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Educational Product	
Educators	Grades 3-5

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The NASA "Why?" Files
The Case of the Inhabitable Habitat

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

In our title, the word inhabitable describes a place (a habitat) in which human beings and other living creatures have what they need to survive.

For human beings and other living creatures on Earth to survive in alien environments such as oceans, deserts, or outer space, the basic requirements for life must exist or be made available. There must be oxygen, water, protective clothing, shelter, and food, to name only a few of the necessities. Habitats created for human, animal, and plant life in outer space or in other, as yet unknown environments, must have the life-supporting essentials that people and other living creatures need for survival.

Scientists are now studying ways to create habitats in space where human beings can live and work. Someday, perhaps people and animals will live on other planets or in underwater cities in the Earth's oceans. Life-sustaining habitats must be created so that we can adapt to environments unlike those of the Earth.

The Case of the Inhabitable Habitat 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 "Why?" Files can be found at the NASA "Why?" Files web site: **http://whyfiles.larc.nasa.gov**

The NASA "Why?" Files
The Case of the
Inhabitable Habitat

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

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For additional information about the NASA "Why?" Files, contact Shannon Ricles at (757) 864-5044 or e-mail **s.s.ricles@larc.nasa.gov**.

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AIAA FOUNDATION Registered users of the NASA "Why?" Files may request an American Institute of Aeronautics and Astronautics (AIAA) classroom mentor. For more information or to request a mentor, e-mail **nasawhyfiles@aiaa.org**.

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Program Overview

In *The Case of the Inhabitable Habitat*, the tree house detectives accept the challenge of designing a habitat that can sustain life on Mars. To design an award winning habitat, the tree house detectives decide that they must first learn more about the planet Mars and the various habitats found here on Earth.

As they begin their investigation, the tree house detectives go to NASA Langley Research Center in Hampton, Virginia to learn more about Mars, the red planet, from Dr. Levine. They also visit Dr. D, a retired science professor, for advice on where to start their habitat research. With his direction, the tree house detectives go on many excursions to speak with various NASA researchers and community experts. They also get a little help from two NASA "Why?" Files Kids Clubs in Houston, Texas and Silver Spring, Maryland.

Kali, one of the tree house detectives, is concerned about the fish in the local bay. They all seem to have disappeared. While conducting their investigation, the tree house detectives use the information they have learned about the basic needs of plants and animals not only to design a very "Martian" habitat, but also to solve the mystery of the missing fish! Along the way, they learn that their "habits" have a big impact on their habitat.

National Geography Standards (grades 3-5)

Standard	Segment 1	Segment 2	Segment 3	Segment 4
The geographically informed person knows and understands				
The World in Spatial Terms				
How to use maps and other graphic representations, tools, and technologies to acquire, process, and report information from a spatial perspective		x		x
Physical Systems				
The physical process that shapes the patterns of Earth's surface	x	x		
The characteristics and spatial distribution of ecosystems on Earth's surface	x	x	x	x
Environment and Society				
How physical systems affect human systems	x	x	x	x
Uses of Geography				
How to apply geography to interpret the past				x
How to apply geography to interpret the present and plan for the future				x

National Science Standards (Grades K – 4)

Standard	Segment 1	Segment 2	Segment 3	Segment 4
Unifying Concepts and Processes				
Systems, orders, and organization	X	X	X	X
Evidence, models, and explanations	X	X	X	X
Evolution and equilibrium			X	X
Form and function	X	X	X	X
Science and Inquiry (Content Standard A)				
Abilities necessary to do scientific inquiry	X	X	X	X
Understandings about scientific inquiry	X	X	X	X
Life Science (Content Standard C)				
Characteristics of organisms	X	X	X	X
Life cycles of organisms		X		X
Organisms and their environments	X	X	X	X
Earth and Space Science (Content Standard D)				
Properties of Earth materials	X	X		
Objects in the sky	X			
Science and Technology (Content Standard E)				
Abilities of technological design	X	X	X	X
Understanding about science and technology	X	X	X	X
Abilities to distinguish between natural objects and objects made by human beings	X	X	X	X
Science in Personal and Social Perspective (Content Standard F)				
Personal health	X	X	X	X
Characteristics and changes in population	X			
Types of resources	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	Segment 2	Segment 3	Segment 4
Unifying Concepts and Processes				
Systems, order, and organization	X	X	X	X
Evidence, models, and explanations	X	X	X	X
Evolution and equilibrium			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 about scientific inquiry	X	X	X	X
Physical Science (Content Standard B)				
Motion and forces			X	X
Life Science (Content Standard C))				
Regulation and behavior	X	X	X	X
Populations and ecosystems	X	X	X	X
Diversity and adaptations of organisms	X	X		
Earth and Space Science (Content Standard D)				
Earth in the solar system	X		X	X
Science and Technology (Content Standard E)				
Abilities of technological design	X	X	X	X
Understanding about science and technology	X	X	X	X
Science in Personal and Social Perspectives (Content Standard F)				
Personal health		X	X	
Populations, resources, and environments				X
Natural hazards			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
History of science			X	

National Mathematics Standards (Grades 3 – 5)

Standard	Segment 1	Segment 2	Segment 3	Segment 4
Geometry				
Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.	x	x	x	x
Use visualization, spatial reasoning, and geometric modeling to solve problems.	x	x	x	x
Measurement				
Understand measurable attributes of objects and the units, systems, and processes of measurement.	x	x	x	x
Apply appropriate techniques, tools, and formulas to determine measurements.	x	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	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	x	x
Problem Solving				
Build new mathematical knowledge through problem solving.	x	x	x	x
Monitor and reflect on the process of mathematical problem solving.	x	x	x	x

