Germ Busters

LEVEL: Grades PreK-12
SUBJECTS: Health, Family and Consumer Science, Language Arts, Science, Social Studies, Mathematics, Physical Education
SKILLS: Analyzing, comparing similarities and differences, concluding, controlling variables, demonstrating, describing, discussing, drawing, experimenting and testing hypotheses, inferring, listening, observing, perceiving time, predicting, reasoning, recording, writing

MATERIALS

Soap; water; paper towels; one easily inflatable balloon; writing and drawing materials; a small strip of paper for each student; stopwatch or watch with a second hand; three large potatoes (as similar to each other as possible); potato peeler; three new, large, self-locking plastic bags; transparencies and/or photocopies of the attached ***Potato Experiment Prediction***, ***Potato Experiment Observations***, and ***Potato Experiment Summary*** sheets. **Optional**: fingernail file, fingernail brush, antibacterial soap. To play a germ buster game, see the materials needed in Session Two, Step 4.

VOCABULARY

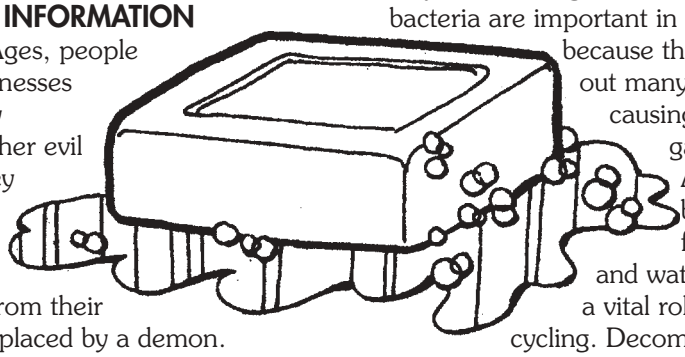
bacteria, germ, microorganisms, soap
Add for older students: control variable, data, experiment, mean, median, mode, prediction, variable.

RELATED LESSON

Could It Be Something They Ate?

SUPPORTING INFORMATION

In the Middle Ages, people believed that illnesses were caused by demons and other evil influences. They believed that, by sneezing, a person's soul might escape from their body and be replaced by a demon. Covering one's mouth, therefore, would help keep the soul in the body.



Today, we know that many diseases are caused by tiny living things that invade the body. We cover our mouths during a sneeze or cough to keep the tiny living things from spreading to other people. Scientists call these tiny things microorganisms or microbes; they are commonly called germs. Bacteria and viruses are among the smallest microorganisms. They are so small they can only be seen through a microscope.

Bacteria are simple, one-celled organisms. Most bacteria range in size from 0.3 to 2.0 microns in diameter. (There are 1,000 microns in one millimeter.) Bacteria exist almost everywhere and make up 80 to 90 percent of Earth's living matter. There are thousands of kinds of bacteria, most of which are harmless to people and do not cause disease. Many kinds of bacteria live on the skin and in the mouth, intestines and breathing passages. There are, for example, more than 600 kinds of bacteria living in the mouth.

Bacteria are beneficial to people in a variety of ways. Within the human intestines, bacteria aid digestion and destroy harmful organisms. Some bacteria are important in the body because they crowd out many disease-causing microorganisms. Also, bacteria are found in soil and water and play a vital role in nutrient cycling. Decomposers such as bacteria and fungi break down organic waste (once living plants and animals or components of them) into food for animal organisms in the soil and nutrients for plant growth. Without microbes, we would be buried in organic waste.

BRIEF DESCRIPTION

Through a controlled experiment, students learn one way bacteria can be spread and the importance of hand washing for personal hygiene and food safety.

