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Educational Product	
Educators	**Grades 3-5**

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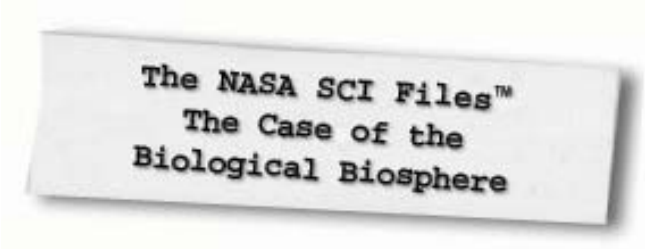

A Lesson Guide with Activities in Mathematics, Science, and Technology

Please Note: Our name has changed! The NASA "Why" Files is now the NASA SCIence Files™ and is also known as the NASA SCI Files™.

http://scifiles.larc.nasa.gov

The Case of the Biological Biosphere lesson guide is available in electronic format through NASA Spacelink - one of NASA's electronic resources specifically developed for the educational community. This publication and other educational products may be accessed at the following address: **http://spacelink.nasa.gov/products**

A PDF version of the lesson guide for NASA SCI Files™ can be found at the NASA SCI Files™ web site: **http://scifiles.larc.nasa.gov**

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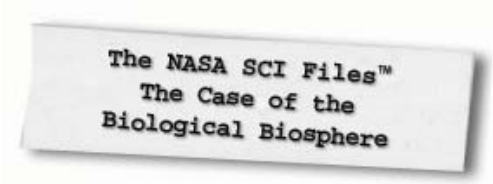

A Lesson Guide with Activities in Mathematics, Science, and Technology

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Registered users of the NASA SCI Files™ may request a Society of Women Engineers (SWE) classroom mentor. For more information or to request a mentor, e-mail **kim.tholen@swe.org**

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Captioning provided by NEC Foundation of America

Program Overview

Jacob is eagerly planning his vacation to Fort Jefferson in the Dry Tortugas. He suddenly becomes aware of the possibility that all his plans could go awry if he gets sick! After hearing that a flu epidemic is on the rise, Jacob sets out to quarantine himself in the tree house and will only let "healthy" tree house detectives inside. The other detectives think that Jacob has gone a little overboard but agree to help him learn more about disease and how it spreads.

Dr. D meets the tree house detectives at the Virginia Marine Science Museum in Virginia Beach, Virginia and helps them understand some of the factors that can cause disease to spread. From there they visit the Centers for Disease Control in Atlanta, Georgia and discover the fascinating world of microorganisms. Jacob continues to insist that quarantine is the only way to go, so they talk with Mrs. Stevens at Johnson Space Center to learn more about how NASA quarantines astronauts and how NASA developed a Health Stabilization Program to aid in the quarantining process.

Jacob has now really become obsessed with becoming ill, and the tree house detectives decide to pick up the pace in learning how to keep Jacob healthy. They go to Dr. D, who teaches them about different types of cells, tissues, organs, and organ systems. Dr. D recommends that they visit his friend, Mr. Frank at Tidewater Community College in Virginia Beach, Virginia to learn more about various types of bacteria. The tree house detectives also enlist the help of a NASA SCI Files™ Kids Club at Sigsbee Elementary School in Key West, Florida to learn how infectious disease can spread and cause an epidemic.

Jacob is not doing too well, and the tree house detectives become truly concerned about his health. They contact Dr. Ann Zilliox to learn about the body's immune system and how vaccines work. Dr. D greets them at the *Grossology* Exhibit at the Virginia Marine Science Museum. The detectives try to concentrate on what Dr. D has to say as they learn how snot and vomit help to protect the body from infection! After leaving Dr. D, the tree house detectives head back to the tree house and decide that they need to learn more about how to keep the body healthy. Beth Sheppard at NASA Johnson Space Center explains to Tony that the astronauts must follow a fitness program to maintain their health both before, during, and after space flight. They decide that a fitness program is the answer for Jacob's grumpy attitude.

In the final segment, Jacob has begun to realize that his idea of quarantine may not be the best idea for staying healthy. The tree house detectives visit Dr. D to report all they have learned about disease and staying healthy. Dr. Ellen Baker, an astronaut, speaks with the detectives and encourages them to apply and practice all that they have learned during their investigation. Jacob just hopes that it is not too late and that he stays healthy just one more day.

National Science Standards (Grades K – 4)

Standard	Segment 1	2	3	4
Unifying Concepts and Processes				
Systems, orders, and organization	X	X	X	X
Evidence, models, and explanations	X	X	X	X
Change, constancy, and measurement	X	X	X	X
Form and Function	X	X	X	X
Science as Inquiry (Content Standard A)				
Abilities necessary to do scientific inquiry	X	X	X	X
Understanding scientific inquiry	X	X	X	X
Life Science (Content Standard C)				
Characteristics of organisms	X	X	X	X
Organisms and their environments	X	X	X	X
Science in Personal and Social Perspective (Content Standard F)				
Personal health	X	X	X	X
Changes in environment	X	X	X	X
Science and technology in local challenges	X	X	X	X
History and Nature of Science (Content Standard G)				
Science as a human endeavor	X	X	X	X

National Science Standards (Grades 5 – 8)

Standard	Segment 1	2	3	4
Unifying Concepts and Processes				
Systems, order, and organization	X	X	X	X
Evidence, models, and explanations	X	X	X	X
Change, constancy, and measurement	X	X	X	X
Form and Function	X	X	X	X
Science as Inquiry (Content Standard A)				
Abilities necessary to do scientific inquiry	X	X	X	X
Understanding scientific inquiry	X	X	X	X
Life Science (Content Standard C)				
Structure and function in living systems	X	X	X	X
Regulation and behavior	X	X	X	X
Populations and ecosystems	X	X	X	X
Diversity and adaptations of organisms	X	X	X	X
Science and Technology (Content Standard E)				
Abilities of technological design	X	X	X	X
Understanding science and technology	X	X	X	X
Science in Personal and Social Perspectives (Content Standard F)				
Personal health	X	X	X	X
Risks and benefits	X	X	X	X
Science and technology in society	X	X	X	X
History and Nature of Science (Content Standard G)				
Science as a human endeavor	X	X	X	X
Nature of science	X	X	X	X

National Mathematics Standards (Grades 3 – 5)

Standard	Segment 1	2	3	4
Number and Operations				
Understand numbers, ways of representing numbers, relationships among numbers, and number systems.		X		
Understand meanings of operations and how they relate to one another.		X		
Compute fluently and make reasonable estimates.	X	X		
Algebra				
Understand patterns, relations, and functions.	X	X		
Use mathematical models to represent and understand quantitative relationships.		X		
Measurement				
Understand measurable attributes of objects and the units, systems, and processes of measurement.		X		
Apply appropriate techniques, tools, and formulas to determine measurements.	X	X	X	
Data Analysis and Probability				
Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.	X	X	X	
Select and use appropriate statistical methods to analyze data	X	X		
Develop and evaluate inferences and predictions that are based on data.	X	X	X	X
Understand and apply basic concepts of probability.	X	X		
Problem Solving				
Solve problems that arise in mathematics and in other contexts	X	X	X	X
Apply and adapt a variety of appropriate strategies to solve problems	X	X	X	X
Communication				
Organize and consolidate mathematical thinking through communication.		X		
Communicate mathematical thinking coherently and clearly to peers, teachers, and others.		X		
Connections				
Recognize and use connections among mathematical ideas.		X		
Recognize and apply mathematics in contexts outside mathematics.	X	X	X	

International Technology Education Association (ITEA Standards for Technology Literacy, Grades 3 – 5)

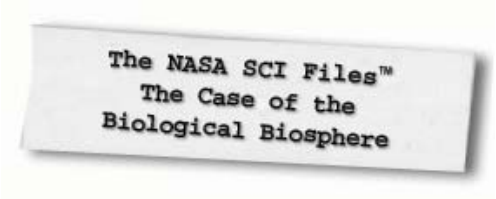
Standard	Segment 1	2	3	4
Nature of Technology				
Standard 1: Students will develop an understanding of the characteristics and scope of technology.	X	X	X	X
Standard 2: Students will develop an understanding of the core concepts of technology.	X	X	X	X
Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.	X	X	X	X
Technology and Society				
Standard 6: Students will develop an understanding of the role of society in the development and use of technology.	X		X	
Abilities for a Technological World				
Standard 11: Students will develop abilities to apply the design process.	X	X	X	
Standard 12: Students will develop abilities to use and maintain technological products and systems.	X	X	X	X
Standard 13: Students will develop abilities to assess the impact of products and systems.	X	X	X	X
The Designed World				
Standard 14: Students will develop an understanding of and be able to select and use medical technologies.	X	X	X	X
Standard 15: Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.			X	X
Standard 17: Students will develop an understanding of and be able to select and use information and communication technologies.	X	X	X	X

National Technology Standards (ISTE National Educational Technology Standards, Grades 3 – 5

Standard	Segment 1	2	3	4
Basic Operations and Concepts				
Use Keyboards and other common input and output devices efficiently and effectively.	X	X	X	X
Discuss common uses of technology in daily life and the advantages and disadvantages those uses provide.	X	X	X	X
Social, Ethical, and Human Issues				
Discuss common uses of technology in daily life and the advantages and disadvantages those uses provide.	X	X	X	X
Technology Productivity Tools				
Use general purpose productivity tools and peripherals to support personal productivity, remediate skill deficits, and facilitate learning throughout the curriculum.	X	X	X	X
Use technology tools for individual and collaborative writing, communication, and publishing activities to create knowledge products for audiences inside and outside the classroom.	X	X	X	X
Technology Communication Tools				
Use technology tools for individual and collaborative writing, communication, and publishing activities to create knowledge products for audiences inside and outside the classroom.	X	X	X	X
Use telecommunication efficiently and effectively to access remote information, communicate with others in support of direct and independent learning, and pursue personal interests.	X	X	X	X
Use telecommunication and online resources to participate in collaborative problem-solving activities for the purpose of developing solutions or products for audiences inside and outside the classroom.	X	X	X	X
Technology Research Tools				
Use telecommunication and online resources to participate in collaborative problem-solving activities for the purpose of developing solutions or products for audiences inside and outside the classroom.	X	X	X	X
Use technology resources for problem solving, self-directed learning, and extended learning activities.	X	X	X	X
Determine when technology is useful and select the appropriate tools and technology resources to address a variety of tasks and problems.	X	X	X	X
Technology Problem-Solving and Decision-Making Tools				
Use technology resources for problem solving, self-directed learning, and extended learning activities.	X	X	X	X
Determine when technology is useful and select the appropriate tools and technology resources to address a variety of tasks and problems.	X	X	X	X
Evaluate the accuracy, relevance, appropriateness, comprehensiveness, and bias of electronic information sources.			X	

National Geography Standards, Grades 3 – 5

Standard	Segment 1	2	3	4
The World in Spatial Terms				
Standard 1: How to use maps and other graphic representations, tools, and technologies to acquire, process, and report information from a spatial perspective.	X			X
Places and Regions				
Standard 4: The physical and human characteristics of places	X			X
Standard 6: People create regions to interpret Earth's complexity				X
The Uses of Geography				
Standard 17: How to apply geography to interpret the past				X



Segment 1

The tree house detectives are concerned about Jacob. He is becoming obsessed with staying well because he is afraid that an illness will prevent him from going on his vacation to Fort Jefferson in the Dry Tortugas. After hearing about a possible flu epidemic, Jacob becomes convinced that he must quarantine himself. The other tree house detectives are not sure this is the smart thing to do, so they decide to help him investigate disease and how it spreads. Dr. Consuelo Beck-Sague, a medical epidemiologist at the Centers for Disease Control (CDC) in Atlanta, Georgia helps the detectives learn more about viruses and bacteria while learning how infectious disease spreads. Now Jacob is even more adamant that quarantine is the right way to go and visits Christina Stevens at NASA Johnson Space Center in Houston, Texas to learn more about NASA's Health Stabilization Program used to keep astronauts healthy before, during, and after space flight.

Objectives

The students will

- understand the conditions necessary for microbe growth.
- learn how minor variations account for various outcomes in an experiment.
- describe the differences between viruses and bacteria.
- identify how infectious disease is transferred from person to person.
- identify ways to avoid infectious disease.
- learn about quarantines.
- conduct an experiment in which a control is necessary to interpret results.

