Bacteria Sandwich App – Mini-Lesson

Free download on the Google Play or iTunes stores

Overview

Bacteria Sandwich is a free, engaging, easy-to-use app for students and others to explore how exponential growth can occur when temperature conditions are optimal for the bacteria. Students can change the initial number of bacteria and temperature to see what happens over 12 hours. How can this bacteria be stopped before it creates a very dangerous lunch? Students can change the elements to determine how to keep those lunches safe!

Materials

- Mobile device(s) able to download free apps.
- Adapter to connect to projector (if using just one device)
- Handout (optional)

Recommended Ages

4th-12th grade

Time Needed

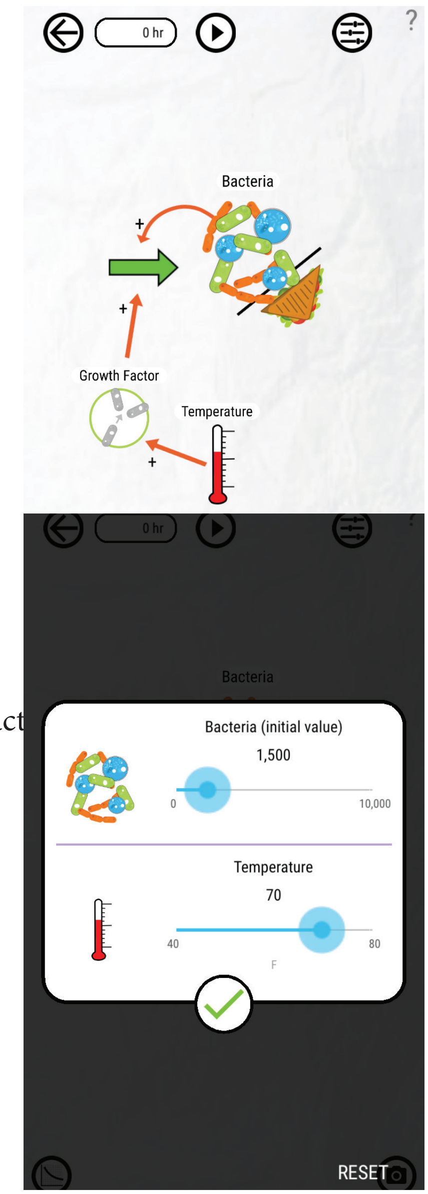
30-60 minutes

Connections to Curricular Standards

- National Social Studies Theme: III. People, Places, and Environments; and VIII. Science, Technology, and Society
- Common Core Math, CCSS.MATH.CONTENT.7.EE.B.3 Solve real-life and mathematical problems using numerical and algebraic expressions and equations.
- State and national Math standards, See article, "Thinking Systemically About Common Core Mathematical Practice Standards."
- Example from Next Generation Science Standards, 3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.

Suggested Instructional Sequence:

- Define terms: bacteria, growth factor, and temperature.
- Work through "The Story" in the app, either as a class or independently.
- Pause and discuss strategies to prevent the bacteria from growing to dangerous levels.



Bacteria Sandwich Controls (sliders)

- Using the handout, continue experimenting with “The Model” to consider different scenarios for controlling the level of bacteria.
- Discuss students’ reflections from their handouts.
- Extend the exploration using the optional extension on the handout to look at potential leverage for preventing illness from tainted food.
- Discuss questions such as:
  1. What kinds of strategies, or even new inventions, might prevent your sack lunch from becoming tainted?
  2. What other undesireable elements grow like the bacteria? What could prevent them from growing?

Additional Ideas and Connections

- Algebra I or II: Use the model with resulting graphs to explore the concept of exponential growth and the underlying equation.
  1. For $y = a(1 + r)^x$ with (a) being the initial number of bacteria and (r) being the growth factor. For example, at 50º F, the growth factor is 0.05.
  2. Calculate the number of bacteria (y) at time (x).
  3. In addition, you can give students the initial and ending values of bacteria so students can calculate the growth factor (r).
- Surface, practice and discuss related mathematical practices.
  1. Make sense of problems and persevere in solving them.
  2. Reason abstractly and quantitatively.
  3. Construct viable arguments and critique the reasoning of others.
  4. Model with mathematics.
  5. Use appropriate tools strategically.
  6. Attend to precision.
  7. Look for and make use of structure.
  8. Look for and express regularity in repeated reasoning.
- Extend student learning with one or more of the optional related resources.