National Technology Standards (ITEA Standards for Technology Literacy, Grades 3 – 5)

Standard	Segment 1	Segment 2	Segment 3	Segment 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 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.	x	x	x	x
Standard 5: Students will develop an understanding of the effects of technology on the environment.				x
Standard 6: Students will develop an understanding of the role of society in the development and use of technology.	x	x	x	x
Standard 7: Students will develop an understanding of the influence of technology on history.	x	x	x	x
Design				
Standard 8: Students will develop an understanding of the attributes of design.	x	x	x	x
Standard 9: Students will develop an understanding of engineering design.	x	x	x	x
Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.	x	x	x	x
Abilities for a Technological World				
Standard 11: Students will develop the 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
The Designed World				
Standard 15: Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.		x		
Standard 17: Students will develop an understanding of and be able to select and use information and communication technologies.	x	x	x	x
Standard 20: Students will develop an understanding of and be able to select and use construction technology.	x	x	x	x

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

Standard	Segment 1	Segment 2	Segment 3	Segment 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
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

The NASA "Why?" Files
The Case of the
Inhabitable Habitat

Segment 1

Jacob finds Kali walking along the beach contemplating what has happened to all the fish. They are gone! Jacob is not worried about the fish problem but is excited about a new contest offered by the Young Astronauts Club at school. He wants the tree house detectives to enter the contest because he knows they can win. After all, they are the "tree house detectives!" However, this contest could be a little more difficult than the other contests because they have to build a habitat to sustain human life on Mars. That is not an easy challenge!

The tree house detectives decide they should first find out more about Mars before they begin to design a habitat. They start their investigation with a search of the NASA Langley Research Center's web site and locate Dr. Levine, a Mars expert. Dr. Levine helps the tree house detectives understand that Mars is very different from Earth and they will need to consider many different factors before beginning their design. Dr. Levine also suggests that they might want to learn a little more about habitats.

A vacation retreat planned for the Discovery Cove in Orlando, Florida is the perfect place for the tree house detectives to learn exactly what a habitat is and what "basic needs" are. After speaking with an expert at Discover Cove and swimming with the dolphins, the tree house detectives are sure they understand habitats and are eager to get home to start their project. Armed with their new knowledge, the tree house detectives head to Dr. D's lab where they find out that they just might need to learn a little bit more before they "dive" into the project.

Objectives

The students will
- compare and contrast Earth and Mars.
- understand that organisms have basic needs.
- understand that organisms only survive when needs are met.
- learn how different environments support different organisms.
- understand that animals and plants need to adapt to survive.

Vocabulary

atmosphere - a mass of gases surrounding a heavenly body such as a planet

biome - a complex community of plants and animals living in a particular geographical area with a particular climate

carbon dioxide - a heavy colorless gas that does not support burning, dissolves in water to form carbonic acid, is formed especially by the burning and breaking down of organic substances (as in animal respiration), is absorbed from the air by plants in photosynthesis, and has many industrial uses

environment - all circumstances surrounding an organism or group of organisms. Circumstances may include a whole complex of factors (such as soil, climate, and living things) that influence the form and the ability of a plant, animal, or ecological community to survive

gravity - force of attraction between all objects in the universe

habitat - any place where organisms live, grow, and interact

inhabit - to live in a place

Mars - third planet from the Sun

terrarium - a small enclosure or container, often of glass, used for growing plants or raising small land animals, such as snakes, turtles, or lizards

Video Component

Implementation Strategy

The NASA "Why?" 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 the web site.

Before Viewing

1. Prior to viewing Segment 1 of *The Case of the Inhabitable Habitat*, read the program overview (p. 5) to the students. List and discuss questions and preconceptions that students may have about Mars and habitats.
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 on the web site to assist in the process.

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

   PBL Questions - Questions for students to use while conducting research

   Problem Log - Printable log for students with the stages of the problem-solving process

   The Scientific Method - Chart that describes the scientific method process
3. Focus Questions - Questions at the beginning of each segment help students focus on a reason for viewing. These can be printed from the web site ahead of time for students to copy into their science journals. Encourage students to take notes during the program so they will be able to answer the questions.

View Segment 1 of the Video

For optimal educational benefit, view "The Case of the Inhabitable Habitat" in 15-minute segments and not in its entirety.

After Viewing

1. Have students reflect on the "What's Up?" questions asked at the end of the segment.
2. Students should work in groups or as a class to discuss and list what they know about Mars and habitats. As a class, they should reach a consensus on what additional information they need to know about habitats and Mars before designing a habitat. Have the students conduct independent research or provide students with the information needed. Visit the NASA "Why?" Files web site for an additional list of resources for both students and educators.
3. Have students discuss possible designs for their own Mars habitat.
4. 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 the curriculum. Activities also help students "solve" the problem along with the tree house detectives.
5. Have the students work individually, in pairs, or in small groups on the Problem-Based Learning (PBL) activity on the NASA "Why?" Files web site.
6. To begin the PBL activity, read the scenario to the students.
7. Read and discuss the various roles involved in the investigation. Have each student choose his/her role.
8. Print the criteria for the investigation and distribute.
9. Have students use the Research Rack located on the web site and the online tools that are available.
10. Having students write 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 related to the concepts.
11. The NASA "Why?" Files web site provides teachers with check lists and rubrics that may assist you in assessment.

Careers

Oceanographer
Marine biologist
Fisherman
Zoologist

Resources (additional resources located on web site)

Books

Arnosky, Jim: *Crinkleroot's Guide to Knowing Animal Habitats*. Aladdin Paperbacks, 2000, ISBN: 0689835388.