Vocabulary

agar– a jellylike substance obtained from a red alga and used especially in culture media or to give firmness to foods

antibiotic– a substance produced by an organism (as a fungus or bacterium) that in a diluted solution inhibits or kills a harmful microscopic plant or animal, and especially one that causes disease

bacteria– plural form of bacterium

bacterium– any of a group of single-celled microorganisms that live in soil, water, organic matter, or the bodies of plants and animals and are important because of their chemical effects and as a cause of disease

cell– one of the tiny units that are the basic building blocks of living things, that carry on the basic functions of life either alone or in groups, and that include a nucleus and are surrounded by a membrane

DNA– deoxyribonucleic acid; any of various nucleic acids are usually the molecular basis for heredity

epidemiology– a branch of medical science that deals with the occurrence, distribution, and control of disease in a population

disease– an abnormal bodily condition of a living plant or animal that interferes with functioning and can usually be recognized by signs and symptoms; an illness

microorganism– an organism (as a bacterium) of microscopic or less than microscopic size

quarantine– a limiting or forbidding of movements of persons or goods that is designed to prevent the spread of disease or pests

RNA– any of various nucleic acids that contain ribose and uracil as structural components and are associated with control of celluar chemical activities

virus– any of a large group of very tiny infectious agents that are too small to be seen with the ordinary light microscope but can often be seen with the electron microscope, that are considered either very simple microorganisms or very complicated molecules, that have an outside coat of protein around a core of RNA or DNA, that can grow and multiply only in living cells, and that cause important diseases in human beings, lower animals, and plants

Video Component

Implementation Strategy

The NASA SCI Files™ is designed to enhance and enrich the existing curriculum. Two to three days of class time are suggested for each segment to fully use video, resources, activities, and web site.

Before Viewing

1. Prior to viewing Segment 1 of *The Case of the Biological Biosphere*, read the program overview (p. 5) to the students. List and discuss questions and preconceptions that students may have about quarantine, disease, bacteria, and viruses.
2. Record a list of issues and questions that the students want answered in the program. Determine why it is important to define the problem before beginning. From this list, guide students to create a class or team list of three issues and four questions that will help them to better understand the problem. The following tools are available in the educator area under the "Tools" section of the web site to assist in the process.

Problem Board–Printable form to create student or class K-W-L chart

Problem-Based Learning (PBL) Questions–Questions for students to use while conducting research

Problem Log–Printable student log with the stages of the problem-solving process

Brainstorming Map–Graphic representation of key concepts and their relationships

The Scientific Method–Chart that describes the scientific method process

3. Focus Questions–Questions at the beginning of each segment that help students focus on a reason for viewing. These can be printed ahead of time from the educator's area of the web site in the activities and worksheet section under "Worksheets." Students should copy these into their science journals prior to viewing the program. Encourage students to take notes while viewing the program to answer the questions. An icon will appear when the answer is near.
4. What's Up? Questions–Questions at the end of the segment help students predict what actions the tree house detectives should take next in the investigation process and how the information learned will affect the case. These questions can be printed from the educator's area of the web site in the activities and worksheet section under "Worksheets."

Careers

epidemiologist
biologist
clinician
public health worker

View Segment 1 of the Video

For optimal educational benefit, view *The Case of the Biological Biosphere* in 15-minute segments and not in its entirety. If you are viewing a taped copy of the program, you may want to stop the video when the Focus Question icon appears to allow students time to answer the question.

After Viewing

1. Have students reflect on the "What's Up?" questions asked at the end of the segment.
2. Discuss the Focus Questions.
3. Students should work in groups or as a class to discuss and list what they know about quarantine, disease, bacteria, and viruses. Have the students brainstorm ideas on how Jacob can avoid infectious disease. Discuss what Jacob should do to have the most effective quarantine. As a class, reach a consensus on what additional information is needed. Have the students conduct independent research or provide students with the information needed.
4. Have the students complete Action Plans, which can be printed from the "Problem Board" area in the "Problem-Solving Tools" section of the web site for the current online investigation. Students should then conduct independent or group research by using books and internet sites noted in the "Research Rack" section of the "Problem Board" area. Educators can also search for resources by topic, episode, and media type under the Educator's main menu option Resources.
5. Choose activities from the educator guide and web site to reinforce concepts discussed in the segment. The variety of activities is designed to enrich and enhance your curriculum. Activities may also be used to help students "solve" the problem along with the tree house detectives.
6. Have the students work individually, in pairs, or in small groups on the Problem-Based Learning (PBL) activity on the NASA SCI Files™ web site.

- To begin the PBL activity, read the scenario to the students.

- Read and discuss the various roles involved in the investigation.
- Print the criteria for the investigation and distribute.
- Have students use the "Research Rack" located on the web site and the online tools that are available.

7. Having students reflect in their journals what they have learned from this segment and from their own experimentation and research is one way to assess the students. In the beginning, students may have difficulty reflecting. To help students, give them specific questions to reflect upon that are related to the concepts.
8. Have students complete a Reflection Journal, which can be found in the Problem-Solving Tools section of the online PBL investigation or in the Instructional Tools section of the Educator's area.
9. The NASA SCI Files™ web site provides educators with general and specific evaluation tools for cooperative learning, scientific investigation, and the problem-solving process.

Resources (additional resources located on web site)

Books

Baeuerle, Patrick A., Norbert Landa, and Patrick Bauerle: *The Cell Works: Microexplorers: An Expedition into the Fantastic World of Cells (Microexplorers Series)*. Barrons Juveniles, 1998, ISBN: 0764150529.

Berger, Melvin: *Germs Make Me Sick! (Lets-Read-And-Find-Out Science, Stage 2)*. Scott Foresman, 1995, ISBN: 0064451542.

Krulik, Nancy E.: *The Magic School Bus in a Pickle: A Book About Microbes (Magic School Bus Book Series)*. Scholastic Trade, 1998, ISBN: 0590393774.

Robbins, Louise: *Louis Pasteur and the Hidden World of Microbes (Oxford Portraits in Science)*. Oxford University Press, 2001, ISBN: 0195122275.

VanCleave, Janice: *Janice VanCleave's Biology For Every Kid : 101 Easy Experiments That Really Work*. John Wiley, 1990, ISBN: 0471503819.

Wenkman, Leeann: *Body Buddies Say..."Wash Your Hands!"* Sunrise Publications, 1999, ISBN: 0967079004.

Web Sites

Centers for Disease Control (CDC)
The Centers for Disease Control and Prevention (CDC) is recognized as the lead federal agency for protecting the health and safety of people. Explore the CDC's web site to learn what is new in disease and the prevention of illness. Body and Mind (BAM) Kids page has activities and a teacher corner.
http://www.cdc.gov/

Boston Museum of Science: Scanning Electron
Look at actual images from an electron microscope, visit some cool links, and in the teacher corner, learn how to build a microscope and make slides.
http://www.mos.org/sln/SEM/index.html

Microbial Zoo
Learn about microbes and microbial ecology.
http://commtechlab.msu.edu/sites/dlc-me/zoo/

How to make a $1.00 compound microscope
Visit this web site to learn how to build your own microscope from common objects.
http://www.funsci.com/fun3_en/ucomp1/ucomp1.html

NASA Johnson Space Center: Medical Operations Branch Mission Support
Visit this web site to learn more about the programs in place to maintain astronauts' health and safety.
http://www.jsc.nasa.gov/sa/sd/sd2/missup.html

Activities and Worksheets

In the Guide

On the Web

Coconuts for You
This "nutty" experiment helps to explain where microbes grow best.

Stop that Germ!
Brainstorm ideas on how to prevent the spread of infectious diseases.

This is Control
Conduct this experiment to learn why a control is necessary.

Growing Cold

Purpose

To learn how temperature affects the growth of bacteria

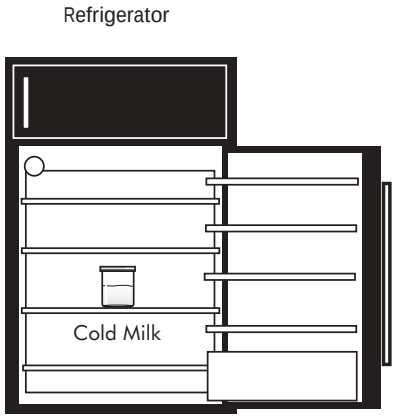
Materials

500 ml of fresh milk
measuring cup
2 pint (500 ml) jars
refrigerator
science journal

Procedure

1. Measure 250 ml of milk and pour into one of the pint jars.
2. Close the jar by replacing the lid.
3. Repeat with the second jar.
4. Place one jar in the refrigerator.
5. Place the second jar in a warm place.
6. Observe each jar once a day for seven days and record your observations.

Diagram 1



Refrigerator with milk inside.

Diagram 2

Conclusion

1. After seven days, describe the difference between the cold milk and the warm milk.
2. Why was the warm milk different from the cold milk?
3. How could the tree house detectives use this information to help Jacob stay well?

Chaotic Chaos

Purpose

To demonstrate that small variations can cause large differences

Materials

large container
pitcher
water
small smooth plastic or rubber ball
permanent marker
clay
science journal

Procedure

1. Make a ball of clay and secure the plastic ball inside the large container with the clay. See diagram 1.
2. Use the permanent marker and mark a dot in the middle on the top of the ball.
3. Fill the pitcher with water.
4. Predict the path of the water flow.
5. Pour a small amount of water on top of the dot and observe how the water runs down the ball and into the container.
6. Record your observations in your science journal.
7. Dry the ball if necessary and repeat steps 4-6 several more times.

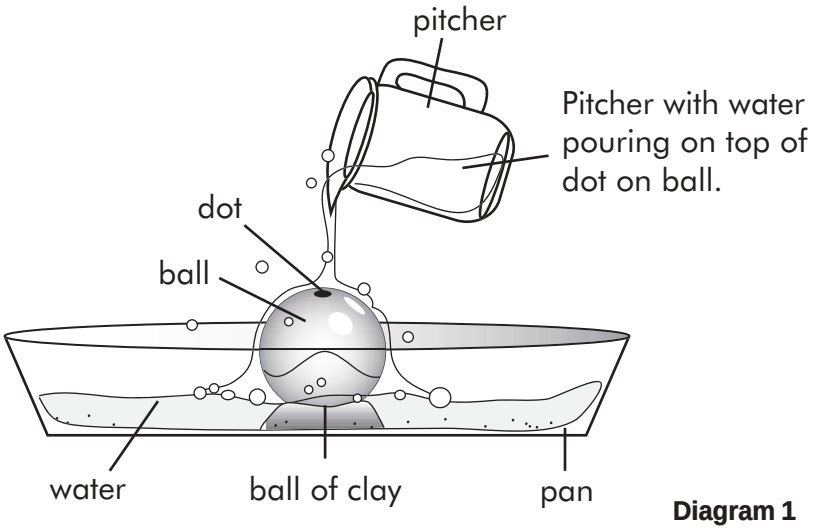


Diagram 1

Conclusion

1. Did the water run the exactly the same way each time? Why or why not?
2. What are some possible variables that caused differences?
3. How can this experiment be used to help Jacob?

Virus Versus Bacteria

Purpose

To learn how viruses differ from bacteria

Materials

Venn diagram sheet
description cards
scissors
tape
science journal

Procedure

1. Read the paragraph below.
2. In your group, compare and contrast viruses and bacteria and record results in your science journal.
3. Separate the description cards by cutting along the dotted lines.
4. Study the Venn diagram and note that one circle is labeled "Virus" and the other is labeled "Bacteria." Observe that the two circles overlap.
5. Place the description cards that describe only viruses in the circle labeled "Virus."
6. Place the description cards that describe only bacteria in the circle labeled "Bacteria."
7. Place the description cards that describe both viruses and bacteria in the overlap portion of the Venn diagram.
8. Once your group agrees on all placements, tape each card to the Venn diagram.
9. Using books, the Internet, or other resources, research viruses and bacteria and make a list of any new traits that you find.
10. Create new description cards and place on the Venn diagram.
11. Share your Venn diagram with the class and discuss.
12. Use construction paper to draw a diagram of a bacterium and a virus and label.

Conclusion

1. How were bacteria similar to viruses?
2. How were they different?
3. Should Jacob be more cautious and stay away from viruses or bacteria? Why?

Viruses and Bacteria:

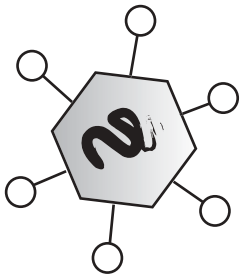
A virus is an organism that is so tiny that it can only be seen with an electron microscope. Viruses are much smaller than bacteria and can cause many diseases in man, plants, and animals. A virus is not a plant or an animal but a special kind of parasite. They consist of nucleic acids with a coat of protein. Unlike bacteria, viruses are not composed of cells but they do reproduce. A virus contains only DNA or RNA but never both. Viral infections are a concern to the human body because the body often does not have any natural defenses in place to fight the virus. However once the virus enters the body, the body adapts to the condition by generating new defenses (antibodies). Antibodies may be artificially created in the body by vaccines. Scientists have discovered that virsuses cause chicken pox, rabies, mumps, polio, measles, yellow fever, and even the common cold. Good hygiene habits are important in preventing viral infections.