OBJECTIVES

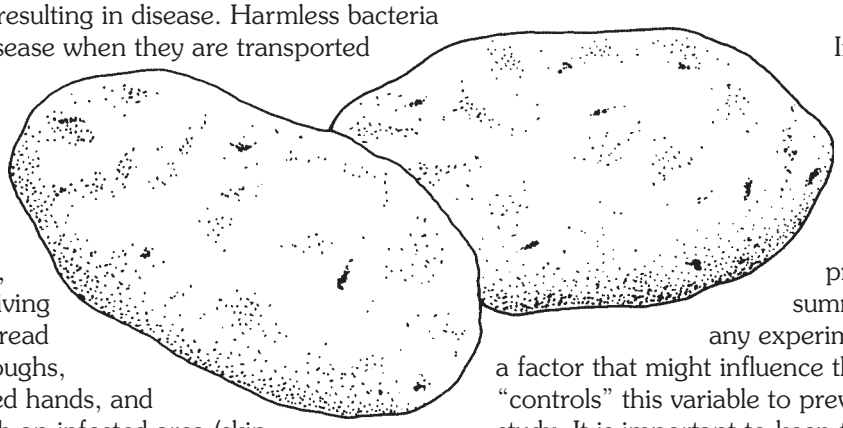
(Note: All five objectives are appropriate for older students; younger students may accomplish only the first four objectives.)
The student will:
- demonstrate proper hand-washing techniques;
- explain when and why it is important to wash hands with soap and water;
- conduct a controlled experiment demonstrating the spread of germs;
- record and analyze observations; and
- predict, observe and summarize the experimental results on observation sheets.

ESTIMATED TEACHING TIME

Session One: One hour (for younger students it is divided into three parts.)
Part One: 10 minutes.
Part Two: 30 minutes.
Part Three: 20 minutes.
Sessions Two to Four: 20 to 30 minutes each. (Sessions need to be at least a week apart.)
Session Five: 20 to 30 minutes.

Viruses are much smaller than bacteria, ranging in size from about 0.001 to 0.3 microns in diameter. If you can imagine a bacterium to be the size of an elephant, a virus would be the size of an ant. Unlike bacteria, viruses are not made up of cells and, therefore, lack some of the substances needed to live on their own. They enter a cell and use the cell's materials to live and reproduce. Viruses cause many common diseases such as chickenpox, measles, mumps, the common cold, and influenza, and serious diseases such as hepatitis, polio, rabies, and Acquired Immune Deficiency Syndrome (AIDS).

Many kinds of bacteria, viruses and other microorganisms can invade the human body and cause disease. Disease-causing microorganisms are called pathogens. Pathogens take over some of the body's cells and tissues and use them for their own growth and reproduction. As they multiply, they damage or destroy the cells and tissues, resulting in disease. Harmless bacteria can also cause disease when they are transported to a place where they are not normally present.



Germs and diseases can be spread by people, animals and nonliving things. People spread germs through coughs, sneezes, unwashed hands, and direct contact with an infected area (skin infections and sexually transmitted diseases). Animals such as mosquitoes, fleas and other blood-sucking insects may transmit germs. Handling or being bitten by infected animals spreads germs. Some pathogens can survive a long time on nonliving objects such as clothing, bedding and tableware. When handled by an infected person, the objects become a source of germs for uninfected persons. Impure drinking water may carry pathogens. Food contaminated with bacterial toxins can result in food poisoning. (See the FLP lesson "Could It Be Something They Ate?" for additional information about food poisoning.)

Washing our hands is the single most effective strategy to prevent a long list of illnesses. Unwashed hands often carry germs into the mouth. This is particularly true when people fail to wash their hands before handling food or after using the bathroom. In summer 1996, researchers sponsored by the American Society for Microbiology recorded the hand-washing behavior of 6,333 users of public restrooms. They found that 74 percent of women and 61 percent of men washed their hands. But nearly one-third failed to lather their hands properly.

The best way, literally, to wash away bacteria and viruses is by vigorously rubbing soaped-up hands back and forth for at least 20 seconds. The time allows for the full benefit of soap's antimicrobial action. Any basic soap or detergent will produce similar results because they break open the outer coat of bacteria, causing them to die.

Physicians conducting surgical scrubs to prepare for operations take a minimum of three minutes and usually five minutes to scrub their fingers, fingernails, hands, and lower arms. There is generally a prescribed number of strokes, 30 strokes to each fingernail and 20 strokes to each area of the skin, with a brush. They use antimicrobial soap or detergent and dry the cleansed skin with a sterile towel. A surgical scrub not only removes dirt, skin oil, and microbes, but also leaves an antimicrobial residue on the skin to prevent growth of new microbes for several hours.