Davies, Nicola and Nic Davies: *Dolphin: Habitats, Life Cycles, Food Chains, Threats.* Raintree/Steck Vaughn, 2000, ISBN: 0739827669.

Hewitt, Sally: *All Kinds of Habitats (It's Science).* Children's Press, 1999, ISBN: 0516211811.

Paige, David: *A Day in the Life of a Marine Biologist*. Troll Associates, 1981, ISBN: 0893754463.

Ride, Sally and Tam O'Shaughnessy: *The Mystery of Mars.* Crown Publishing, 1999, ISBN: 0517709724.

Sipiera, Paul P.: *I Can Be an Oceanographer.* Children's Press, 1987, ISBN: 0516019058.

Web Sites

Mars Airplane—100 Years of Powered Flight
View photographs of the Martian landscape and learn what future travel will be available when we travel to the planet Mars.
http://marsairplane.larc.nasa.gov/

Mars Team Online—Kids' Corner
Play a Mars memory match, solve a slider puzzle, or create your own Mars pathfinder scale model and much more at this web site.
http://quest.arc.nasa.gov/mars/kids/index.html

Mars Education
Web site that is a useful resource for students, teachers, and parents. Students can download printable images to create your own Mars Pathfinder model and much more.
http://marsnt3.jpl.nasa.gov/education/index.html

Mars
A comprehensive web site with everything you want to know about Mars.
http://www.seds.org/nineplanets/nineplanets/mars.html

SeaWorld™
Whether it's coming face to face with polar bears, feeding dolphins by sunset, or braving the "Great White" coaster, SeaWorld will take you to extremes!
http://seaworld.com/

Science@NASA News Article: Bizarre Boiling
Read how NASA researchers conducted experiments onboard the Space Shuttle to determine the differences between what happens to boiling fluids on Earth and what happens to them in orbit. See a Quicktime™ video of these experiments and more.
http://science.nasa.gov/headlines/y2001/ast07sep_2.htm

Ranger Rick's Kids Zone
Become a junior wildlife expert at the National Wildlife Federation web site. Here kids can learn what is best for wild animals and their environments, journey through wetlands, and learn about endangered species. Explore a habitat with the "Thank a Tree" game and enjoy much more.
http://www.nwf.org/kids/index.html

National Geographic for Kids
Visit Creature Feature and learn about more than 20 different animals while reading facts and watching Quicktime™ videos. Read some pretty amazing facts or laugh at the jokes and tongue twisters in Fun & Games. Go to Family Xpeditions and find printable maps of almost any place on Earth. You can even get help with your homework!
http://www.nationalgeographic.com/kids/

Activities and Worksheets

In the Guide

Earth Versus Mars
Compare and contrast Earth and Mars 15

How Fast Does It Need To Go?
Calculate the time it would take to travel to Mars at various speeds 16

Biomes
Learn about the major biomes of Earth 17

Welcome to My Habitat
Learn about various habitats and create a habitat in a shoebox 18

Don't Burst My Bubble
Create a large bubble habitat for the classroom or home 19

How Does Your Garden Grow
Create a mossy garden in a bottle 20

On the Web

Wish You Were Here!
Create a travel brochure or presentation to attract tourist to Mars

Earth Versus Mars

Problem

To compare and contrast Earth and Mars

Materials

various references on Mars and Earth
science journal
pencil

Procedure

1. Using various books, encyclopedias, and internet sites, fill in the missing information in the data chart.
2. Continue to research and add additional information to the chart or in your science journal.
3. Sort all information into categories.
4. Create a Venn diagram, chart, graph, or other representation to share with the class to show how Earth and Mars are alike and different.

Data Chart

PERTINENT INFORMATION	EARTH	MARS
Distance from Sun in Millions of km	149.6	
Diameter (km)		6,794
Volume (Earth = 1)	1	0.149
Orbital Tilt	23.45	25.19
Average Temperature at Surface	15° C	
Gravity	1	0.38
Length of Year	365 Earth Days	Earth Days
Length of Day	24 Earth Hours	Earth Hours
Number of Moons (Satellites)		

How Fast Does It Need to Go?

Problem

To calculate the time it would take to reach Mars traveling at various speeds

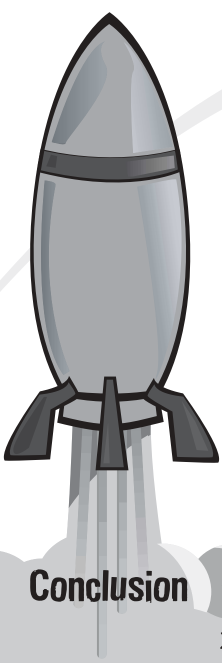
Materials

calculator
pencil

Procedure

1. Mars is approximately 78,000,000 kilometers from Earth.
2. Use a calculator and the formulas in the chart below to determine how long it would take to reach Mars at the various speeds. Be sure to round to the nearest whole number. The first one is done for you.
3. Calculate your age if you traveled to Mars at that speed.

Travel Speed in km per hour (km/h)	Hours	Days	Months	Years	Age on Arrival
	$\frac{\text{Distance}}{\text{Speed}}$	$\frac{\text{Hours}}{24}$	$\frac{\text{Days}}{30}$	$\frac{\text{Month}}{12}$	Years + Your Age
Walking 3.6 km/h	$\frac{78,000,000}{3.6}$ =21,666,667	$\frac{21,666,667}{24}$ = 902,778	$\frac{902,778}{30}$ = 30,093	$\frac{30,093}{12}$ = 2,508	2,508 + 9 = 2, 517
Running 7.5 km/h					
Bicycling 13.2 km/h					
Car 80 km/h					
Jet Airplane 1500 km/h					
Rocket 40,000 km/h					
Space Shuttle _____ km/h					



Conclusion

1. Which forms of travel allow you to reach Mars in your lifetime? ______________________
2. To reach Mars in your lifetime, what would be the minimum speed you could travel? What factors need to be considered? ____
____
____
3. Determine the speed of a space shuttle and calculate.