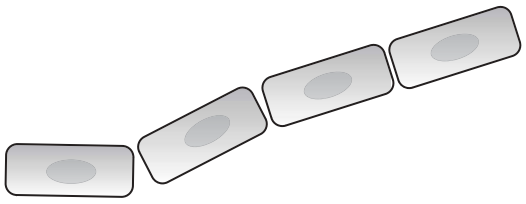
Bacteria are tiny one-celled organisms that can be seen with a light microscope. Bacteria are found everywhere and most bacteria are good. For example, bacteria in the soil cause dead animals and plants to decay and make the soil rich for new plants. However, if bacteria not normally found in the human body enter the body, they will begin to multiply rapidly and cause an illness. Bacteria have both RNA and DNA located in the cell. Some bacteria such as E. coli are found naturally in certain parts of the body, but if they move to another part, they will cause illness also. Strep throat and bacterial pneumonia are two types of bacterial infection. Most bacterial infections are fought off by the body's own defenses, but some may overwhelm the defense network. Luckily, most can be cured with drugs known as antibiotics.

Virus Versus Bacteria (continued)

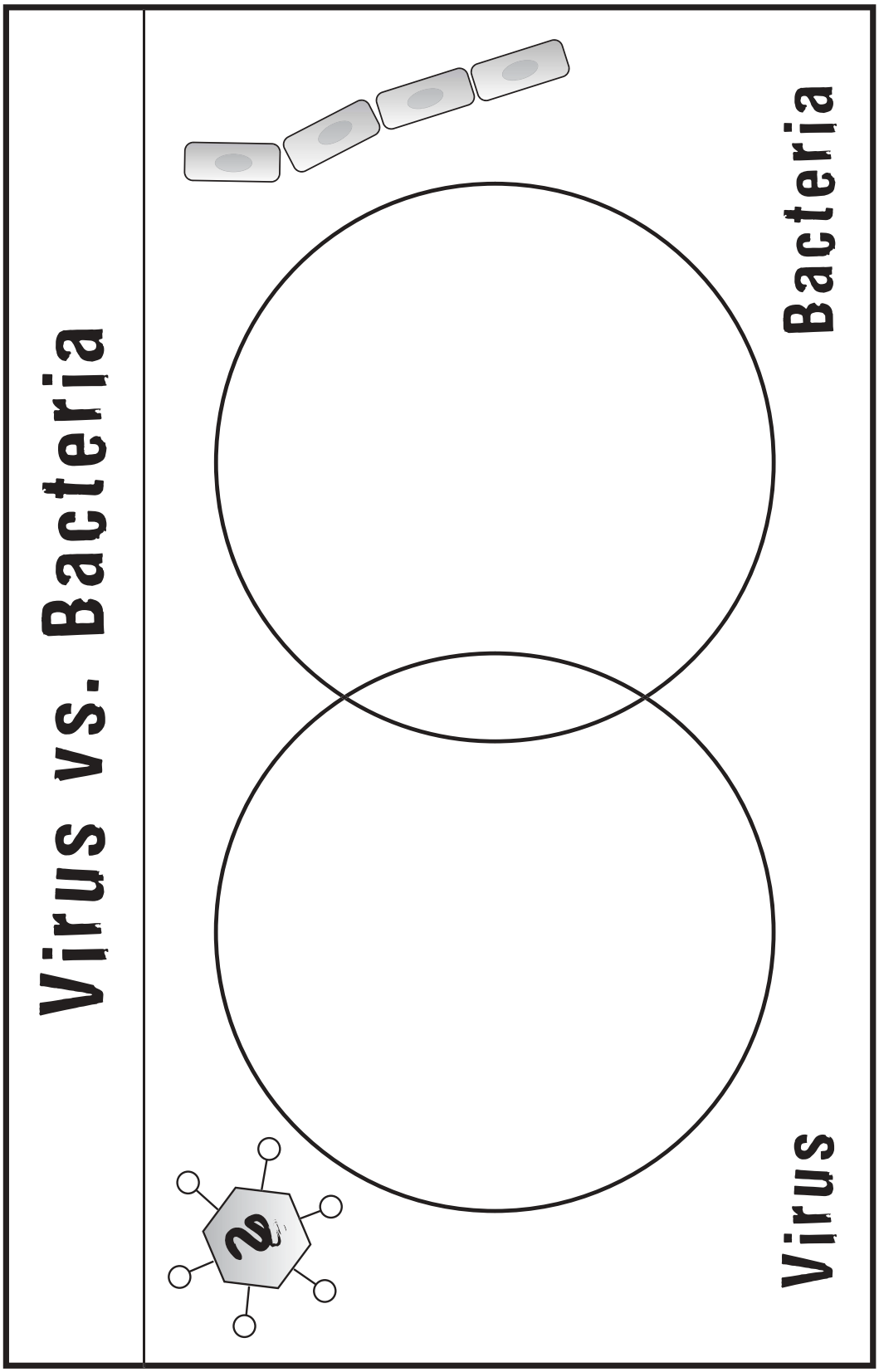
Description Cards

Has a protein coat	Not composed of cells	Can reproduce	Mumps and measles are types of these
One-celled organisms	Vaccines protect you from these	E. coli is a type of these	Antibiotics help kill these
Most are good	Has only DNA or RNA	Has both DNA and RNA	Antibodies are a natural defense for these
Makes you sick	Most are bad	Can be seen with an electron microscope	Can be seen with a light microscope





Virus Versus Bacteria Diagram



Stop in the Name of Infection

Purpose: To simulate how infection can be spread

Teacher Note Be sure to check with students and parents to find out if any have allergies to hand lotion.

Materials

- list of prefixes and suffixes
- paper
- pencil
- colored pencils
- construction paper

Procedure

1. Put a small amount of hand lotion on your hands and rub them together, spreading the lotion on both the top and bottom of your hands.
2. Hold your hands over a large container and have your partner sprinkle a small amount of glitter into your hands.
3. Gently rub your hands together to spread the glitter evenly.
4. Use a paper towel to wipe the glitter off your hands.
5. Have your partner rinse his/her hands with cold water.
6. Both you and your partner wash your hands with warm water and soap.

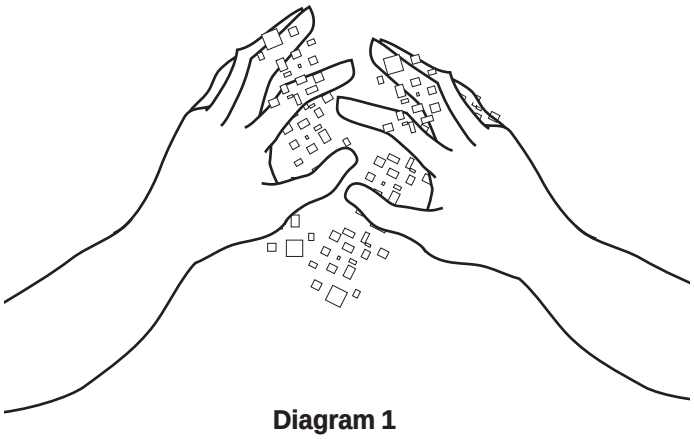


Diagram 1

Conclusion

1. The glitter represented germs (bacteria and/or viruses) that you can easily pick up by coming in contact with surfaces that they are on. Did cleaning your hands with just a paper towel do a good job of getting the "germs" off your hands? Why or why not?
2. What would happen if you came in contact with other people?
3. Did washing your hands with cold water get all the "germs" off your hands? How about the warm water and soap?
4. Why is it important to properly wash your hands frequently?
5. After conducting this experiment, what would you recommend to Jacob to help him stay healthy?

Answer Key

Growing Cold

1. The warm milk is thick and has white lumps in it. It also smells sour. The cold milk looks and smells much like it did when it was first placed in the refrigerator. It is also probably still drinkable.
2. The warm milk was exposed to warm temperatures that promote the growth of bacteria that can cause food to go bad and spoil. Cooler temperatures slow down the growth of the bacteria. However, eventually the milk in the refrigerator will spoil if it is left in there long enough. The bacteria are present in the milk and just grow very slowly when cold.
3. The tree house detectives could make sure that all the food Jacob eats has been properly refrigerated. They could also install an air conditioning system to keep the temperature cold in the tree house.

Chaotic Chaos

1. The water did not run exactly the same way each time. There were many variables that caused the water to run differently.
2. Some possible variables are scratches, grooves, or striations on the ball, the amount of water poured, the position of the water as it is poured (impossible to pour it exactly the same each time), and possible movement of the ball or vibration in the classroom.
3. This experiment should help Jacob see that it is impossible to control everything. No matter how hard he tries, he just can't control all the variables. Therefore, quarantine may not be the best answer. He needs to keep researching to find out more about staying healthy.

Viruses Versus Bacteria

1. Some ways that bacteria are similar to viruses are that they both reproduce, cause illness, and are too small to see with the naked eye.
2. Some ways that bacteria are different from viruses are that viruses are smaller than bacteria, are not composed of cells, and have only DNA or RNA, not both.
3. Jacob should be careful of viruses and bacteria as they both can cause illness.

Stop in the Name of Infection

1. Cleaning your hands with just a paper towel was not very effective in getting the "germs" off your hands. The glitter was stuck to your hands by the hand lotion.
2. Much of the glitter remained and could easily be passed on to other people you come in contact with.
3. Washing your hands in cold water was a little more effective, but a lot of glitter remained on your hands. Hand lotion may have an oil base to it, and the oil is difficult to remove with just cold water. Warm, soapy water was much more effective in getting rid of the "germs."
4. It is important to properly wash your hands frequently throughout the day to remove any bacteria or viruses that you may have come in contact with. Using common sense, you should know to wash your hands after going to the bathroom, shaking someone's hand that is sick, or touching objects that a sick person has been in contact with.
5. Recommend that Jacob wash his hands frequently.

On the Web

Coconuts for You

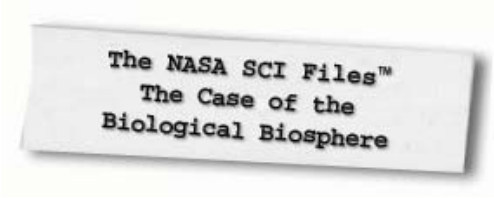
1. Mold was growing on the inside of the coconut. The outside looked normal, with no mold visible.
2. Mold is a form of fungus, and the fungi came from the air. Fungi are all around you—in the air, on your clothes, skin, hands, and even your mouth.
3. Fungi cannot make their own food because they do not have chlorophyll, so they take food from a host organism. All fungi must have food, air, and water to live and when they land on a nice moist airy piece of food like the coconut, they multiply and grow very well.

Stop that Germ!

1. The glitter came off the block and onto everyone's hands. The same thing happened when the block was passed around the class, but now everyone has different colored glitter on their hands. Germs have been spread.
2. When you wiped the block with the paper towel some of the glitter came off but a lot of it stayed on the block. The soap and water took more of the glitter off the block than the paper towel.
3. Answers will vary but should include that washing your hands before you eat will help to keep germs from getting on the food that goes into your mouth and into your body. The fewer germs entering the body, the less likely a person is to get sick. Washing your hands after you use the restroom helps to keep the germs that are associated with your waste products from entering your body through your mouth (putting your hands in your mouth), eyes (rubbing your eyes), or nose (rubbing your nose). Washing with warm water and soap for 15 seconds is recommended.

This Is Control Calling

1. Answers will vary.
2. Answers will vary, but expect that if conditions were right, then the plant that received fertilizer grew better than the plant that did not. Fertilizer is a plant food and when added to the soil, it provides additional nutrients that help to enhance plant growth.
3. It is necessary to have a control for comparison. If you did not have a control plant, then you would not know how the plant would have grown normally without fertilizer; therefore, you would not have had anything to compare it to.
4. It was important to keep all the variables the same in each cup so that you would know that the fertilizer is what made the plants grow differently. Answers will vary.



Segment 2

Jacob continues to insist that quarantine and a Health Stabilization Program will keep him well before his vacation. The other tree house detectives are not convinced and decide to continue the investigation. They visit Dr. D to learn more about cells, tissues, organs, and organ systems. Dr. D sends the detectives to Mr. Frank at Tidewater Community College in Virginia Beach, Virginia, who helps the detectives learn about three types of bacteria. He tells them that some bacteria is actually "good" bacteria. Back at the tree house, the detectives decide that they need to learn more about how an epidemic spreads. They contact the Society of Women Engineers (SWE) to help locate a NASA SCI Files™ Kids Club. Sigsbee Elementary School in Key West, Florida is conducting an experiment that is perfect for demonstrating the spread of infectious disease.