In this lesson, students will be conducting a controlled experiment using potatoes to demonstrate the spread of germs. Like real scientists, students will predict, observe and summarize the experiment. In any experiment, a control variable is a factor that might influence the results. The researcher "controls" this variable to prevent it from affecting the study. It is important to keep the condition of control variables as similar to each other as possible.

The controlled variables in this experiment include the plastic bags, potatoes, air in the bags, location in the classroom, and time. To ensure similar conditions, use three identical plastic bags and very comparable potatoes. Be sure the bags contain the same amount of air, and place them in the same location. Allow the same length of observation time for all three bags. By controlling these variables, we know they are <u>not</u> responsible for the results of the experiment.

The experimental variable, however, <u>is</u> responsible for the outcome of the experiment. In this case, the experimental variable is the treatment of the potatoes because of the condition of students' hands. The potatoes will be treated as follows: 1) no handling, 2) handling with dirty hands, and 3) handling with properly washed hands. By controlling the other variables, the changes in the potatoes <u>are</u> dependent upon the three different treatments.

Students will be making a prediction about what they think will happen to the potatoes as a result of the different treatments. Their careful observations will serve as the basis for comparing and summarizing the experimental results. We hope that based on this experiment, students will make personal decisions and behavioral changes about how and when they wash their hands.

GETTING STARTED

Purchase three large and similar potatoes. Gather the necessary supplies listed in the Materials section. Make transparencies of all the attached sheets to use as collective record sheets with younger students and to record examples for older students. Photocopy the attached ***Potato Experiment Prediction***, ***Potato Experiment Observations***, and ***Potato Experiment Summary*** sheets for <u>each</u> pair or small group of older students.

The day of the experiment peel three similar potatoes. Wash all three potatoes for at least 20 seconds with soap and water after peeling them. Before peeling the potatoes, your hands and the peeler should be washed thoroughly. Put one potato in each of the new, large, self-locking plastic bags to be used later. Label the bags potato 1, 2 and 3. Two to three weeks may be necessary to see revolting results among the potatoes.

SAFETY WARNING: Bags should not be opened after the potato has been handled and sealed inside because of these possibilities: infectious microbes growing on the potatoes; irritation of the nose and throat by mold spores; and foul smell.

PROCEDURE

<u>SESSION ONE</u>

1. Tell students that potatoes are being used in our experiment to discover how germs or bacteria can be spread. At this point, do <u>not</u> discuss the design of the experiment, since it may affect how students behave in the hand-washing experience during Step 3. Explain that during the next couple of weeks, they will be observing the potatoes to gather information and see the results.

2. Potato 1 is the unhandled potato in this experiment. Leave it in the bag slightly moist, and keep it sealed. Potato 2 is handled with dirty hands. Pass this potato around the room for all students to handle. (The dirtier the students' hands, the better.) Seal potato 2 back in its plastic bag. If it is very dry, put a couple of drops of water on the potato. Be sure the bag has the same amount of air as potato 1. Potato 3 is handled <u>later</u> by students with properly washed hands and then will be sealed in a bag. If you do not proceed immediately with Step 3, make sure all students wash their hands after handling potato 2.

3. Conduct the hand-washing activity with students. The ideal situation is a central sink your whole class can gather around. A sink in the classroom, the school nurse's office, cafeteria, Family and Consumer Science room, or art room can serve this function.

   Have students wash their hands, one student at a time. Stand by the students with a watch or stopwatch and say, "Let's see how long it takes you to wash your hands." Give all students slips of paper with their hand-washing times on them.

   Optional: Divide the class into lab groups. Have each group select one student representative. Only the representatives wash their hands and have their times recorded.

4. Discuss the hand-washing experience by asking:

   - Why do you wash your hands?
   - How did you learn how to wash your hands?
   - When do you wash your hands at school? At home?
   - When do you think it is important to wash your hands?

5. Have students look at their hand-washing times. Write the hand-washing times on the board. Ask:

   - Which time is the longest? The shortest? (Older students can average the hand-washing times.)
   - Which time do you think is the best? (Don't give any feedback at this point. Students may think the shortest time is best.)