Biomes

Problem

To learn about the major biomes

Materials

reference books, encyclopedias, or internet web sites
pencil
colored pencils or markers
science journal
various objects needed for presentation

Procedure

1. In your group, research your assigned biome: tundra, grassland, tropical rain forest, coniferous forest, deciduous forest, desert, freshwater, or marine.
2. In your science journal, record the types of plants and animals that live in each biome and describe its important features.
3. Present your biome to the class by illustrating it on construction paper, creating a diorama or Power Point presentation, or any other way you choose.

Extensions

1. On a world map locate the three major forest biomes.
2. Compare and contrast them. Describe the location and climate (temperature and rainfall), and give examples of vegetation, animals, and birds of each.
3. Compare and contrast land biomes to marine or freshwater biomes.
4. Research what makes a desert unique and discuss desertification.

Welcome to My Habitat

Problem

To learn the various plants, animals, and physical characteristics of different habitats

Materials

shoe box with lid
blue cellophane
scissors
crayons or markers
glue
hole-punch (optional)
various materials for chosen habitat

Procedure

1. Determine the type of habitat you will present. It can be any land, freshwater, or saltwater biome.
2. Research the habitat, and in your science journal, list the kinds of plants and animals found in the habitat and its physical characteristics. Make sure you have included all the basic needs.
3. Design your shoe box habitat on paper and make a list of items you will need to collect or bring from home.
4. Carefully cut a rectangular piece from the shoe box lid to create an opening. Tape a piece of blue cellophane over the entire opening. See diagram 1.
5. Using your design and collected items, construct the habitat inside the box. See diagram 2.
6. Using scissors or a hole-punch, punch a small hole in one end of the box to serve as a viewfinder. See diagram 3.
7. Place the lid on your habitat and look through the viewfinder.
8. Share your habitat with the class.

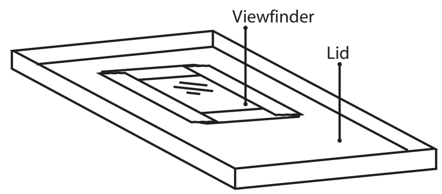


Diagram 1

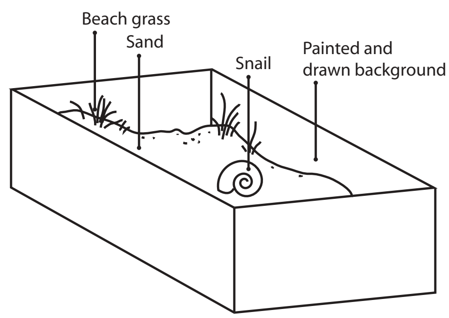


Diagram 2

Extensions

1. Before sharing as a class, have students observe the other students' habitats and guess which habitat was illustrated.
2. Use large refrigerator size boxes to create a large habitat. Have each member of the group act as a ranger or ecology tour guide to explain one specific aspect of the habitat, such as the animal life, plant life, or characteristics. Invite other classes or parents for tours.

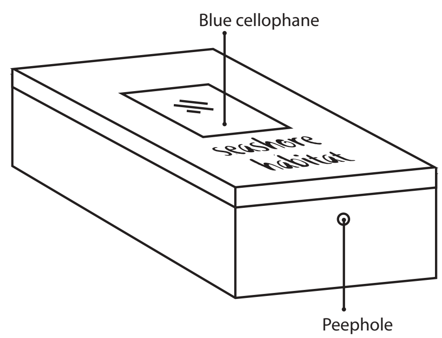


Diagram 3

Don't Burst My Bubble

Problem

To create a large classroom habitat

Procedure

To make the biome bubble:

1. Fold tarp in half, lining up the sides as evenly as possible.
2. Using strong tape, such as duct tape, tape the two pieces of tarp together on both shorter sides of the tarp. See diagram 1.
3. On the longer side of the tarp, leave an opening large enough to fit the box fan plus 1-meter. See diagram 2.
4. Place box fan at the far left of the opening in the tarp so that the air from the fan is blowing into the bubble. See diagram 3.
5. Tape the top layer of the tarp to the top of the box fan.

To create the habitat:

1. Have the class decide which habitat they would like to create.
2. Divide the class into groups to research the various aspects of the habitat. One group might be assigned to plants, another to animals, and so on.
3. Have the students artistically create the plants, animals, and physical characteristics of the habitat.
4. Use the fan to blow up the bubble and either have the students or the teacher place the plants, animals, and other items created in the bubble. Use tape and/or string to suspend items from the top of the bubble.
5. Invite other classes or parents to tour your habitat.

Extension

1. Use this large habitat to discuss and show how basic needs are met within a habitat.
2. Create a Martian habitat bubble!
3. Create a "hallway" habitat. Invite other classes to join you, with each class creating a different habitat.