Objectives

The students will

- investigate an animal cell
- model the following: cell > tissue >organ > system > body
- understand three types of bacteria
- learn how an epidemic occurs

Vocabulary

bacillus—an aerobic, rod-shaped, spore-producing bacterium

cell—the smallest unit or building block of all living things

coccus—a spherical or nearly spherical microorganism, especially a bacterium

cytoplasm—a jelly-like material in cells that is the living part of the cell

digestive system—the group of body parts used in digestion

epidemic—an outbreak of a disease that spreads more quickly and more extensively among a group of people than would normally be expected

homeostasis—a state of equilibrium, or a tendency to reach equilibrium

immune system—the interacting combination of all the body's ways of recognizing cells, tissues, objects, and organisms that are not part of itself, and which initiates the immune response to fight them

nucleus—the control center that directs all cell activities

organ—a group of different tissues such as the heart, lungs, or stomach working together to perform a job

respiration—the process by which oxygen combines with glucose to produce energy and two waste byproducts, carbon dioxide, and water vapor

respiratory system—the group of body parts used in respiration

streptococcus—a spherical bacterium that often causes disease, for example, scarlet fever or pneumonia. The bacteria link together in pairs or chains.

tissues—a group of similar cells that perform a special job

toxin—a poison produced by a living organism, especially bacteria, capable of causing disease and also of stimulating the production within the body of antibodies to counter their effects

variable—something capable of changing or varying

Video Component

Implementation Strategy

The NASA SCI Files™ is designed to enhance and enrich the existing curriculum. Two to three days of class time are suggested for each segment to fully use video, resources, activities, and web site.

Before Viewing

1. Prior to viewing Segment 2 of *The Case of the Biological Biosphere*, discuss the previous segment to review the problem and what the tree house detectives have learned thus far. Download a copy of the Problem Board from the NASA SCI Files™ web site in the educator area under the "Tools" section. Have students use it to sort the information learned so far.
2. Review the list of questions and issues that the students created prior to viewing Segment 1 and determine which, if any, were answered in the video or in the students' own research.
3. Revise and correct any misconceptions that may have been dispelled during Segment 1. Use tools located on the Web, as was previously mentioned in Segment 1.

4. Focus Questions–Print the questions from the web site ahead of time for students to copy into their science journals. Encourage students to take notes while viewing the program to answer the questions. An icon will appear when the answer is near.
5. What's Up? Questions–Questions at the end of the segment help students predict what actions the tree house detectives should take next in the investigation process and how the information learned will affect the case. These questions can be printed from the web site ahead of time for students to copy into their science journals.

View Segment 2 on the Video

For optimal educational benefit, view *The Case of the Biological Biosphere* in 15-minute segments and not in its entirety. If you are viewing a taped copy of the program, you may want to stop the video when the Focus Question icon appears to allow students time to answer the question.

After Viewing

1. Have students reflect on the "What's Up?" questions asked at the end of the segment.
2. Discuss the Focus Questions.
3. Have students work in small groups or as a class to discuss and list what new information they have learned about the quarantine, disease, bacteria, cells, tissues, organs, body systems, viruses, and how infectious disease is spread. Organize the information and determine if any of the students' questions from Segment 1 were answered.
4. Decide what additional information is needed for the tree house detectives to determine the best way for Jacob to stay healthy for his trip. Have students conduct independent research or provide students with information as needed. Visit the NASA SCI Files™ web site for an additional list of resources for both students and educators.
5. Choose activities from the educator guide and web site to reinforce concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced and use activities to aid student understanding in those areas.
6. If time did not permit you to begin the web activity at the conclusion of Segment 1, refer to number 6 under "After Viewing" on (p.15) and begin the Problem-Based Learning activity on the NASA SCI Files™ web site. If the web activity was begun, monitor students as they research within their selected roles, review criteria as needed, and encourage the use of the following portions of the online, Problem-Based Learning activity:

   Research Rack–books, internet sites, and research tools

   Problem-Solving Tools–tools and strategies to help guide the problem-solving process

   Dr. D's Lab–interactive activities and simulations

   Media Zone–interviews with experts from this segment

   Expert's Corner–listing of Ask-An-Expert sites and biographies of experts featured in the broadcast

Careers

biology professor
respiratory therapist
dermatologist
cardiologist
cellular biologist

7. Have students write in their journals what they have learned from this segment and from their own experimentation and research. If needed, give students specific questions to reflect upon as suggested on the PBL Facilitator Prompting Questions instructional tool found in the educator's area of the web site.
8. Continue to assess the students' learning, as appropriate, by using their journal writings, problem logs, scientific investigation logs, and other tools that can be found on the web site. Visit the Research Rack in the tree house, the online PBL investigation main menu section "Problem-Solving Tools," and the "Tools" section of the educator's area for more assessment ideas and tools.

Resources

Books

Balkwill, Fran, Dr.: *Cell Wars (Cells and Things).* First Avenue Editions, 1994, ISBN: 087614637X.

Cole, Joanna: *The Magic School Bus: Inside the Human Body*. Scholastic Trade, 1990, ISBN: 0590414275.

Ganeri, Anita: Inside the Body: *A Lift-The-Flap Book*. DK Publishing, 1996, ASIN: 0789409992.

Hawcock, David: *Amazing Pull-Out Pop-Up Body In A Book.* DK Publishing, 1997, ISBN: 078942052X.

Parker, Steve: Eyewitness: *Human Body (Eyewitness Books)*. DK Publishing, 1999, ISBN: 0789448831.

Sweeney, Joan: *Me and My Amazing Body*. Crown Publisher, 1999, ISBN: 0517800535.

VanCleave. Janice: *Janice VanCleave's The Human Body for Every Kid : Easy Activities that Make Learning Science Fun*. John Wiley & Sons, 1995, ISBN: 0471024082.

Walker, Richard: *Encyclopedia of the Human Body*. DK Publishing, 2002, ISBN: 0789486725.

Websites

Reference Resources: Human Body

BrainPOP: Here is a terrific educational, health resource for kids, offering animated movies that explain the human body.
http://www.kidinfo.com/Health/Human_Body.html

My Body

This great web site teaches you all about the human body and much more. Come explore the skin and why you need to wash it daily. Learn why you vomit and run a fever sometimes and much more.
http://kidshealth.org/kid/body/mybody.html

Activities and Worksheets

In the Guide

On the Web

Cool Breezes
Learn how the skin helps the body stay cool

Body System Booklet
Create a booklet of the various body systems by using the Internet and other resources

Finding the Flu
Discover when the flu is most likely to occur in the United States

Going Cellular

Problem

To identify the structures found in a typical animal cell by constructing a model

Teacher Prep

Prepare gelatin dessert mix according to package directions, using only half the recommended amount of water. Let the mixture cool to room temperature. For each group or each student, pour the mixture into a re-sealable bag (one-third full).

Background

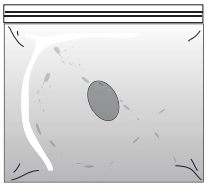
Your body contains trillions of cells. Each cell has a specific job to perform, and all cells must work together to keep you alive and healthy. All cells in your body have at least three parts: a cell membrane, a nucleus, and cytoplasm. Cells come in different shapes and sizes, but most are too small to see with the unaided eye. Cells live for different amounts of time. Bone cells can live for years, while cells in your small intestines only live a few days. Cells die in your body every second, but new cells are constantly being made to replace them.

Materials

- re-sealable plastic bag
- gelatin dessert mix
- banana slices
- seedless grapes
- lettuce leaf
- cherries
- fruit snacks
- plastic knife
- cookie sheet(s)
- tape
- food prep gloves (optional)
- spoons (optional)
- paper plates (optional)
- science journal

Procedure

1. Wash hands thoroughly with warm soapy water or use plastic food preparation gloves.
2. To prepare fruit for making a cell–
   a. Peel two or three seedless grapes (lysosomes).
   b. Slice a piece of banana (nucleus).
   c. Remove stems from four cherries (mitochondria).
   d. Cut a lettuce leaf into two 1-cm strips (Golgi bodies).
   e. Use the plastic knife to cut three 1-cm strips of fruit snack. Press the ends of the strips together to make one long strip. Fold the strip back and forth several times to make it look crinkled (endoplasmic reticulum).



3. Open the bag and insert the fruit and lettuce into the gelatin mixture.
4. Press the bag together to squeeze out any excess air and seal it closed.
5. Lay the bag flat on a cookie sheet and arrange the fruit so that it is not bunched together. This can be done without reopening the bag.
6. Create a label with your name or group's name and tape it to your bag.
7. Place the cookie sheet with the bags in the refrigerator for three to four hours until firmly set.
8. Once the cell has set, observe and draw a diagram of your cell in your science journal. Be sure to label the diagram by using the terms cytoplasm, nucleus, mitochondria, lysosomes, endoplasmic reticulum, Golgi bodies, and cell membrane. If desired, color the diagram.
9. Carefully squeeze the bag and note any change in the shape of the cell and placement of the organelles (cell parts). Record in your science journal.
10. If your teacher directs, enjoy eating your cell!

Conclusion

1. What did the gelatin represent?
2. What job does the nucleus perform for the cell?
3. What did the plastic bag represent?

Extension

1. Research the function of each organelle and describe its job within the cell.
2. Investigate a plant cell and describe how it is different from an animal cell.
3. Look at prepared slides of different types of cells. Compare and contrast nerve cells, muscle cells, and red blood cells.
4. Make your own slides of cells by taking swabs from the inside of your cheek.
5. Learn who first discovered the cell and who developed the cell theory.

Give Me Some Skin

Problem

To understand that the skin is a sensor that warns you of danger

Materials

3 paper clips
metric ruler
touch chart
red and blue marker
science journal

Background

Your skin is the largest organ of your body. An adult skin can weigh four kg and be over 1.8 square meters in area. The skin is made up of many layers. The outer layer is called the epidermis and its top has dead and dying cells that you are constantly shedding. The layer under the epidermis is called the dermis where new skin cells are made to replace the dead ones. The dermis, contains nerves, muscle, and a blood supply. It also contains glands that oil your skin and make you sweat. The bottom layer contains mainly fat that cushions your skin and attaches to your muscle. Your skin does four important jobs. It helps keep your body cool and comfortable, it is a sensor that warns you of danger, it provides protection from dirt and bacteria, and it helps eliminate your body's waste material.

Procedure

1. Unfold the three paper clips and then fold in half.
2. Use a metric ruler to measure the distance between the two ends of each paper clip. Bend the ends so that the ends of one paper clip are about 4 cm apart, the second one, 2 cm apart, and the third one, 1 cm apart.
3. Have your partner close his or her eyes. Touch your partner very lightly on the bare upper arm with both ends of the first paper clip.
4. Ask your partner if he or she can feel one or two points and record in touch chart.
5. Repeat steps 3-4 with the 2-cm and 1-cm paper clips.
6. Test the other areas listed in the chart.
7. Once you have tested all areas, switch places with your partner and repeat the tests.

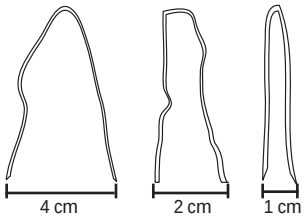


Diagram 1

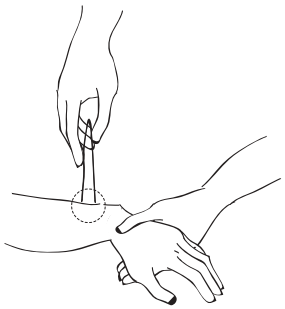


Diagram 2

Test Area	4 cm	2 cm	1 cm
Upper Arm			
Forearm			
Top of Wrist			
Back of Right Hand			
Fingertip			
Palm of Left Hand			

Conclusions

1. Which areas in your arm were most sensitive?
2. Which areas in your partner's arm were least sensitive?
3. Explain why some areas are more sensitive than others.
4. How does your skin warn you of danger?

Just Breathe

Problem

To demonstrate how the lungs work as part of the respiratory system

Materials

2-liter plastic bottle
plastic straw
clay
9-inch balloon
12-inch balloon
2 rubber bands
tape
scissors

Teacher Prep

Cut the bottom off each bottle used

Background

The respiratory system consists of the respiratory tract, which includes the nose, mouth, windpipe, and lungs. Air enters through the mouth or nose and then passes into the windpipe (trachea). The trachea divides into two bronchial tubes that lead to two separate lungs. The lungs are about the size of footballs, and they fill the chest cavity from neck to ribs. Each lung contains hundreds of millions of tiny air sacs called alveoli. Oxygen passes through the alveoli in dissolved form into the blood. The diaphragm, a dome-shaped muscle under the chest, contracts and flattens, bringing air into your lungs automatically, without your having to consciously think about it. Because the body's nervous system controls the flow of air in and out, breathing is called an involuntary control. You can voluntarily control your breathing by forcing your diaphragm to contract either more quickly or more slowly.