6. Have older students calculate and graph the median, mode and mean (or average) of the hand-washing times.

7. Ask:

   - What do you think a germ is?
   - Where do you think they live?
   - Can germs live on you? *(Yes.* Help students

understand that our hands are one of the most common places for germs.*)*

- How big are they? Can we see them? *(No, they are microscopic.)*

- Do you think washing your hands does anything to germs?

- Why do you think it is important to use soap and water when washing our hands?

8. Explain to students that there are germs on almost everything in our world. Real germs are so small you can see them only with a microscope. Share the Supporting Information about bacteria and viruses. Help students understand that some bacteria are beneficial.

   Germs move only short distances and can "hitchhike" on our hands. When we handle our food and eat with dirty hands, germs can enter our bodies through our mouth. Germs can make us sick, but we can stop them by washing our hands with soap and water. Washing with soap and water is one of the most important steps to staying healthy.

9. Demonstrate the effect of using soap when washing hands by blowing up the balloon. The balloon represents a germ. Release the air from your balloon by popping it with a pin. In a dramatic voice, tell the students that this represents soap's effect on germs. Soap acts like a "germ buster." It breaks open the outer coats of the bacteria, causing the germ to die. When we use soap with water, we wash the germs away so they cannot make us sick.

10. Ask:

    - When is it most important to wash your hands?

    - To do an effective job, how long should we wash our hands?

    For soap to work on germs, tell them they should wash their hands for <u>20</u> seconds. Discuss the actual length of their hand-washing times (from Step 3). Share the Supporting Information about physicians' hand-washing procedures.

11. Ask students to suggest important rules to follow in proper hand-washing technique. Record the rules in a visible place. Hopefully, students will suggest rules including:

    - using soap;
    - rubbing hands for 20 seconds; and
    - rinsing with water.

    Note: There does not appear to be agreement on water temperature. Some say it should be as hot as the person can stand. Others say use a comfortable temperature so you will properly wash your hands.

12. Highlight the rules as you or a student model the proper hand-washing technique.

    - Turning the water on to get hands wet (if using bar or powder soap) and shutting it off (remind them <u>not</u> to waste water). Wetting hands is not usually necessary when using liquid soap.
    - Using soap (as a bar or liquid)
    - Vigorously rubbing your hands together, front and back
    - Counting to 20 <u>slowly</u> (representing 20 seconds) while rubbing hands
    - Rinsing hands with water
    - Drying hands using a clean towel, paper towel, or air blower

    Students can demonstrate the rules by going through all the steps as a class.

13. Have a group of students or the whole class properly wash their hands so potato 3 can be handled. (See Extension 1 for a Hand Washing Song.) It is very important that potato 3 be handled only by <u>clean</u> hands. After the potato is handled, seal it in its bag with the same amount of air as bags 1 and 2. If it is very dry, put a couple of drops of water on the potato. Place all three bags together in a visible place. Ask :

    - What is the same about the three potatoes and bags? Different?

    - What has been done to each of them?

    Group the similarities and differences. With older students, introduce the concepts of control and experimental variables. Have them identify the control and experimental variables in this experiment. (See Supporting Information.)

SESSION TWO

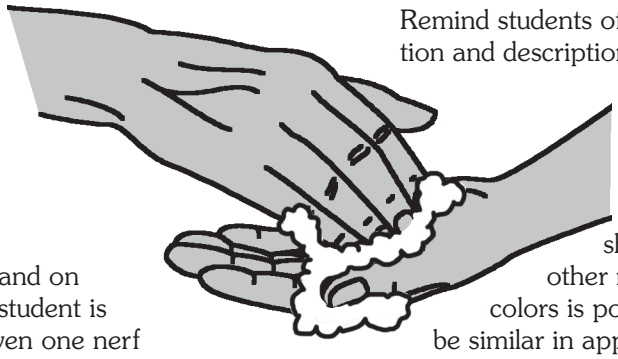
1. Use the transparency ***Potato Experiment Prediction***. For older students, distribute copies to pairs or groups to record their predictions.

2. Discuss the directions with students. Have them consider what was done to each potato in completing their prediction drawings. Talk with students about the importance of looking carefully at the potatoes. Urge them to record minute details. In a visible place make a long list of words that could be used to describe the potatoes.

3. Have groups finish the last two questions on the sheet. With younger students, complete the transparency together.

4. Pass the potato bags around. Make sure they are not opened! (See the Safety Warning in Getting Started.) Groups need this prediction sheet to complete the summary sheet.

