain*
What is happening before/during and after the phenomenon?
Students complete the **Elaborate** routine outlined above and can **Extend** by: Why could symptoms such as swollen lymph nodes or a fever be a good thing?
Supporting resource: PLTW ID Activity 3: Infection Fighters

Session 4:
Students complete the **Engaging Phenomenon** routine outlined above with: Precautions for Ebola vs. Precautions for heart disease (leading cause of death)
*Look for: questions related to why one has so many obvious precautions while one does not*
Students complete the **Exploration Activity** routine outlined above with:
Apply new knowledge of communicable diseases and microorganisms to analyze student interviews, catalog symptoms, and identify patterns, Then use this information to determine what illness is being spread around school.
Students use the **Explain r**outine to answer the target question.
*Look for: Students use evidence to explain,* Why do the doctors need separate precautions for various diseases?
Students complete the **Elaborate** routine outlined above and can **Extend** by: Defend why all bacteria is/isn't bad?
Supporting resource: PLTW ID Project: Mystery at School

Session 5:
Design Challenge: Solve the mystery infection project

*Look for: questions related to source/transmission and prevention of the spread*
Students complete the **Exploration Activity** routine outlined above with:
how can you evaluate the success of the solution?
Students complete the **Elaborate** routine outlined above and can **Extend** by: WHat measures could the school take to prevent the disease from spreading in the future?
Supporting resource: PLTW ID Problem: Disease Detectives

Introduce Unit Design Challenge: Develop a Susceptible - infected-susceptible model to investigate how hand washing affects the spread of an illness in a classroom, introduced @ Modeling and Simulation Introduction

Session 6: PLTW: Activity 1: Simulation Game

- Students investigate how computer models can be used to describe this spread of disease, predict trends, and ultimately prevent further spread.

Session 7: PLTW: Activity 2: Virtual Ecosystem

- Students explore a computer model built to simulate the spread of a communicable disease such as the cold or flu.

Session 8: PLTW: Activity 3: Building Computer Models

- Students use Tynker to build a game to learn about agents and rules.

Session 9: PLTW: Project: Playing with Parameters

- In this project students learn how to program a model so that it has parameters, or values that can be changed. Building on the things they learned while making the dodgeball game in the previous activity, they build a model of a dinosaur ecosystem with parameters for predators and food.

Session 10: PLTW: Problem: Simulating Infectious Diseases

- In this problem , students build a program in Tynker™ that simulates a group of students moving randomly around a classroom. Some of the students will be sick at the start of the simulation. The simulation will have a hand washing rating parameter. If the class is very good at washing hands, the illness will take longer to spread. If the class is bad at hand washing everyone will get sick quickly.

**Unit Culmination Structure:**
Students review the information collected in their notebooks, wall chart, and Unit Summary Document adding any new information or information synthesized throughout to each chart. They use this information to complete a performance assessment.
Performance Assessment: analyze safety measures being implemented to stop the spread of a disease
Students use the collected information to name the criteria for success for the unit design problem (general model attached below)
Unit Design problem: design precautionary measures to a disease

Unit Phenomenon Summary Doc. Copy
ClaimEvidenceReasoningPosters.pdf
Formulating_Science_Questions.pdf
Question Formulation Technique - Google Docs.pdf

Sample_Success_Criteria.pdf

Science_Target_Board.pdf

Unit_Summary_Poster.pdf

xSample_Notebook_Page.pdf

## Differentiation (with supports)


## Differentiation (enrichment)

Coding Puzzles

## Sample Student Work/ Exemplars

(Identifiable personal information should not be displayed)

See attachment below for Tynker solutions

Grade 5 Coding Examples

## Additional learning experience

Special assemblies/field trips