Materials

large, clear, thick, plastic tarp
strong tape
box fan
various art supplies
tape
string
hole punch

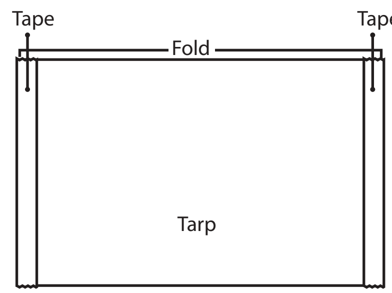


Diagram 1

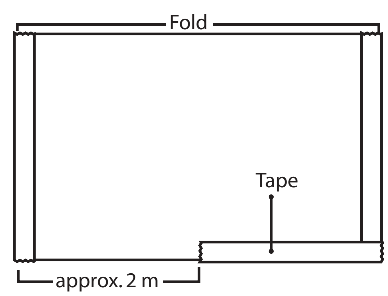


Diagram 2

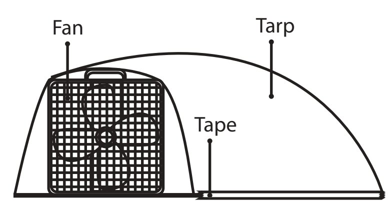


Diagram 3

How Does Your Garden Grow?

Problem

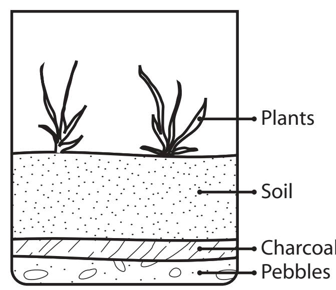
To create a mossy garden in a bottle

Materials

large, wide-mouthed bottle
small pebbles (about a 1/2 cup)
charcoal (about 1/2 cup)
peat-based potting soil
different types of moss, ferns, or lichens
1 cup of water
big spoon
spray bottle with water

Procedure

1. In the bottom of the large bottle, spread a layer of pebbles.
2. Cover the pebbles with a layer of charcoal.
3. Cover the top of the charcoal with about a 10-cm layer of potting soil.
4. Press the soil down with either the spoon or your hand.
5. Using the spoon, dig a small hole for the first plant.
6. Gently place the plant into the bottle and cover the plant's roots with soil. Press the soil down firmly around the plant.
7. Repeat with the remaining plants arranging them attractively in the bottle.
8. Carefully pour a cup of water into the bottle.
9. Leave the bottle open and place it in a cool place where the light is good but not too bright. Avoid direct sunlight.
10. If you want, after there are no more drops of water on the inside of the glass, you can put a top on your bottle.
11. Care of your garden is minimal. Just spray it with water occasionally to keep the soil moist and snip off any dead leaves with a small pair of scissors.
12. Watch the ferns and mosses to see how they grow or change. Look for tiny spores or grass-like stems to see how they reproduce.



Answer Key

How Fast Do You Need to Go?

Travel Speed in km per hour (km/h)	Hours	Days	Months	Years	Age on Arrival
	Distance / Speed	Hours / 24	Days / 30	Month / 12	Years + Your Age
Walking 3.6 km/h	78,000,000 / 3.6 =21,666,667	21,666,667 / 24 = 902,778	902,778 / 30 = 30,093	30,093 / 12 = 2,508	2,508 + 9 = 2, 517
Running 7.5 km/h	10,400,000	433,333	14,444	1,204	
Bicycling 13.2 km/h	5,909,091	246,212	8,207	684	
Car 80 km/h	975,000	40,625	1,354	113	
Jet Airplane 1500 km/h	52,000	2,167	72	6	
Rocket 40,000 km/h	1,950	81	3	0.25 or 1/4 of a year	
Space Shuttle 29,000 km/h	2,690	112	4	0.33 or 1/3 of a year	

1. You could best reach Mars in your lifetime by traveling on a rocket or space shuttle. A jet airplane could travel to Mars in only 6 years, but it is not equipped for space travel.
2. If an average life span is about 80 years, and a student is about 10 years old, the sudent could travel at a minimum speed of around 150 km/h. Some factors for a traveler to consider would be how many supplies to carry for that length of time and whether the traveler would be in good health upon arrival. Would the traveler be able to conduct experiments?
3. See table above.

The NASA "Why?" Files
The Case of the
Inhabitable Habitat

Segment 2

The tree house detectives find that they may not be able to take as much food to Mars as they had planned and going hungry is definitely not in the plan. To make sure they will have enough food and to help the tree house detectives solve the fish problem, they set out to learn more about the food web and food chain by visiting Ranger Kertesz at Sandy Bottom Nature Park in Hampton, Virginia. The next step in solving their food problem is to speak with NASA researcher, John Gruener at Johnson Space Center in Houston, Texas. Mr. Gruener shows the tree house detectives how NASA is solving the problem of growing plants in space! Mr. Gruener directs the tree house detectives to Mrs. Schwartz's classroom in Silver Spring, Maryland to learn why students across the country grew "control" plants to help NASA researchers.

Objectives

The students will

- learn that there is an intricate relationship among all organisms and their environment.
- understand the relationship between the food chain and food web.
- understand the relationship between producers, consumers, and decomposers.
- learn that the Sun is the main source of energy for all ecosystems.
- learn how plants are grown in a controlled environment to help create a bioregenerative life support system.

Vocabulary

bioregenerative life support system - a fully self-contained system that would wed people, plants, microbes, and machines into a miniature "ecosystem" capable of supporting space travelers indefinitely

carnivore - an organism that eats other animals

consumer - an organism, usually an animal, that feeds on another organism

decomposer - an organism (a bacterium or a fungus) that lives on and breaks down dead organisms into simpler substances

food chain - a representation of a series of events in which food energy and matter are transferred from one organism to another

food web - the whole group of interacting food chains in an ecological community

herbivore - an organism that feeds mostly on plants

nutrients - a substance that promotes growth

omnivore - an organism that feeds on both plant and animal substances

organism - an individual living thing that carries on the activities of life by means of organs that have separate functions but are dependent on each other: a living person, plant, or animal

photosynthesis - the process by which plants that contain chlorophyll make carbohydrates from water and from carbon dioxide in the air in the presence of light

prey - an animal hunted or killed by another animal for food

predator - an animal that lives by killing and eating other animals

producer - an organism that is able to make its own food by using a source of energy to turn simple raw materials into food; source of all food in an ecosystem

respiration - the physical and chemical processes (such as breathing and oxidation) by which a living thing obtains the oxygen it needs to produce energy and eliminates waste gases (such as carbon dioxide)

transpiration - the process by which green plants give off water vapor through the stomata in their leaves

Video Component

Implementation Strategy

The NASA "Why?" 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 Inhabitable Habitat*, 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 "Why?" Files web site and have students use it to sort the information learned thus 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 student's 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 during the show to answer the questions.