Optional: Play a germ buster game outside or in the gymnasium. This game can be played as part of or between sessions. You will need chalk or masking tape, four or five nerf balls, and colored string or yarn arm bands or paper headbands for all but one student. Outline a giant hand on the ground or floor. One student is the germ buster and is given one nerf ball (represents soap bubble). The object of the game is for the germ buster to hit the germs with the soap bubble. All of the other students are the germs. They wear the arm or headbands and can move anywhere inside the hand boundaries.



Begin with one germ buster. The germ buster air dribbles the soap bubble (passes nerf ball between hands; the nerf ball cannot touch the ground) while chasing the germs. The germs try to avoid the soap bubble and must stay inside the hand boundaries. When a germ gets hit with the soap bubble, he or she takes off the arm or headband and becomes a germ buster. Once there are two germ busters, they air dribble the soap bubble to each other. A germ buster may not run if he or she has possession of the soap bubble. This provides the opportunity for teamwork and strategies. Additional soap bubbles may be added for more excitement. The last germ caught becomes the germ buster for the next game.

SESSION THREE (a week later)

1. Use the transparency ***Potato Experiment Observations***. Distribute copies to groups of older students to record their first set of observations.

2. On the Day line, have students record the number of days passed since setting up the experiment. Discuss the directions with students. (They do not have any other observations to compare yet. That will occur in subsequent weeks.) After passing the three bags around, have groups finish their observations. Stress the importance of observing carefully and taking notes on every possible detail. Explain that one skill practiced by scientists is making accurate and detailed observations in their observations gathering. For younger students, complete the transparency with them. Groups need this observation sheet for future reference.

SESSION FOUR (a week later)

Using the second column on the ***Potato Experiment Observations*** sheet, have groups make another set of observations. Pass the bags around. Remind students of the importance of careful observation and description. Record the number of days. This time students can compare their first set of observations with this set for additional comments. Complete the transparency with younger students. (Potato 2 may be starting to show growth of molds, mildews and other microbial growth. A multitude of colors is possible. Potato 1 and potato 3 should be similar in appearance.) Groups need this sheet for the summary.

SESSION FIVE (another week later)

1. (If potato 2 is not showing dramatic microbial growth, wait a few more days.) Have groups make their last set of observations using the third column on the observation sheet. Pass around the bags of potatoes. Students now have two other sets of observations to compare with this one for additional comments. Complete the transparency with younger students.

2. Using the Prediction and the Observation sheets, have groups complete the ***Potato Experiment Summary*** sheet. Discuss the directions with students. Remind students that all of the "before" potatoes were peeled. Allow groups time to discuss their findings and make conclusions. You may need to assist students with the interpretation of their observations. Complete the transparency with younger students. Discuss questions on the sheet. Summarize, by asking:

- What was the initial difference you could observe about the potatoes?

- What were the differences between potatoes 1, 2, and 3? Similarities?

- What did you observe over time?

- Based on your observations, what do you conclude about the potatoes?

- What recommendations would you make about hand washing based on your findings?

- What are important rules to follow when washing your hands? *(Use water, use soap, and wash for 20 seconds.)*

- How can what you learned in this experiment help you decide when it is important to wash your hands?

Dispose of the potatoes in their plastic bags.

EVALUATION OPTIONS

1. Have students respond to a series of statements with thumbs up for true, thumbs down for false.

   - If our hands look clean, we do not need to wash them. *(false)*

   - It does not matter how long I wash my hands. *(false)*

   - I need to wash my hands with soap and water for 20 seconds to get rid of germs. *(true)*

   - If I am the only one eating my food, I do not need to wash my hands before eating. *(false)*

2. Have students write about or make a drawing demonstrating the rules for washing hands. Have older students design information signs about hand washing and how it prevents the spread of disease, signs that can be placed in restrooms or other appropriate places.

3. Have students practice washing their hands properly at the sink, demonstrating the rules. Have them count aloud to 20. Remind students not to waste water. Have them describe why it is important to follow these rules.