Related Curricular Resources

See the Creative Learning Exchange website to download lessons, purchase materials and access additional online simulations for:

- *The Shape of Change – The Infection Game*, an exploration of a pattern of infection, initially exponential. Book available from the Creative Learning Exchange http://www.clexchange.org/cleproducts/shapeofchange.asp
- *Dollars and Sense*, a series of lessons and simulations for elementary through high school students that explore patterns with money. Some lessons look at the accumulation of credit card debt, similar to bacteria reproducing over time. Availabale at http://www.clexchange.org/curriculum/dollarsandsense/default.asp
- *Model Mysteries* Chapter 1, Growing, Growing, Gone, a lesson to build your own model to explore a population of zombie chickens growing in a similar pattern to bacteria in a sandwich. Available from the Creative Learning Exchange at http://www.clexchange.org/curriculum/modelmysteries/
- Food Safety Articles https://www.fsis.usda.gov/wps/portal/fsis/topics/food-safety-education/get-answers/food-safety-fact-sheets/safe-food-handling/danger-zone-40-f-140-f/ct_index
- *Food Technology & Processing - Bacterial Food Poisoning,* by Al B. Wagner, Jr., Professor and Extension Food Technologist
  http://aggie-horticulture.tamu.edu/food-technology/bacterial-food-poisoning/

Acknowledgments and Sources

- Lesson written by Anne LaVigne for the Creative Learning Exchange, http://www.clexchange.org
- App by BTN, http://learnwithbtn.com/
- Potash, Jeff, "Thinking Systemically About Common Core Mathematical Practice Standards." http://static.clexchange.org/ftp/documents/implementation/IM2014_CommonCoreMath.pdf
- National Social Studies Standards, https://www.socialstudies.org/standards/strands
- Next Generation Science Standards, https://www.nextgenscience.org/standards/standards