Procedure

1. Fasten the small balloon to one end of the straw by wrapping a rubber band around it. Be sure to fasten it tightly.
2. To make a diaphragm, cut a circular shape from the large balloon big enough to cover the bottom of the bottle so that there is approximately a 3-cm overlap.
3. Stretch the balloon over the bottom of the bottle and fasten it with a rubber band. To seal the rubber to the bottle, add a layer of tape around the edge of the balloon where it meets the bottle. See diagram 1.
4. Insert the straw with the balloon into the bottle so that the balloon is inside but not touching the bottom of the bottle.
5. Use clay to plug the opening and to secure the straw. See diagram 2.
6. Carefully observe the lung model. Predict what will happen to the balloon inside the model when you pull down on the rubber sheet. Record results in your science journal.
7. Have your partner hold the bottle while you place one hand over the straw opening. With the other hand, gently pull down and push up on the rubber sheet at the bottom of the bottle. Observe and record your observations.
8. Switch places with your partner and repeat.
9. Close your mouth, hold your nose, and try to expand your diaphragm. Record what happened in your science journal.

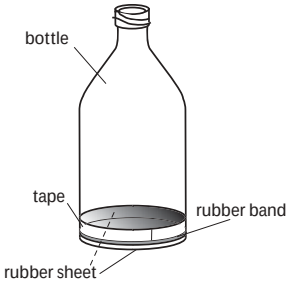


Diagram 1

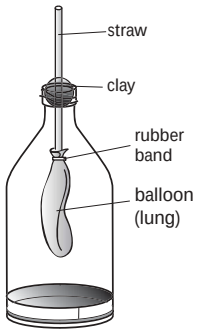


Diagram 2

Conclusion

1. Explain what happened to the balloon on the inside of the bottle (lung).
2. Compare the parts of the lung model to the respiratory system.
3. Trace the flow of air through the respiratory system.
4. Why is Jacob concerned about the respiratory system?

Extension

1. Use a stethoscope to trace the flow of air through the respiratory system. Place it on the nose, trachea, and chest while breathing in and out normally.
2. Create a simplified lung model to demonstrate what smoking can do to lungs by using a 2-liter bottle, straw, clay, cotton balls, and cigarettes. Place 5-10 white cotton balls in the bottom of the bottle. Insert straw and seal with clay as in previous experiment but without the balloon attached. Place a cigarette into the straw with the filter end down. Take the model to an open-air area and light the cigarette. Gently squeeze the bottle to simulate inhaling and exhaling. It will probably take 2-4 cigarettes to turn the cotton balls a yellowish color. Discuss what happens to your lungs when you smoke.

Tiny Creatures

Background

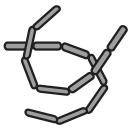
To compare and contrast three types of bacteria

Procedure

1. In your group, research three types of bacteria: coccus, bacillus, and streptococcus. You may want to assign a bacterium to each group member.
2. Record your findings in the chart below.
3. In your group, compare and contrast the three types of bacteria.
4. Design and draw a picture of your bacterium on construction paper.
5. In your science journal, write a brief description of your bacterium.
6. Present your group findings to the class.

Materials

Internet
book resources
3 pieces of construction paper
colored pencils
science journal



coccus	bacillus	streptococcus

Outbreak (Teacher Sheet)

Problem

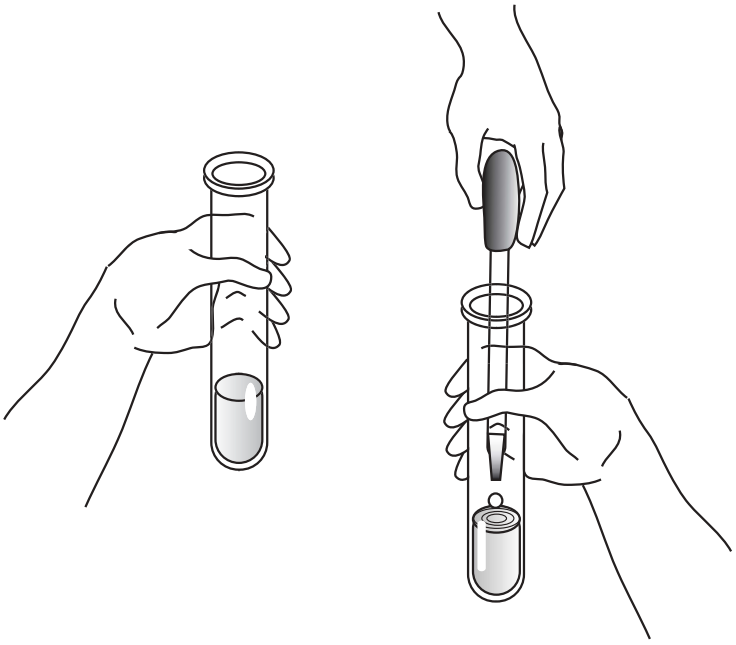
To simulate an epidemic

Materials

test tubes
eyedroppers
ammonia (non-sudsy)
cabbage juice (prepared)
distilled water
science journal

Teacher Prep

1. Cut 1-2 leaves of red cabbage into small pieces and place in a small bowl. Add water and microwave for about 2 minutes. Pour the solution into a flask or jar and set aside.
2. Use a grease pen or marker to number a test tube for each student.
3. Prepare the infected test tube by filling it 2/3 full of ammonia (non-sudsy). Remember the number of this test tube.
4. Fill the remaining test tubes 2/3 full of distilled water.
5. If necessary, demonstrate how to use an eyedropper.
6. Review safety rules.
7. Pass out the test tubes.
8. Explain to the students that one student has a cold virus (tube of ammonia) and that they will learn how viruses spread.
9. Using the eyedropper, have students exchange test tube liquids following the directions on the student data sheet. You may want to have the students choose their exchange partners before beginning the experiment to create less confusion upon exchange.
10. Once all exchanges have been completed, have the students return to their desks and carefully hold their test tubes.
11. Place 100 drops of the cabbage juice (indicator) into each test tube and have students observe any color change. This may take a few minutes. Some of the solutions will turn different colors: yellow (ammonia), green (most infected), blue (slightly infected), and purple (not infected).
12. Explain to the students what the different colors indicate.
13. Have the students try to retrace their patterns and attempt to find the initial "carrier" of the virus.



Outbreak (Student Sheet)

Student Name: _____ Test Tube #: _____

Student Data Sheet

Procedure

1. Using the eyedropper, place four drops of your liquid into another student's test tube, being careful not to touch his/her liquid with your eyedropper.
2. Have that student add four drops of his/her liquid to your test tube. Squeeze your eyedropper into your test tube to return all of the liquid to your test tube.
3. Use your eyedropper to slightly stir the liquid in your test tube.
4. Record the exchange in the chart below.
5. Repeat steps 1-4 with three different students.
6. Once the exchanges have been completed, return to your desk.
7. After your teacher adds the indicator solution to your test tube, observe the color and record.

Trial	Name of Student	Number of Drops Exchanged
1		
2		
3		
4		

Conclusion

1. When the indicator was added to your test tube, what color did the liquid become?
2. What did the change in color indicate?
3. When you eat or drink after a person, you can exchange body fluids. Describe how that exchange can result in transmitting a disease to another person.
4. Describe how this experiment could simulate the spread of an epidemic.
5. Discuss and identify ways to help control the spread of infectious disease.

Answer Key

Going Cellular

1. The gelatin represented cytoplasm.
2. The nucleus is the control center that directs all activities of the cell.
3. The plastic bag represented the cell membrane, which is a thin, film-like outer layer that holds a cell together and separates it from its environment.

Give Me Some Skin

1. Answers will vary.
2. Answers will vary.
3. Some parts of the body are more sensitive than others because receptors are not evenly spread over the body. Instead they are arranged in clusters. Areas that are most sensitive are those that have the greatest number of receptors in one place. Some of the most sensitive parts of your body are the fingertips and the end of your nose. The area least sensitive to touch is the back of the shoulder.
4. Your skin alerts your brain when it is in danger by sending signals to the brain when the skin feels pain. If you touch something hot, your skin will signal that the skin is hurting, and your brain will tell your hand to move away from the heat source that is burning you.

Just Breathe

1. When you pulled on the rubber sheet, the balloon inside the bottle had room to expand. This ability to expand caused a difference in air pressure. The pressure inside the balloon dropped and the higher air pressure from outside rushed in to equalize the pressure causing the balloon to inflate.
2. The straw opening represents the mouth and/or nose, the straw is the trachea, the balloon is the lung, and the rubber sheet is the diaphragm.
3. When we inhale, air enters through the mouth and/or nose and goes into the trachea and then into the lungs. When we exhale, air leaves the lungs and goes through the trachea and back out the mouth and/or nose.
4. The respiratory system is of particular concern to Jacob because most infectious diseases affect either the respiratory system or the digestive system. After taking the petri dishes, Mr. Frank, Jacob learned that there are a lot more airborne microbes in the tree house than in his own home. These microbes could be infectious, and if he breathes them in, he might get sick.

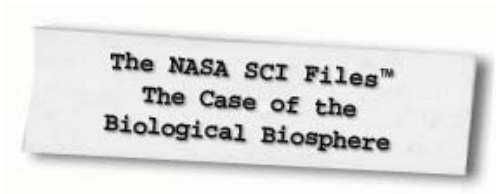
Outbreak

1. Answers will vary but should be yellow, green, blue, or purple.
2. The change in color indicated the amount of infection that the person received.
3. Eating or drinking after another person causes you to intake a small amount of their body fluids. If they are infected with a disease or illness, you expose your body to those germs. You can then possibly become ill.
4. This experiment shows how quickly an infectious disease can spread without people even knowing it until it is too late. We come in contact with numerous people throughout the day, and if we are infected we can possibly infect them too.
5. You can control the spread of infectious disease by not eating or drinking after other people. You should also wash your hands frequently and not put your hands in your mouth or near your nose and eyes. Germs can enter these areas more easily than other areas. Covering your mouth when you cough or sneeze can also prevent the spread of infection.

On the Web

Cool Breezes

1. The alcohol felt cooler because it evaporated faster than water. The quick evaporation helps the body heat to radiate away from the skin more quickly, thereby cooling it faster.
2. On very hot humid days the air is already full of water vapor and it is unwilling to accept more. The perspiration on your skin tends to stay on your skin rather than evaporating into the air. If the humidity is at 80 percent, that means that the air contains 80 percent of the water it can hold. At this humidity, your cooling system is slower and operates at only about 20 percent efficiency. Therefore, you feel sweaty and sticky.
3. Bathing in alcohol used to be an acceptable means of bringing a fever down. However it is no longer recommended because alcohol can be absorbed through the skin and cause alcohol poisoning, which can be deadly.
4. You could make your skin feel cooler by fanning yourself or standing in a cool breeze. The moving air helps to evaporate the water more quickly.



Segment 3

Jacob is beginning to feel the effects of his quarantine. His sleep has been disturbed and his eating habits are not the best. All these things are starting to take a toll on Jacob, but he insists that quarantine is the best way to stay healthy. The tree house detectives decide that they need to learn more about the immune system so they visit an immunologist, Dr. Zilliox in Norfolk, Virginia. She discusses specialized white blood cells and antibodies and explains how you can strengthen the immune system. Dr. D agrees to meet the detectives at the Grossology Exhibit at the Virginia Marine Science Museum in Virginia Beach, Virginia. At the exhibit, the detectives learn that even though vomit and mucus are really "gross," they help the body to stay healthy.

Objectives

The students will

- learn how the immune system works to maintain health.
- understand that various body fluids and functions are necessary to maintain health.
- understand the importance of diet, rest, and exercise to maintain a healthy body.

Vocabulary

antibodies— substances produced by the body that combine with an antigen and counteract its effects or those of the microscopic plant or animal on which the antigen occurs

cilia— tiny hairlike cell structures that make lashing movements

immunologist— a person who specializes in immunology

mucus— a slippery sticky substance produced especially by mucous membranes (as of the nose and throat) which it moistens and protects

vaccine— a preparation of killed, weakened, or fully infectious microbes that is given (as by injection) to produce or increase immunity to a particular disease

white blood cells—cells in the immune system that help fight infection

Video Component

Implementation Strategy

The NASA SCI Files™ is designed to enhance and enrich the existing curriculum. Two to three days of class time are suggested for each segment to fully use video, resources, activities, and web site.

Before Viewing

1. Prior to viewing Segment 3 of *The Case of the Biological Biosphere*, discuss the previous segment to review the problem and what the tree house detectives have learned thus far. Download a copy of the Problem Board from the tree house section of the NASA SCI Files™ web site and have students use it to sort the information learned so far.
2. Review the list of questions and issues that the students created prior to viewing Segment 2 and determine which, if any, were answered in the video or in the students' own research.
3. Revise and correct any misconceptions that may have been dispelled during Segment 2. Use tools located on the web, as was previously mentioned in Segment 1.
4. Focus Questions–Print the questions from the web site ahead of time for students to copy into their science journals. Encourage students to take notes during the program to answer the questions. An icon will appear when the answer is near.
5. What's Up? Questions–Questions at the end of the segment help students predict what actions the tree house detectives should take next in the investigation process and how the information learned will affect the case. These questions can be printed from the web site ahead of time for students to copy into their science journals.