4. Have students describe a variable they could control in an experiment about germs. Have them conduct the experiment.

EXTENSIONS AND VARIATIONS

1. Have students sing the following song while washing their hands. It reinforces the lesson concepts and is more fun than counting to 20. It takes approximately 20 seconds to sing.

HAND WASHING SONG
Song tune: "Frere Jacques"
Lyrics used with permission from
Ruth Ellen Williams, Westerville, OH

I wash my fingers,
I wash my hands,
Cause germs can hurt,
Germs can hurt!
My hands are getting cleaner,
My hands are getting cleaner!
Good-bye Dirt,
Good-bye Dirt!

2. Conduct the potato experiment again. This time use four potatoes. Potato 1 and 2 are treated exactly as in the first experiment. On potato 3 use regular soap and on potato 4 use antibacterial soap. In the set-up, students are controlling all the variables except the treatment of the potatoes. Students make predictions and observations and summarize the experimental results. Did the type of soap make a difference?

   Optional: Antibacterial soap eliminates practically all the microbes on the hands and keeps them wiped out for many hours. Have students design and conduct the experiment using antibacterial soap. Students wash their hands with antibacterial soap and every hour for a specific number of hours, the students handle a different clean potato. Potatoes are placed in individual plastic bags and sealed. Students record their observations.

   Optional: Germs need warmth, moisture and nourishment (food) to grow. Have students design and conduct potato experiments using these variables. For example, how does temperature affect bacterial growth?

3. Investigate the nutrient cycle and benefits of microorganisms such as bacteria. There are numerous kinds of microorganisms responsible for breaking down and decomposing organic waste. The microorganisms decompose waste into simpler elements or compounds that enrich soil and provide nutrients for new plants. What would happen if there were no microorganisms to decompose waste or to enrich the soil? (See the FLP lesson "From Apple Cores to Healthy Soil.")

4. Arrange a fingerpainting activity for students. Record the time it takes for students to wash all the paint from their hands. Where did the paint seem most difficult to remove? How might this be similar to washing germs off our hands?

5. Demonstrate cleaning fingernails with a fingernail file and fingernail brush, soap and water. Discuss with students why it's important to clean under the fingernails regularly. Discuss how fingernails can be a hiding place for germs.

6. Invite the school nurse, a health-care professional or a department of health employee to visit the classroom to talk about the diseases that are transmitted by contact and the importance of proper hand washing in the medical profession. Have the speaker demonstrate the time, the technique and other things done to prevent the spread of germs. Be sure to find out the type of soap used.

7. Invite the school cook, a department of health employee or a food-industry employee to visit the classroom to talk about the importance of proper hand washing in the food industry. Have students notice that all restaurant and grocery store restrooms have - or should have - signs stating, "All employees must wash their hands before returning to work." Why?

8. Have students check their desks or a variety of surfaces within the classroom. Give students a one-inch slice of potato. Have them wipe the slice across the surface, place it in a plastic bag, seal the bag, and observe the potato slice for bacterial growth. Or, if agar plates are available, have students use a cotton swab tip to check for germs on various surfaces. If microscopes are available, have students take a closer look at the growth.

9. Have students keep records of their hand-washing practices for one month or throughout the school year. Were there times students needed to be reminded about correct hand washing? What effect did correct hand washing have on absences?

10. Have students conduct a survey on the number of students who wash their hands before eating lunch. Display the results in the cafeteria. Compare their results to the American Society for Microbiology research results provided in the Supporting Information.

11. Have older students conduct research on diseases that interest them. Ask students to describe the germ, provide a picture of the germ, and identify it as a bacteria or virus.

ADDITIONAL RESOURCES

Berger, Melvin. *Germs Make Me Sick (Trumpet Special Edition)*. Trumpet Club. 1985. ISBN: 059098067X.

Berger, Melvin. *Germs Make Me Sick (Revised Edition)*. HarperCollins. 1995. ISBN: 0064451542.