Bacteria Sandwich

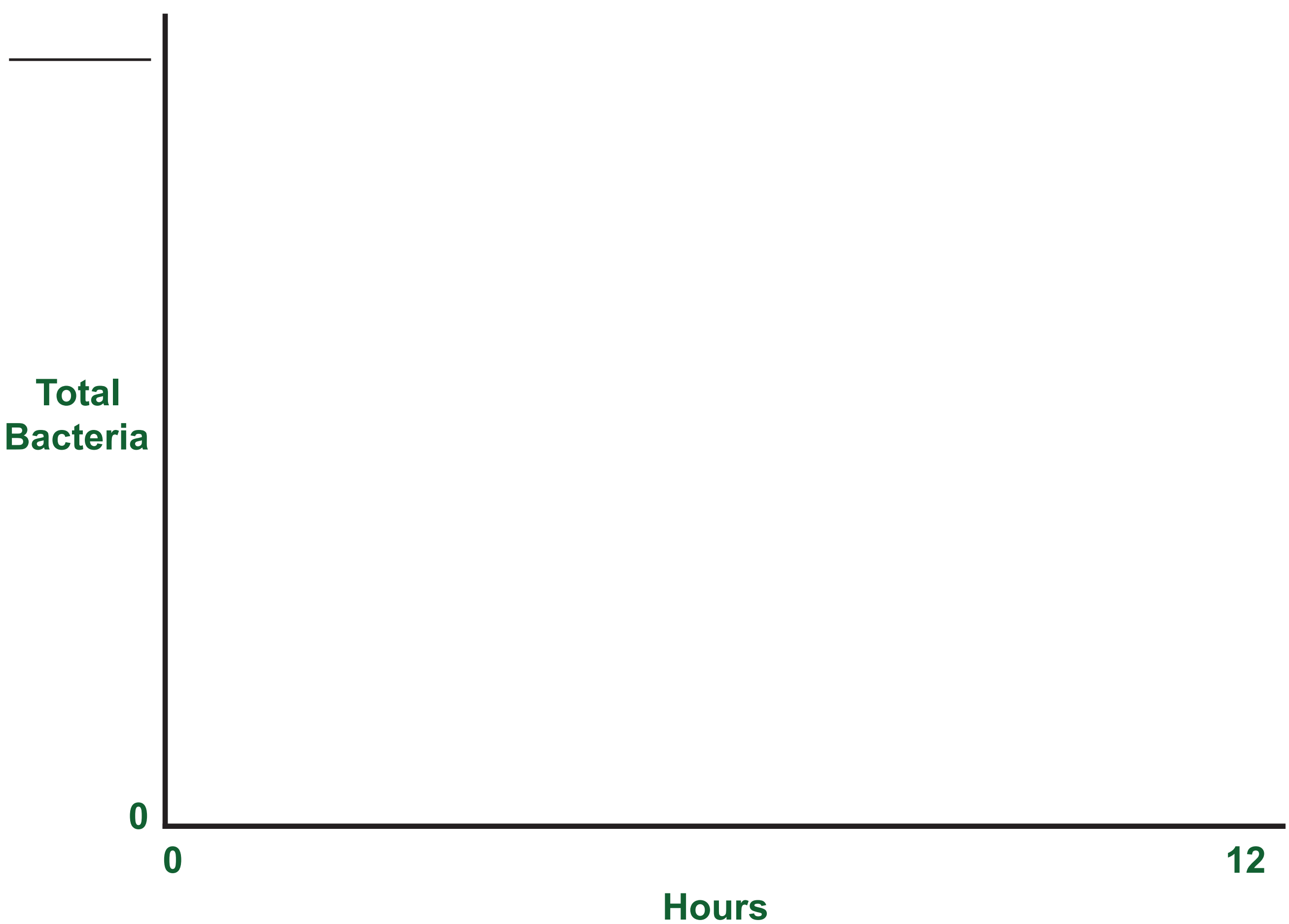
Name:________________________

Bacteria:________________
(initial value)

Temperature:__________________

Label and draw two runs on the graph – one that shows the bacteria number growing too large and one that shows the number staying low enough to be safe for consumption.

Bacteria in the Sandwich



Reflection

What worked best and was also realistic to prevent the rise of bacteria to an undesired level? Why?

What other situations could you study using this app?

Extension

Instructions
Read the article excerpt and use the article and simulation to complete the handout.

Excerpt
“Foodborne illness is an ever-present threat that can be prevented with proper care and handling of food products. It is estimated that between 24 and 81 million cases of foodborne diarrhea disease occur each year in the United States, costing between $5 billion and $17 billion in medical care and lost productivity.

“Chemicals, heavy metals, parasites, fungi, viruses and bacteria can cause foodborne illness. Bacteria related food poisoning is the most common, but fewer than 20 of the many thousands of different bacteria actually are the culprits. More than 90 percent of the cases of food poisoning each year are caused by *Staphylococcus aureus, Salmonella, Clostridium perfringens, Campylobacter, Listeria monocytogenes, Vibrio parahaemolyticus, Bacillus cereus,* and Entero-pathogenic *Escherichia coli*. These bacteria are commonly found on many raw foods. Normally a large number of food-poisoning bacteria must be present to cause illness. Therefore, illness can be prevented by (1) controlling the initial number of bacteria present, (2) preventing the small number from growing, (3) destroying the bacteria by proper cooking and (4) avoiding re-contamination.

“Poor personal hygiene, improper cleaning of storage and preparation areas and unclean utensils cause contamination of raw and cooked foods. Mishandling of raw and cooked foods allows bacteria to grow. The temperature range in which most bacteria grow is between 40 degrees F (5 degrees C) and 140 degrees F (60 degrees C). Raw and cooked foods should not be kept in this danger zone any longer than absolutely necessary. Undercooking or improper processing of home-canned foods can cause very serious food poisoning.