View Segment 3 of the Video

For optimal educational benefit, view *The Case of the Biological Biosphere* in 15-minute segments and not in its entirety. If you are viewing a taped copy of the program, you may want to stop the video when the Focus Question icon appears to allow students time to answer the question.

After Viewing

1. Have students reflect on the "What's Up?" questions asked at the end of the segment.
2. Discuss the Focus Questions.
3. Have students work in small groups or as a class to discuss and list what new information they have learned about quarantine, disease, bacteria, cells, tissues, organs, body systems, viruses, the immune system, exercise, and how infectious disease is spread. Organize the information, place it on the Problem Board, and determine if any of the students' questions from Segment 2 were answered.
4. Decide what additional information is needed for the tree house detectives to determine if Jacob is on the right track to staying healthy. Have students conduct independent research or provide students with information as needed. Visit the NASA SCI Files™ web site for an additional list of resources for both students and educators.
5. Choose activities from the educator guide and web site to reinforce concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced and use activities to aid student understanding in those areas.
6. If time did not permit you to begin the web activity at the conclusion of Segments 1 or 2, refer to number 6 under "After Viewing" (p. 15) and begin the Problem-Based Learning (PBL) activity on the NASA SCI Files™ web site. If the web activity was begun, monitor students as they research within their selected roles, review criteria as needed, and encourage the use of the following portions of the online, PBL activity:

   Research Rack–books, internet sites, and research tools

   Problem-Solving Tools–tools and strategies to help guide the problem-solving process.

   Dr. D's Lab–interactive activities and simulations

   Media Zone–interviews with experts from this segment

   Expert's Corner–listing of Ask-An-Expert sites and biographies of experts featured in the broadcast
7. Have students write in their journals what they have learned from this segment and from their own experimentation and research. If needed, give students specific questions to reflect upon as suggested on the PBL Facilitator Prompting Questions instructional tool found in the educator's area of the web site.
8. Continue to assess the students' learning, as appropriate, by using their journal writings, problem logs, scientific investigation logs, and other tools that can be found on the web site. Visit the Research Rack in the tree house, the online PBL investigation main menu section, "Problem-Solving Tools," and the "Tools" section of the educator's area for more assessment ideas and tools.

Careers

fitness coordinator
immunologist
personal trainer
lab technician
nurse
Red Cross volunteer
blood donor

Resources

Books

Branzei, Sylvia and Jack Kelly: *Grossology and You.* Price Stern Sloan Publishing, 2002, ISBN: 0843177365.

Cobb, Vicki: *Blood and Gore, Like You've Never Seen*. Scholastic Paperbacks, 1998, ISBN: 0590926659.

Dawson, Susan and Susan Norton: *Pyramid Pal—Adventures in Eating*. Griffin Publishing, 2000, ISBN: 1580000703.

Kalbacken, Joan: *The Food Pyramid (True Books, Food & Nutrition)*. Children's Press, 1998, ISBN: 0516263765.

Leedy, Loreen: *The Edible Pyramid: Good Eating Every Day*. Scott Foresman, 1996, ISBN: 0823412334.

Masoff, Joy: *Oh, Yuck: The Encyclopedia of Everything Nasty*. Workman Publishing Company, 2000, ISBN: 0761107711.

Rockwell, Lizzy: *Good Enough to Eat: A Kid's Guide to Food and Nutrition*. Harpercollins Juvenile Books, 1999, ISBN: 0060274344.

Walker, Pam and Elaine Wood: *The Immune System (Understanding the Human Body)*. Lucent Books, 2002, ISBN: 1590181514.

Web Sites

Yucky Gross & Cool Body
Come and explore this web site, play some really gross games, and learn all about those yucky things your body does!
http://yucky.kids.discovery.com/body/

Amazing Facts About the Human Body
This web site has over 30 really amazing facts about the human body!
http://www.faculty.fairfield.edu/fleitas/bodies.html

The Immune System—An Overview
This web site takes an in-depth look at the immune system and its parts. Great resource for teachers and older students.
http://www.thebody.com/step/immune.html

Cells Alive!
Explore this site to learn all you would ever want to know about cell biology, immunology, microbiology, and more. This site also offers great interactive pages on various types of cells and their parts.
http://www.cellsalive.com/

Activities and Worksheets

Red, White, and Plasma

Purpose

To create a model of blood and its various components

Teacher Note

This experiment can be done as a class or in small groups. Report covers and plastic grocery bags may be used for the red and white plastic sheets.

Materials

- sheet of red plastic
- sheet of white plastic
- brown construction paper
- several hole-punches
- scissors
- water
- yellow food coloring
- 2 small jars with lids

Background

Blood consists of both liquids and solids. However, the solid part of the blood is made from such tiny particles that they cannot be seen without a microscope. Red blood cells, white blood cells, and platelets are the solid particles of blood. The liquid part of the blood is called plasma. Now imagine the head of a pin. About a million red blood cells would fit on top of it!

Procedure

1. Using the hole-punch and the appropriate color sheet of plastic or paper, punch 1,000 red holes and 50 brown holes.
2. Use the scissors to cut out 2 white ameba shapes.
3. Place all the holes and the 2 ameba shapes in an empty jar.
4. Fill the second jar with water about one-half full and add 1-2 drops of yellow food coloring.
5. Pour a small amount of the yellow liquid into the jar, with the holes barely covering the cells.
6. In your science journal, draw a picture of your model and explain each component.
7. Conduct research on each part of blood and share your findings with your classmates.

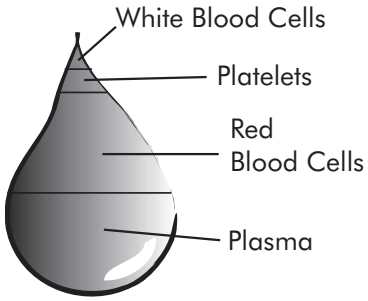


Diagram 1

Conclusion

1. When you poured the yellow liquid into the jar, what did it represent?
2. Why does blood look red when the liquid is yellow?
3. What would happen to your blood if an infection entered your body?
4. Why do you think there are different kinds of cells?
5. Describe the function of each cell.
6. How can Jacob make sure that his blood will keep him healthy?

Extension

Conduct research to discover how the blood flows through the circulatory system. Draw a diagram tracing the flow, being sure to label all the organs.

You Are What You Eat

Purpose

To learn how to plan a balanced diet to strengthen the immune system

Materials

daily diet record
science journal
calorie counter books
calculator (optional)

Teacher Prep

Either have the students keep track of all they eat throughout a day and record the foods and amounts in their science journals or use "Make It Nutritious" from the NASA SCI Files™ web site <*http://scifiles.larc.nasa.gov*> For a free food calorie counter visit– <*http://www.lhj.com/home/Food-Calorie-Counter.html*>

Background

Nutrition is the science that deals with food and how the body uses it. Food gives the body energy to think, function, and grow. It is very important for the body to receive the correct amounts and right types of foods each day so that all the organs and systems can work efficiently and stay healthy. In 1992, the United States Department of Agriculture created a food pyramid that shows the kinds of foods and the number of servings needed each day to keep us healthy. Although many other factors are also considered in making good food choices such as fat, sugar, and salt content, the food pyramid is a good guide to planning a healthy diet.

Procedure

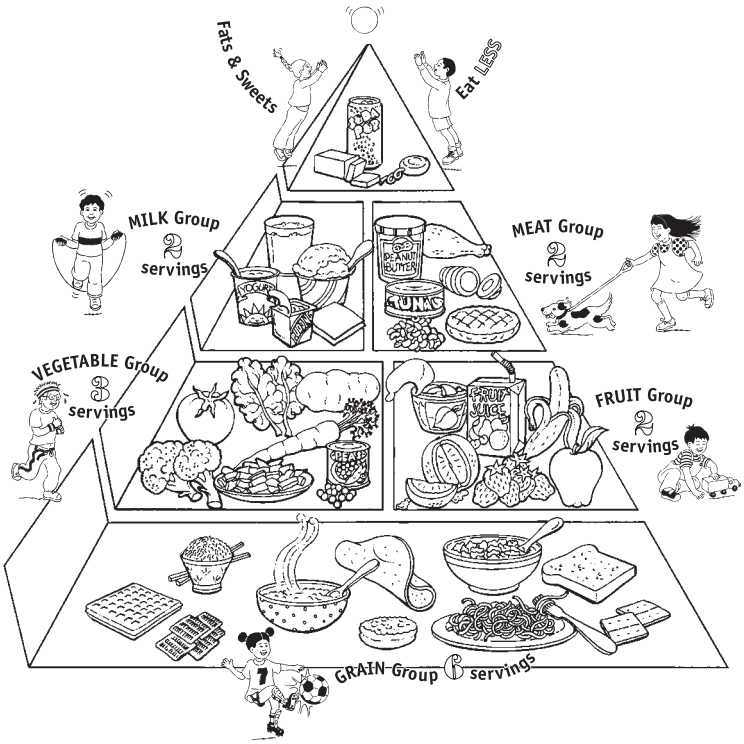
1. Look at your daily diet record to see what you ate the previous day. Use a calorie counter book or internet web sites to determine the number of calories you ate for each meal and snack. Record in the calorie chart below and total the number of calories for the day.
2. Average the number of calories eaten per meal (divided total by three).
3. Total the number of calories eaten by your group and find the average number of calories eaten per person (divide total by number of people in group). Check your diet to determine if your diet was healthy, somewhat healthy, or not healthy at all.
4. In your group, discuss the food pyramid and why it is shaped like a pyramid. Brainstorm reasons why the foods at the top of the pyramid should be limited. Record all answers in your science journal.
5. Use the food pyramid to determine how many servings of each category you ate and record in the category chart.
6. Discuss how you can improve your diet to have a more healthy balance.
7. Plan a menu that reflects a healthier diet.
8. Share your diet choices and menu with the class.

Meal	Calories	Serving Type
Breakfast 1. 2 3.		
Lunch 1. 2 3.		
Dinner 1. 2 3.		
Snacks 1. 2 3.		

Total Calories per day: _____ **Average Calories per meal:** _____
Total Calories per group: _____ **Average Calories per person:** _____

You Are What You Eat (continued)

Meal	Bread, Cereal, Rice and Pasta Group	Milk, Yogurt, and Cheese Group	Vegetable Group	Fruit Group	Meat, Poultry, Fish, Dry Beans, and Nuts Group	Fats, Oils, and Sweets
Breakfast						
Lunch						
Dinner						
Snacks						



Extension

Using the menu you created, make a bar graph showing how many items belong to each food group. Some items can represent two groups; for example, a sandwich could be a meat and a grain. Evaluate the menu for nutritional value.

Vomit or Mucus Anyone?

Purpose

To make an edible vomit and mucus

Procedure

VOMIT

1. With adult help, place 1/4 cup of apple sauce into a frying pan and as it begins to heat, add 1 packet of unflavored gelatin and stir.
2. Add 1-2 pinches of cocoa and stir thoroughly.
3. Turn off the heat and sprinkle a small amount of oatmeal into the mixture, but don't stir completely so you will have some "chunky" areas.
4. Repeat with raisin bran.
5. Remove the vomit from the pan and place onto a plate.
6. Spread out the vomit and shape it until it looks real.
7. Stick some raisins or cereal bits for a more realistic look and let it cool for 1-2 hours.
8. Use a spatula to remove the vomit from the plate.

MUCUS

1. Heat 1⁄2-cup water just until it boils and remove from heat.
2. Pour into a large bowl and add 3 packets of unflavored gelatin.
3. Let the gelatin soften for a few minutes and then stir with a fork.
4. Add enough corn syrup to make 1 cup of thick glop.
5. Stir with a fork and lift out the long strands of gunk.
6. As it cools, add water one spoonful at a time until you achieve the desired consistency for snot.