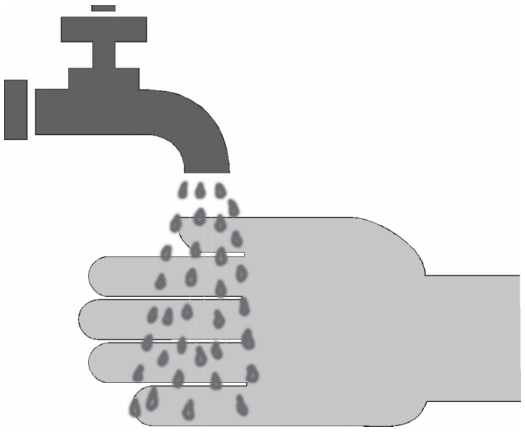
Cole, Joanna. *The Magic School Bus Inside Ralphie: A Book About Germs*. Scholastic Trade. 1995. ISBN: 0590400258.

Colombo, Luann. *Gross But True Germs*. Little Simon. 1997. ISBN: 068981495X.

Food Safety and Inspection Service. USDA, Room 1180-South, 14th Street & Independence Ave. SW, Washington, DC, 20250-3700. 1-800-535-4555. http://www.fsis.usda.gov/

Germ Alert. Lifetime Learning Systems. 200 First Stamford Place, Stamford, CT 06902. (203) 705-3600. (Hands-on educational program for students in grades 4-6. Send a letter on school stationery to receive information.)

Hector, Maria, and AC® Meet the Germs. (20 minute video) Balducci Productions. 1-800-881-5235.



Katz Bobbi. *Germs! Germs! Germs! (Hello Science Reader Level 3)*. Cartwheel Books. 1996. ISBN: 0590672959.

Krulik, Nancy. *The Magic School Bus In A Pickle: A Book About Microbes*. Scholastic Trade. 1998. ISBN: 0590393774.

Lovett, Sarah. *Extremely Weird Monsters*. John Muir Publications. 1996. ISBN: 156261293X.

Maynard, Christopher. *MicroMonsters: Life Under the Microscope*. DK Publishing, Inc. 1999. ISBN: (hardcover) 0789447576, (paperback) 0789447568.

Rainis, Kenneth G., Bruce J. Russell. *Guide to Microlife*. Franklin Watts. 1997. ISBN: 0531112667.

Rowan, Kate. *I Know How We Fight Germs*. Candlewick Press. 1999. ISBN: 0763605034.

Stricklin, Julie (illustrator), Petronella J. Ytsma, and Judith Ann Rice. *Those Icky Smelly Cavity Causing But…Invisible Germs*. Gryphon House. 1997. ISBN: 1884834302.

Public Health Service, Food and Drug Administration, Office of Public Affairs, U.S. Department of Health and Human Services. 5600 Fishers Lane, Rockville, MD 20857. 1-800-FDA-4010.

WEB SITES

Fight Bac. Partnership for Food Safety Education. 2002. http://www.fightbac.org/

Food Safety and Inspection Service, United States Department of Agriculture. 2002. http://www.fsis.usda.gov/

Microbe Zoo. 2002. http://commtechlab.msu.edu/sites/dlc-me/zoo

EDUCATOR'S NOTES

 Conceptual Framework Reference: I.A., I.F.3., VI., VI.B.1.

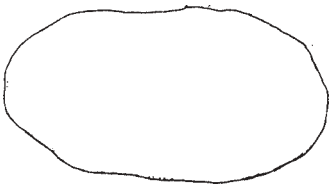
POTATO EXPERIMENT PREDICTION

Names:_____

Directions: Complete the questions below.

1. What do you think will happen to the three potatoes in three weeks? This is your guess or prediction. Draw what you think each potato will look like over time and write why you think that.

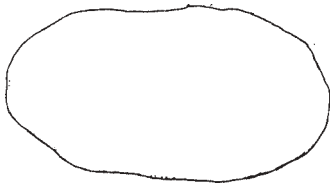
Potato 1:



Why?

_____

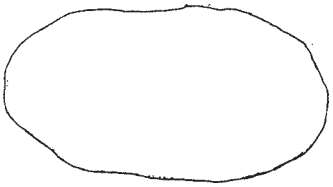
Potato 2:



Why?

_____

Potato 3:



Why?