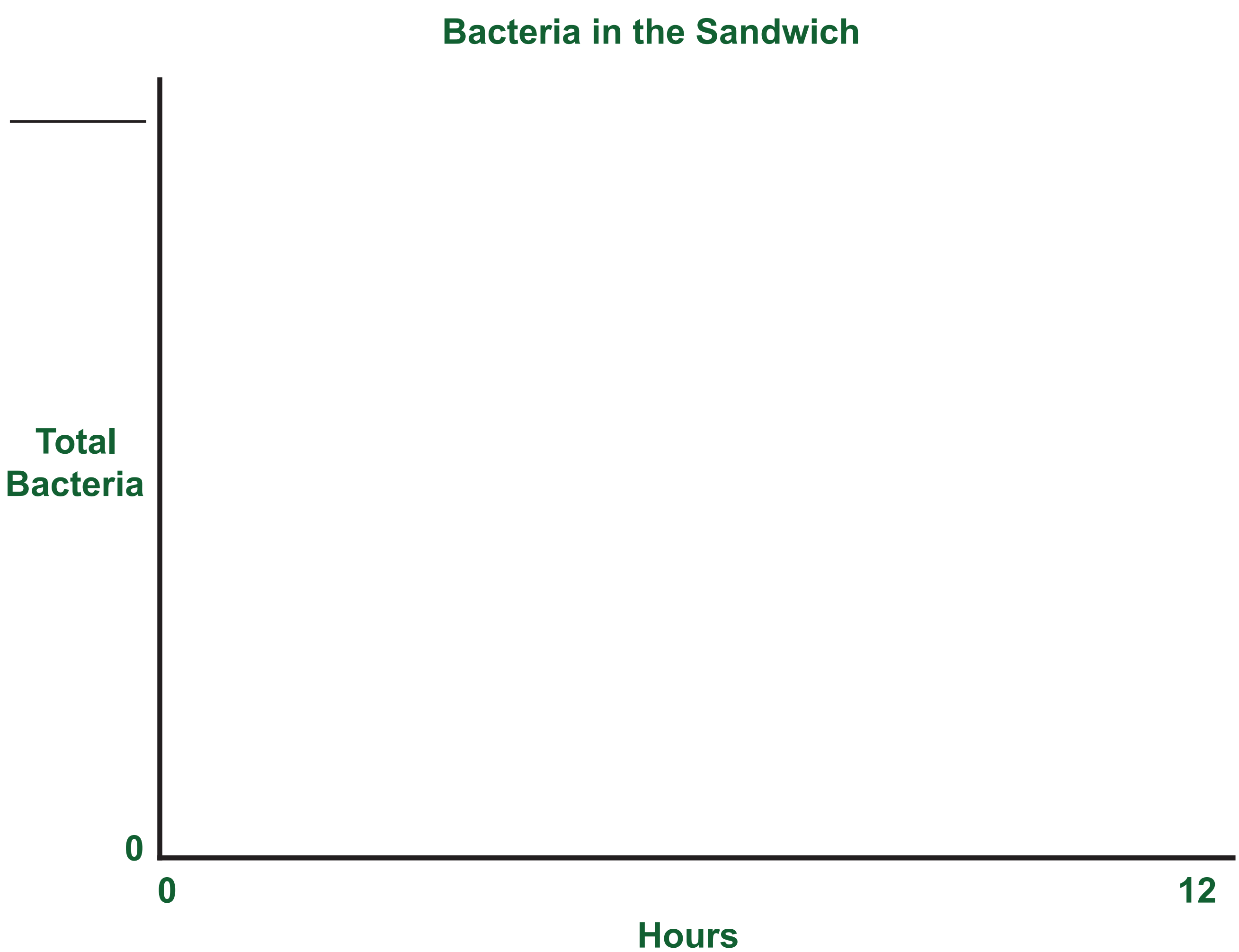
“Since food-poisoning bacteria are often present on many foods, knowing the characteristics of such bacteria is essential to an effective control program.”

From “Food Technology & Processing - Bacterial Food Poisoning” by Al B. Wagner, Jr., Professor and Extension Food Technologist
http://aggie-horticulture.tamu.edu/food-technology/bacterial-food-poisoning/

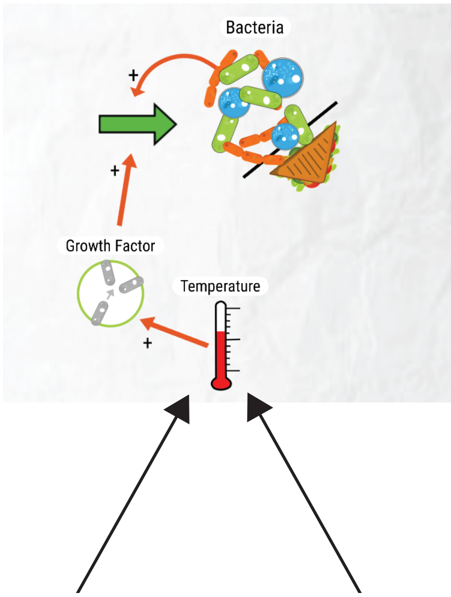
Initial Bacteria Considering the Initial Number of Bacteria

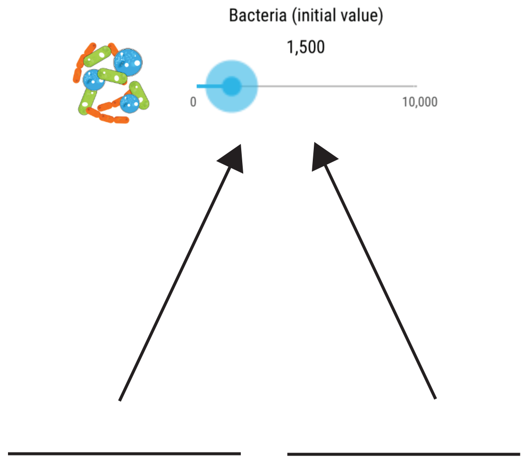
What strategies can people use to keep this number low initially?

Determine: How many bacteria to begin with are too many? Experiment with the simulation to see if you can prevent the problem by starting with a lower number of bacteria. Show and describe one example of what you did that works.



Using the diagram from the simulation, add at least two ways to affect the initial number of bacteria and two ways to affect the temperature.





Describe the elements in your diagram and how they impact one another.

What recommendations would you make to a school cafeteria to make sure food is safe to eat?