Conclusion

1. Explain how vomiting helps your body to stay healthy.
2. Explain how snot helps your body to stay healthy.

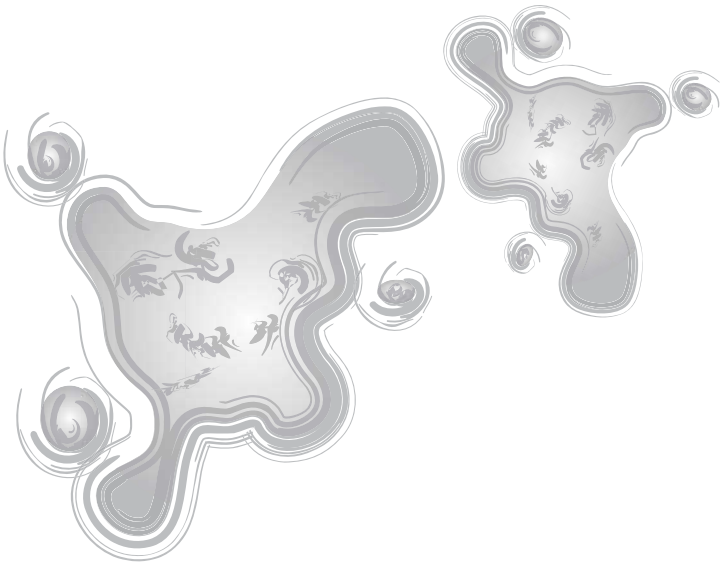
Materials

Vomit

frying pan
spatula
plate
measuring cup
spoon
1 packet of unflavored gelatin
1/4 cup of apple sauce
powdered cocoa
oatmeal
raisin bran cereal

Mucus

light corn syrup
3 packets unflavored gelatin
measuring cup
bowl
stove or microwave
fork



Fitness For Life

Purpose

To develop a fitness plan

Materials

books on fitness (optional)
construction paper
colored pencils
stapler
science journal

Background

Fitness is a combination of flexibility, strength, and stamina. Flexibility is the ability of your body to bend and stretch easily. For your muscles to be flexible, exercise is key. Strength is the amount of weight your muscles can lift. Eating protein and exercising helps strengthen your muscles, which makes you strong. Stamina is your body's ability to endure. You can increase your stamina also by exercising and maintaining a healthy body weight.

Procedure

1. In your group, brainstorm examples of flexibility, strength, and stamina and record all answers in your science journals. For example a ballerina touching her toes is an example of flexibility.
2. Create 2-3 exercises that would develop the body's flexibility, strength, and stamina.
3. Design and make a booklet with a section for each category listing the exercises you have developed. Illustrate and staple the sides together to bind.
4. Share your exercises with your class, teaching them how to perform each one.
5. As a class, decide which exercises in each category you would like to perform daily to help you and your classmates stay physically fit.
6. Design and create an exercise routine and post it on a chart or poster.

Conclusion

1. Why should you exercise on a daily basis?
2. What are warm-up exercises and why should you do them before any exercise routine?
3. How can exercise benefit Jacob and help keep him healthy?

Extension

Choose ten exercises from the lists created by the students. Have the students copy each exercise on a separate sheet of paper and illustrate. In a large open play area, set up ten stations, placing one exercise sheet at each station. Number the stations 1-10. Divide and number the students into ten groups. Lead the students in warm-up exercises; then, have each group go to its respective numbered station and perform the exercise until you signal. At the signal, the students will rotate to the next station.

Answer Key

Red, White, and Platelets

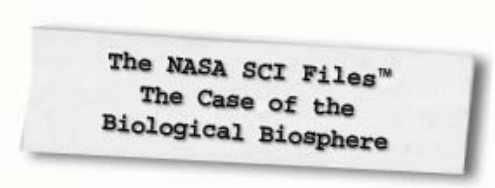
1. The yellow liquid represented plasma.
2. The blood looks red because there are so many red blood cells it gives blood its color.
3. If an infection entered your body, the white blood cells would begin to multiply to fight the germs.
4. There are different types of cells in your blood to perform different jobs.
5. Answers will vary, but should include that red blood cells are the most numerous, giving blood its identifying color. These cells carry oxygen and carbon dioxide throughout the body. White blood cells act as the body's defense mechanism, fighting against infection. Platelets contain substances that help blood clot to prevent excessive blood loss. The plasma is what helps the cells move throughout the body.
6. There is no positive way to make sure that Jacob stays healthy. However, eating right and getting plenty of rest and exercise can help your body stay healthy, which will help your immune system function properly.

Vomit or Mucus Anyone?

1. Answers will vary but should include that vomiting helps rid the body of harmful substances.
2. Answers will vary but should include that snot acts as a barrier to dirt and germs.

Fitness For Life

1. Answers will vary but should include examples and explanations of how exercising on a daily basis helps maintain good health.
2. Warm-up exercises are those that help you gently stretch your muscles before you begin your exercise routine. It is important to do warm-up exercises so that you do not damage your muscles.
3. Exercise can benefit Jacob just like everyone else; it will help him maintain a healthy body so that his body can fight off disease and infection when it needs to.



Segment 4

Jacob is getting close to the departure date of his long-awaited vacation, but he is not doing too well. The tree house detectives try to convince him he must get more rest and eat healthy. They contact Beth Shepherd, lead astronaut strength, conditioning, and rehabilitation specialist at NASA Johnson Space Center in Houston, Texas. Mrs. Shepherd helps the tree house detectives understand why exercise is important in staying healthy. Now the tree house detectives decide that a fitness program is the next step in keeping Jacob healthy. While at NASA Johnson Space Center, they also speak with Dr. Ellen Baker, an astronaut who explains the rigors of working and living in space and how astronauts stay healthy. Dr. Baker reiterates the importance of rest, diet, and exercise. Jacob finally agrees that maybe his methods are not working and ends his quarantine. The detectives go to Dr. D to wrap up their investigation, and Jacob prepares to set sail for the Dry Tortugas, hoping that he stays well just one more day.

Objectives

The students will

- understand the importance of diet, exercise, and rest.
- understand that a person's health is dependent upon many variables.

Vocabulary

ISS—International Space Station

yellow fever—an infectious, often fatal, viral disease of warm climates, transmitted by mosquitoes and marked by high fever, hemorrhaging, vomiting of blood, liver damage, and jaundice

Video Component

Implementation Stratey

The NASA SCI Files™ is designed to enhance and enrich the existing curriculum. Two to three days of class time are suggested for each segment to fully use video, resources, activities, and web site.

Before Viewing

1. Prior to viewing Segment 4 of *The Case of the Biological Biosphere*, discuss the previous segment to review the problem and what the tree house detectives have learned thus far. Download a copy of the Problem Board from the NASA SCI Files™ web site in the tree house section and have students use it to sort the information learned so far.
2. Review the list of questions and issues that the students created prior to viewing Segment 3 and determine which, if any, were answered in the video or in the students' own research.
3. Revise and correct any misconceptions that may have been dispelled during Segment 3. Use tools located on the Web, as was previously mentioned in Segment 3.
4. Focus Questions–Print the questions from the web site ahead of time for students to copy into their science journals. Encourage students to take notes during the program to answer the questions. An icon will appear when the answer is near.

View Segment 4 of the Video

For optimal educational benefit, view *The Case of the Biological Biosphere* in 15-minute segments and not in its entirety. If you are viewing a taped copy of the program, you may want to stop the video when the Focus Question icon appears to allow students time to answer the question.

After Viewing

1. At the end of Segment 4, lead students in a discussion of the focus questions for Segment 4.
2. Have students discuss and reflect upon the process that the tree house detectives used to help Jacob stay healthy and infection free. The following instructional tools located in the educator's area of the web site may aid in the discussion: Experimental Inquiry Process Flowchart and/or Scientific Method Flowchart.
3. Choose activities from the educator guide and web site to reinforce concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced and use activities to aid student understanding in those areas.
4. Wrap up the featured online Problem-Based Learning investigation. Evaluate the students' or teams' final product, generated to represent the online PBL investigation. Sample evaluation tools can be found in the educator's area of the web site under the main menu topic "Tools."
5. Have students write in their journals what they have learned about disease, cells, infection, health, body systems, and/or the problem-solving process and share their entry with a partner or the class.

Resources

Books

D'Amico, Joan and Karen Eich Drummond: *The Healthy Body Cookbook: Over 50 Fun Activities and Delicious Recipes for Kids.* John Wiley, 1999, ISBN: 0471188883.

Frost, Helen: *Drinking Water (The Food Guide Pyramid).* Pebble Books, 2000, ISBN: 0736805346.

Roccio, Nina M.: *Five Kids & A Monkey Solve the Great Cupcake Caper: A Learning Adventure About Nutrition and Exercise.* Creative Attic, 1997, ISBN: 0965395510.

Careers

astronaut
mission specialist
astronaut trainer
personal trainer
travel agent

Web Sites

Education World
This site is a great place for teachers to stop and shop for new lessons on the human body.
http://www.education-world.com/a_lesson/lesson065.shtml

A Look Inside the Human Body
Just click on a body system and explore the world of the circulatory system, the digestive system, and many more. Well done and comprehensive.
http://users.tpg.com.au/users/amcgann/body/

The Human Body
This web site is packed with information for students on a variety of topics from viruses to DNA.
http://www.hipopl.org/kids/homeworkcontents/homeworkhelp/human_body/human_body.htm

NASA Spacelink
Visit this NASA web site to learn more about the world of space and astrobiology. Just click on "Instructional Materials" for a wealth of educational resources.
http://spacelink.nasa.gov

Activities and Worksheets

Flexing Your Muscles

Purpose

To create a model of the arm to understand how muscles work

Materials

- thin cardboard or tag board
- scissors
- paper clip
- metric ruler
- 2 long balloons
- marker
- tape
- string
- science journal

Background:

Your body is able to twist, turn, flip, bend, reach, and much more due to muscles. There are over 600 muscle groups in the human body, all working together to make sure you can move when needed. However, all this activity results from just one muscle action—contraction. When muscles contract, they make themselves shorter, and when muscles are not contracting, they are relaxing. Your muscles work in teams and every set of muscles has at least one opposing set, so your movements can be reversed. It is very important to keep your muscles healthy by proper exercise.

Procedure

1. Measure the length of your arm from your shoulder to your elbow and record in your science journal. See diagram 1.
2. Measure the length of your arm from your elbow to your wrist and record.
3. Using the measurements cut a cardboard square equal to the measurement for the upper arm.
4. Cut two cardboard squares equal to the measurement for the lower arm.
5. Roll each piece of cardboard tightly and secure with tape. See diagram 2.

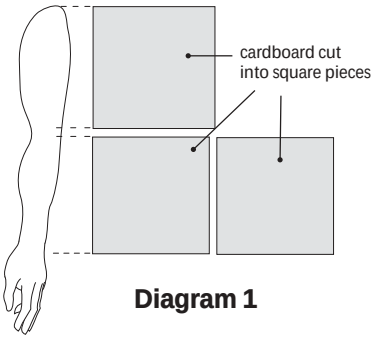


Diagram 1

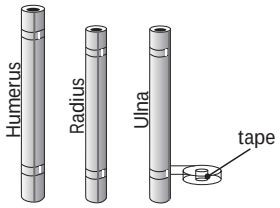


Diagram 2

6. Label the cardboard for the upper arm "Humerus."
7. Label one of the cardboard pieces for the lower arm "Radius" and the other "Ulna."
8. With adult help, make a hole on one end of each of the three rolls.
9. Unbend a paper clip and thread it through the holes, as shown in diagram 3.

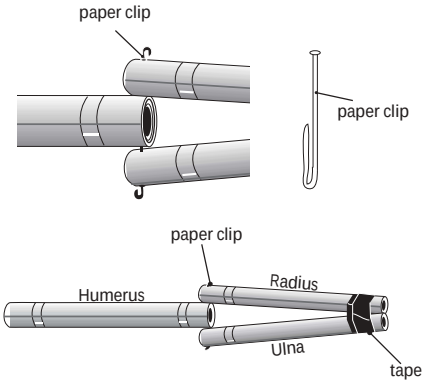


Diagram 3

10. Loop the ends to secure.
11. Slightly inflate both balloons and tie a knot at both ends. See diagram 4.
12. Using string, tie one balloon to the top of the humerus and to the middle of radius and ulna. See diagram 5. This balloon represents the biceps.

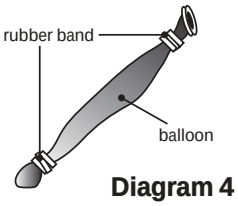


Diagram 4

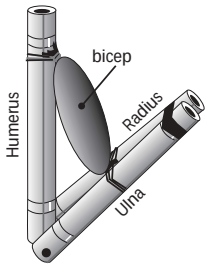


Diagram 5

13. Tie the other balloon to the top and bottom of the humerus being sure to include the radius and ulna. See diagram 6.

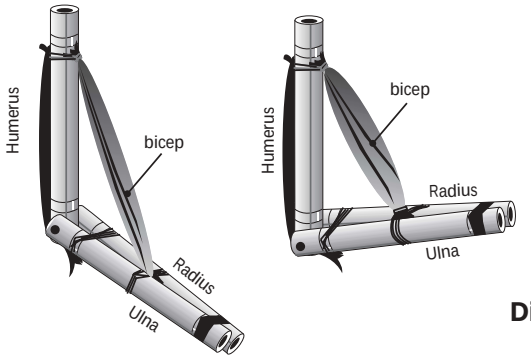


Diagram 6

14. Optional: Trace the outline of your hand onto a piece of cardboard and cut it out. Attach the cutout to the end of the radius and ulna.
15. Bend your arm up and down and observe. Record your observations.