2. What are the reasons for your predictions?

3. On what knowledge are you basing your prediction? In other words, what do you already know?

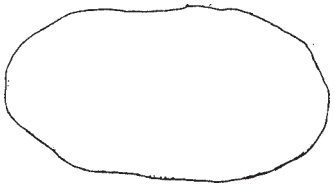
POTATO EXPERIMENT OBSERVATIONS

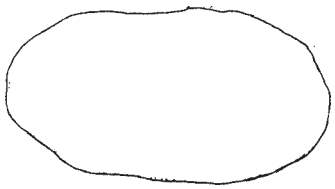
Names:_____

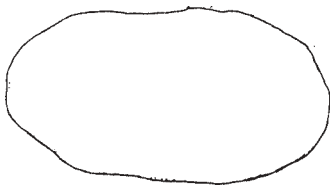
Directions: Draw on the potatoes to show what you see happening. Write your observations below each potato. Do the potatoes look as you thought they would? Why or why not? Compare each set of your observations. How are they the same? Different?

Day:_____ Day:_____ Day:_____

Potato 1:

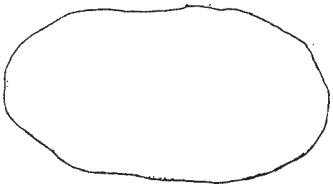


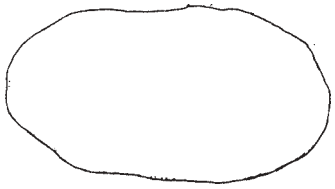


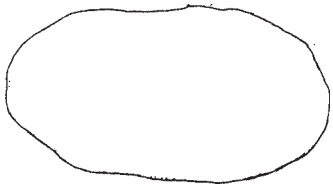


Observations: Observations: Observations:

Potato 2:

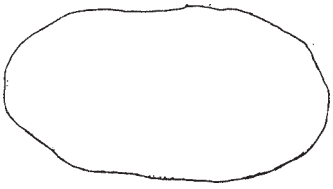


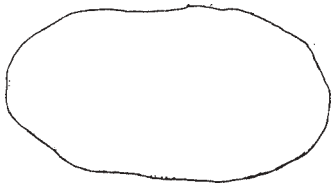


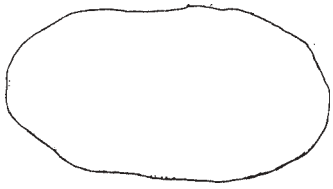


Observations: Observations: Observations:

Potato 3:







Observations: Observations: Observations:

POTATO EXPERIMENT SUMMARY

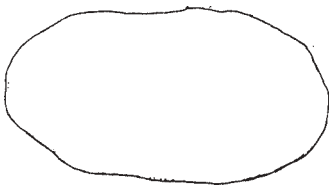
Names:_____

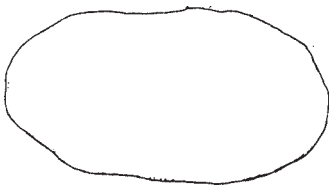
Directions: Compare all the observations you gathered on your potato observation sheet to answer the questions.

1. How did each potato change over time? Draw what the "before" and "after" potatoes look like and describe them.

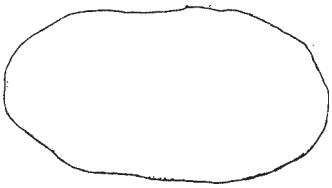
BEFORE **AFTER**

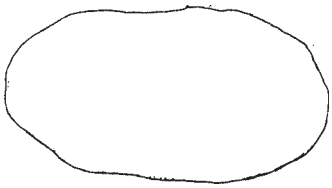
Potato 1:

Describe: 

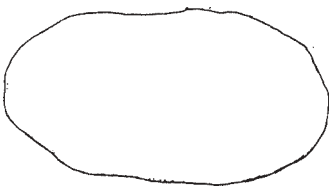
Describe: 

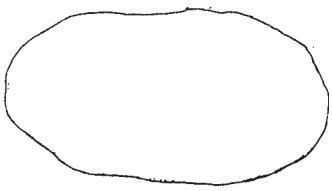
Potato 2:

Describe: 

Describe: 

Potato 3:

Describe: 

Describe: 

2. Go back and read your original guess or prediction about each potato. How did your prediction compare with what your observations showed?

3. What conclusions can you make from this experiment?

4. What have you learned?

Give a man a fish

and you feed him for a day.

Teach a man to fish

and you feed him for a lifetime.

Chinese Proverb