Careers

geologist
dietician
teacher
park ranger
forester
conservationist
botanist
biologist

View Segment 2 of the Video

For optimal educational benefit, view *The Case of the Inhabitable Habitat* 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. Lead students to reflect on the "What's Up?" questions asked at the end of the segment.
2. Have students work in small groups or as a class to discuss and list what new information they have learned about Mars and habitats. Organize the information and determine if any of the students' questions from Segment 1 were answered. Decide what additional information is needed for the tree house detectives to continue designing their habitat for Mars. Have students conduct independent research or provide students with information as needed. Visit the NASA "Why?" Files web site for an additional list of resources for both students and educators.
3. If students are designing their own Mars habitat, have them share their preliminary designs and ask the class to comment on each design by asking questions and offering suggestions.
4. Choose activities from the educator guide and web site to reinforce the 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.
5. If time did not permit you to begin the web activity at the conclusion of Segment 1, refer to number 5 under "After Viewing" on page 13 and begin the problem-based learning activity on the NASA "Why?" Files web site. If the web activity was begun, monitor students as they research within their selected role, 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
   Dr. D's Lab - interactive activities and simulations
   Media Zone - interviews with experts from this segment
6. Have students write in their journal what they have learned from this segment and their own experimentation and research. If needed, give students specific questions to reflect upon.
7. Continue to assess the students' learning, as appropriate, by using their journal writings, checklists, rubrics, and other tools that can be found at the NASA "Why?" Files web site in the "Tools" section of the educators' area.

Resources

Books

Burnie, David and Paul Burne: *Eyewitness: Plant.* DK Publishing, 2000, ISBN: 0789458128.

Fleischman, Paul: *Weslandia*. Candlewick Press, 1999, ISBN: 0763600067.

Relf, Patricia: *The Magic School Bus Hops Home: A Book About Animal Habitats*. Scholastic Trade, 1995, ISBN: 0590484133.

Smith, Sue, and Miriam Katin: *Exploring Saltwater Habitats (Exploring Habitats).* Mondo Pub, 1995, ISBN: 1879531321.

Wilkes, Angela: *My First Nature Book.* Alfred A. Knopf, 1990, ISBN: 039486610.

Wroble, Lisa A.: *The Oceans (Endangered Animals & Habitats).* Lucent Books, 1998, ISBN: 1560064641.

Web Sites

United States Environmental Protection Agency
Kids are invited to explore their environment, learn about recycling, discover the missing ozone, and much more. Includes a teacher and student resource section.
http://www.epa.gov/kids/index.htm

NASA's Classroom for the Future, Exploring the Environment
This web site provides tools to help teachers make students more environmentally aware and to acquire the values and attitudes necessary for sustainable development. Modules encourage collaborative groups of students to conduct research in environmental areas and to generate products that demonstrate understanding.
http://www.cotf.edu/ete/

Leafy Green Astronauts
Read how NASA researchers are learning to grow plants in space and how these far-out crops will eventually take their place alongside people, microbes, and machines in self-contained habitats for astronauts.
http://science.nasa.gov/headlines/y2001/ast09apr_1.htm

Teaming Up on Space Plants
Learn how students, NASA researchers, and astronauts are teaming up to learn more about how plants grow in space.
http://science.nasa.gov/headlines/y2001/ast10may_1.htm

Children of the Earth United - Planet Earth Education
Learn about animals, plants, ecology, nature centers, and more. This site provides a forum for people to share their ideas and knowledge of the environment.
http://www.childrenoftheearth.org/

MaJa's Rain Forest Kid's Page
Visit MaJa's Rain Forest at the San Antonio Botanical Garden web site. Learn how to make your own terrarium, view some weird plants, or plant a seed and discover what happens.
http://www.sabot.org/kids/

The Monterey Bay Aquarium—Splash Zone
This site is loaded with cool pictures, activities, and even music. Learn about various marine life and different ocean habitats. Create your own tide pool and add sea creatures that become animated if they are correctly placed. While enjoying this cool site, you will also learn about careers in marine science.
http://www.mbayaq.org/efc/efc_se/se_sz.asp

National Park Service: Smokey the Bear
Discover the only American hero with his own zip code. Learn what you can do to help protect our forest environments. Discover the history of Smokey the Bear while exploring links for games, songs, junior forest ranger programs, and much more.
http://www.smokeybearstore.com/national_park_service.htm

Activities and Worksheets

In the Guide

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Simulate the interaction and relationship among organisms and their envrionments . . 28

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A crossword puzzle activity 30

Chain Reaction
Learn how a change in populations can affect the food web 31

Sprouts to Grow
Activity that shows how plants compete to grow and survive 32

Answer Key
. . . . 33

On the Web

Plot Your Population
Activity to observe a plot of land and count the number of organisms

How Are We Related?