Conclusion

1. Explain what happens when the biceps contract.
2. Why is it important to exercise your muscles?

Extension

1. Perform various movements and find the muscle teams responsible.
2. Research and create a report on the three types of muscles.
3. Research and create a report on foods to eat to promote healthy muscles.
4. Compare and contrast voluntary and involuntary muscles.

Flexibility is the Key

Purpose

To experience gentle stretching exercises to help improve flexibility

A main component of good physical conditioning is having a flexible body. In general, girls are usually more flexible than boys, but by doing some gentle stretching exercises, you can develop good flexibility.

In a large, open area, while wearing comfortable clothing, perform these exercises:

Hippy, Hippy, Leg (Hip and Leg)

Lie on the floor. Lift one leg and grasp the lower leg with both hands. Pull the leg gently toward the nose, keeping the leg straight. Stretch out to the side. Raise the other leg and repeat.

Supple Spine (Spine)

Lie on your stomach. Raise your upper body off the floor, arching the spine. Raise both feet and try to touch your head with your toes.

Low and Behold (Spine and Arms)

Kneel and sit on your heels. Bend down toward the floor until your forehead touches the floor. Stretch your arms in front of you and inhale. Exhale as you stretch your arms out a little farther. Repeat three or four times.

Reach and Reaching (Arm and Shoulders)

Sit on the floor and bend your right arm over the right shoulder. Bend your left arm under your left shoulder. Try to make your hands reach and hold each other. Repeat in the opposite direction.

Kneeing It (Knee)

Stand with both feet flat on the ground. Bend both knees as far as you can without lifting the heel from the floor.

Anklets (Ankle)

Lie on the floor. Lift one leg and bend the knee so the lower leg is parallel to the floor. Point the toes forward trying to make a straight line. Pull the toes back and stretch the toe toward the shin. Switch legs and repeat. Repeat several times with both legs.

Extension

Create an exercise log and record the exercises you perform each day. Be sure to record the day, date, type of exercise, and the time spent performing each exercise. Evaluate your program with class members and teacher.




Getting to the Heart of the Matter

Purpose

To find your body's resting heart rate
To understand the necessity of exercising the heart muscle

Materials

stopwatch or watch with second hand
large area
science journal

Teacher Prep

Demonstrate how to take someone's pulse using the radial artery located inside the wrist. Have students practice finding each other's pulse and counting the beats.

Procedure

1. Sit quietly for 5-10 minutes.
2. Estimate your pulse rate for one minute and record in chart below.
3. Have your partner take your pulse rate for one minute and record.
4. Switch roles and find your partner's pulse rate for one minute and record.
5. Stand and touch your toes with your fingertips and stand upright again. Repeat this movement 15-20 times as quickly as possible.
6. Have your partner find your pulse rate for one minute and record.
7. Switch roles and repeat steps 5-6.
8. Do 20-25 jumping jacks as quickly as possible.
9. Have your partner find your pulse rate for one minute and record.
10. Switch roles and repeat steps 8-9.

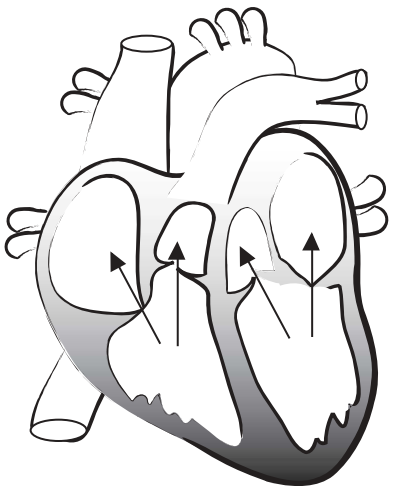
	My Pulse	My Partner's Pulse
Resting		
Toe Touching		
Jumping Jacks		

Conclusion

1. Explain what happened to your heart rate after performing the toe-touching exercise.
2. How did your heart rate change after the jumping jacks? Why?
3. Describe what happened to your body after each exercise.
4. Predict what could happen to your pulse rate if you were to run 2 km. Explain your answer.
5. Is there a limit to how fast your heart can beat?

Extension

1. Research how to find your "target heart rate" during exercise and conduct exercises to maintain the target heart rate.
2. Research and give a report on why your resting heart rate lowers as you become more physically fit.



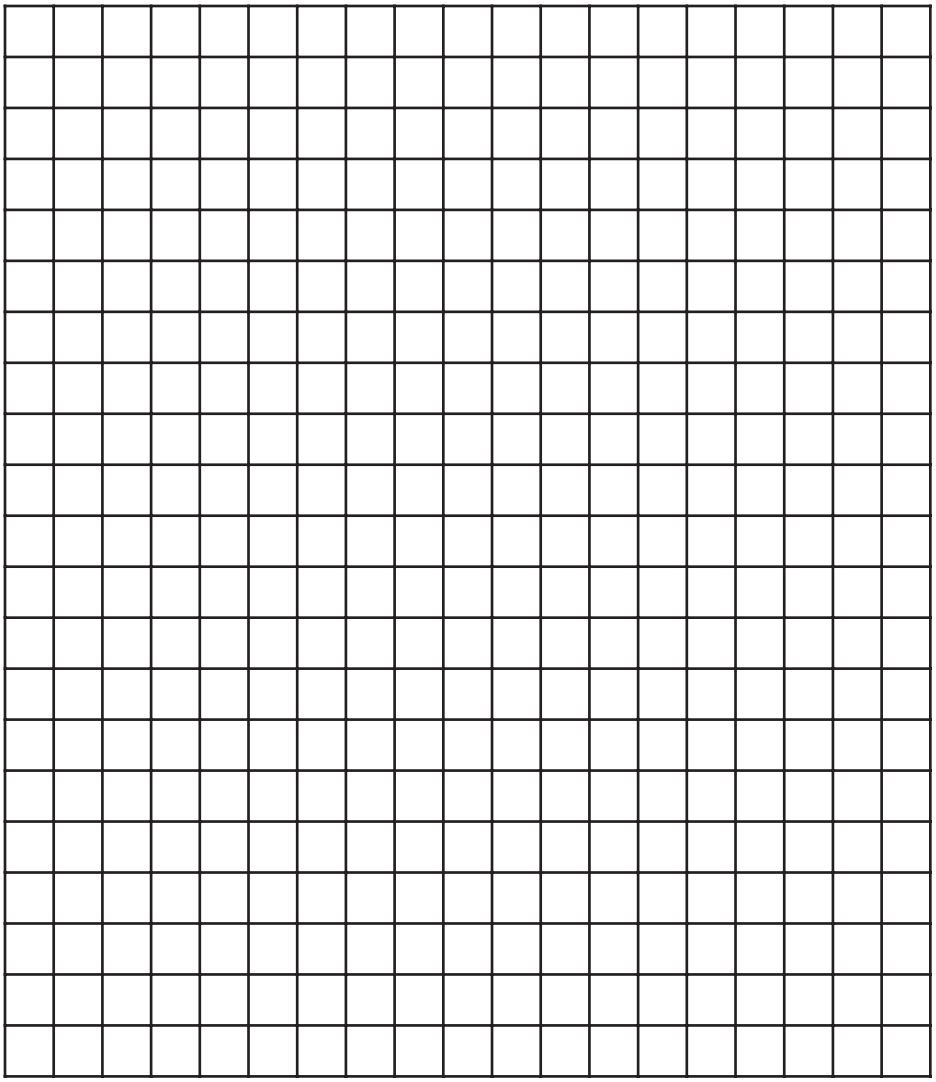
Biologically Speaking Word Search

Word Bank

cell	muscle	exercise	respiratory	vaccine
bacteria	quarantine	epidemiology	digestive	immunologist
virus	health	disease	toxin	mucus
antibiotic	epidemic	homeostasis	organ	vomit

B N C E L L T D S E A V E S P P A R A T U V
A N M O S P S M G X S A B E H A G U Y I N O
C A Q U M O R P S E V C A C X N R O L E D M
T B F U S P E R U R K M E I C A I P E V V I
E N S A A C O M B C H T I H B G L C H I A T
R H E D L R L U A I R A U X S R L I S T C E
I K A I W O A E N S I N E T I O I I I S C E
A J I L I E S N S E C J I L P L L E U E I N
E L S T Y I D J T I B L S H E A L T H G N T
Z V I R U S I R E I D A I E S I R V A I E I
R E T N E C I P E I N E E T H S C A R D E A
Q Z Q U I C K I A T S E M T F R T E P U N L
R N L D S H I N D I V T L T I S I I T I T T
Y G E A R S Z A S R S U O D R O N C Y A I O
K I V N R T S A Q I A I D N R N E N H J K X
J S E Y K O T C G F Y I Y I I I W N B O N I
H F R T J S Y O R E O P E L L C F I I D A N
P E N E O G L A E R T C K C I B A T S T R F
U E R E I O S I D K Z U U A E O I S H I C T
Y K M E N I T G A D T B I S B O L L I I I S
T O E U S B E K I S R I H Y O M J A C O N I
H G M M A I M O R E S P I R A T O R Y A L P
O M W E P I D E M I C E I K K I N Y I R P V
I F A A N T I B I O T I C L F U M U C U S V

Across the Biosphere



Create a crossword puzzle using the following terms and the grid.

Vocabulary

cell
bacteria
virus
antibiotic
muscle
quarantine
health
epidemic
epidemiology
disease
organ
vaccine
immunologist
mucus
vomit

Add your own:

_____
_____
_____
_____

Across

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Down

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Answer Key

Flexing Your Muscles

1. When the biceps contract, they get larger. When someone "shows us his muscle" he is contracting his biceps, which creates a bulge. The biceps contract to pull up the lower arm bone.
2. Answers will vary but should include that exercise is important to keep muscles in good physical condition so that they are able to do all the motions required of the body throughout the day. Poor muscle condition can lead to poor health.

Getting to the Heart of the Matter

1. Your heart rate increased.
2. Your heart rate had a greater increase because jumping jacks required more physical activity than the toe-touching exercise. With increased physical activity, the heart has to pump harder to oxygenate the blood.
3. Answers will vary but should include that during each exercise, the body responded according to its level of fitness. The less physically fit people are, the more difficulty they will have in breathing and the more easily they will tire. After the exercises were complete, the pulse rate returned to normal.
4. Answers will vary but should include that the pulse rate will increase.
5. There is a limit to the number of beats per minute the heart can beat safely. If a heart beats too fast it can cause serious health problems.

Biologically Speaking (Word Search)

B N C E L L T D S E A V E S P P A R A T U V
A N M O S P S M G X S A B E H A G U Y I N O
C A Q U M O R P S E V C A C X N R O L E D M
T B F U S P E R U R K M E I C A I P E V V I
E N S A A C O M B C H T I H B G L C H I A T
R H E D L R L U A I R A U X S R L I S T C E
I K A I W O A E N S I N E T I O I I I S C E
A J I L I E S N S E C J I L P L L E U E I N
E L S T Y I D J T I B L S H E A L T H G N T
Z V I R U S I R E I D A I E S I R V A I E I
R E T N E C I P E I N E E T H S C A R D E A
Q Z Q U I C K I A T S E M T F R T E P U N L
R N L D S H I N D I V T L T I S I I T I T T
Y G E A R S Z A S R S U O D R O N C Y A I O
K I V N R T S A Q I A I D N R N E N H J K X
J S E Y K O T C G F Y I Y I I I W N B O N I
H F R T J S Y O R E O P E L L C F I I D A N
P E N E O G L A E R T C K C I B A T S T R F
U E R E I O S I D K Z U U A E O I S H I C T
Y K M E N I T G A D T B I S B O L L I I I S
T O E U S B E K I S R I H Y O M J A C O N I
H G M M A I M O R E S P I R A T O R Y A L P
O M W E P I D E M I C E I K K I N Y I R P V
I F A A N T I B I O T I C L F U M U C U S V

On the Web

Health Superstitions (And Other Quacky Ideas)

1. Answers will vary but might include that false advertisement, phony doctors, ignorance (lack of knowledge), and fear can all start a superstition.
2. Answer will vary but might include that people often believe in superstitions because they learned them fom their parents or because they have a health crisis that has made them feel desperate or deprived them of hope.

In the Beat of a Heart

1. As the heart contracts, blood is forced through the blood vessels at a rhythmic rate. All blood vessels have this throbbing motion, but the vessels in the wrist are close to the surface of skin and can be more easily felt.
2. Heart rates vary among people for many reasons. A person's heart, age, health, and/or the amount of physical activity occurring may determine this variance. For an average adult, a pulse rate between 60 and 80 is normal and for children it is about 80 to 140 beats per minute.