Materials

index cards (1 per student)
large ball of yarn or string
hole punch
50-60 cm of string per student

Problem

To simulate the interaction and relationship among organisms and their environment

Procedure

1. Choose something from the environment such as the sun, grass, soil, worm, bird, coyote, or so on, and write it on your index card. Do not duplicate items.
2. Punch holes in the top left and right corners of the index card.
3. Tie one end of the string into each hole punched. See diagram 1.
4. Place your name card around your neck.
5. In a large open area, stand in a circle so that everyone can see your name card.
6. Have one student hold the ball of yarn by the end of the string and pass the ball of yarn to another student that he/she is related to. Explain the relationship. For example: I am a bird and I eat the worm. The worm might then say, "I need soil to live in," and he/she would pass the ball to the soil.
7. Continue until all relationships have been exhausted. You may have had the ball of yarn passed to you several times.
8. Have one student drop his/her yarn and see what happens to the web.
9. Discuss how organisms and the environment relate.

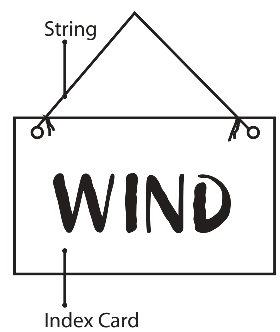
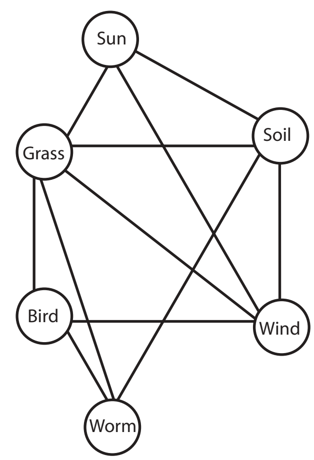


Diagram 1



Conclusion

1. How will removing one part of the environment affect the other parts? ________________________________
____
____
2. What part(s) of the environment seem to be the most important for maintaining the relationships in the circle? ________________________________
____
____
3. Describe important factors to consider when creating a habitat for Mars. What part of a new habitat would be the most important for maintaining an environment that would meet the basic needs of humans on Mars? ________________________________
____
____
____
____

A Community Connected

Problem To understand how producers, consumers, and decomposer are related

Think about the community in which you live and complete the chart below with as many producers, consumers, and decomposers as possible.

PRODUCERS	CONSUMERS			
	Herbivores	Carnivores	Omnivores	Decomposers

1. Using the organisms you have listed, illustrate several food chains.
2. Using all the organisms listed, describe and illustrate a food web.
3. Discuss and explain how the food chain would work in a habitat on Mars. Make a list of producers, consumers, and decomposers you would need in your habitat.

Who Am I?

Word Bank

prey
consumer
decomposer
herbivore
predator
producer
carnivore
omnivore

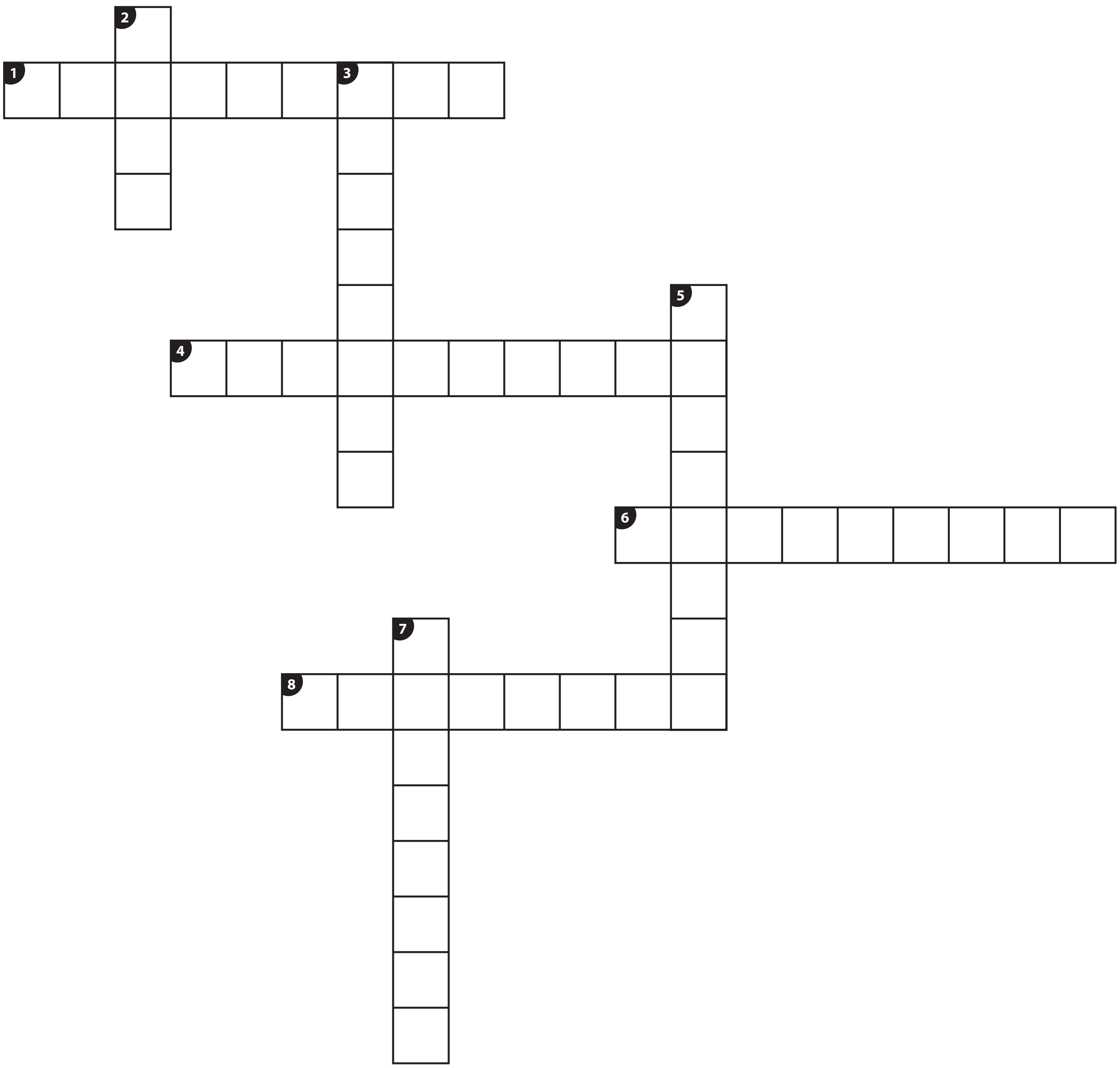
Complete the crossword puzzle by using words from the word bank:

Across:

1. I am a vegetarian.
4. I change dead plants and animals into soil.
6. I prefer to eat animals.
8. I can make my own food.

Down:

2. I try to keep from being eaten.
3. I'm not fussy. I eat anything!
5. I hunt my food.
7. I never make my own food.



Chain Reaction

Problem

To understand how a change in a population within a food web can have widespread effects on the other populations there

Materials

scissors
string or yarn
population cards

Procedure

1. Using scissors, cut out the Sun and population cards.
2. Cut twenty 15-cm pieces of string or yarn.
3. Place the Sun card at the top and arrange the plant cards in a row.
4. Use a piece of string to link each plant card to the Sun card.
5. Use two pieces of string to link one herbivore to two plants.
6. Use two pieces of string to link a carnivore to two herbivores.
7. In your science journal, draw your final arrangement.
8. Half the plant population has been destroyed by fire. Remove four plant cards.
9. Rearrange the web so that all the animals have a food source. Remember that it takes two plants to feed one herbivore and two herbivores to feed one carnivore.
10. If you have extra cards, remove them when they represent organisms that have died out.
11. In your science journal, draw the new arrangement.

Conclusion

1. Describe the shape of the beginning and ending food web.
2. Which organisms were affected by the destruction of the plants? Why?
3. Explain how the destruction of a "crop" would affect astronauts living in a Martian habitat.
4. List and describe examples of other ways that populations are destroyed or affected.

Population Cards

Sun			
Plant	Plant	Plant	Plant
Plant	Plant	Plant	Plant
Herbivore	Herbivore	Herbivore	Herbivore
Carnivore	Carnivore		

Sprouts to Grow

Problem

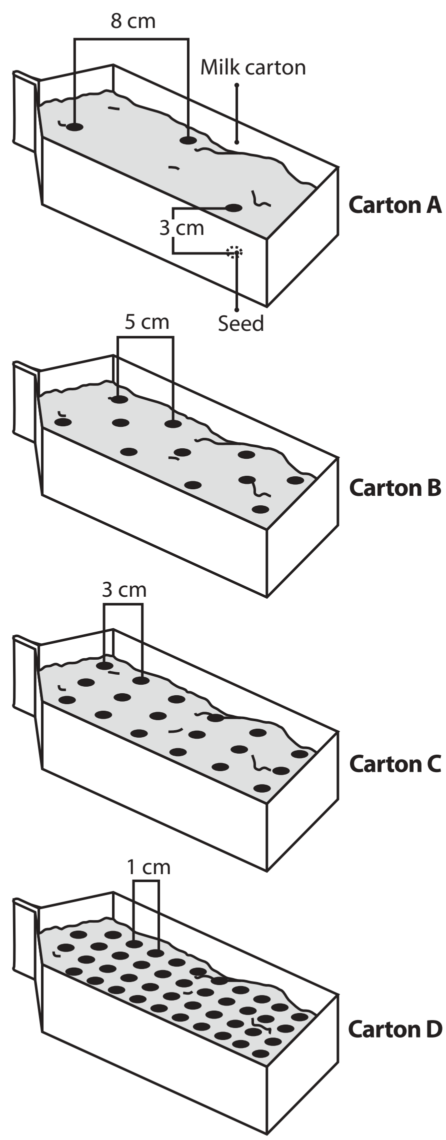
To learn how different degrees of competition among plants affect their growth and survival

Materials

4 clean half-gallon milk cartons
dried beans
soil
large plastic or foil tray
scissors
marker
metric ruler
science journal
spray bottle (optional)

Procedure

1. Using the scissors, cut off the spout side of each milk carton.
2. On the opposite side, use the scissors to punch three or four small holes for drainage.
3. Using the marker, label each carton A, B, C, or D.
4. Fill each carton about two-thirds full of soil.
5. In carton A, use your finger to poke holes in the soil about 3 cm deep and 8 cm apart.
6. Place a bean in each hole and cover gently with soil.
7. Repeat steps 4-5 with the remaining cartons, setting holes as specified.
8. Carton B: 3 cm deep and 5 cm apart
9. Carton C: 3 cm deep and 3 cm apart
10. Carton D: 3 cm deep and 1 cm apart
11. Place the cartons on a large tray and put the tray in a sunny space.
12. Water the soil carefully. Use a spray bottle to help keep from disturbing the beans. The soil should be moist but not soaking wet.
13. Observe the cartons daily and record your observations in your science journal.
14. Once the plants begin to sprout, choose three plants from each carton and measure their height daily. Record in your science journal.
15. At the end of a set time period, such as one month, take an average height of the plants in each carton. Create a graph.
16. Share your data with other groups/students and take a class average for each carton. Create a graph.



Conclusion

1. Did the seeds sprout at the same time? Why or why not?
2. Did the seedlings grow at the same rate? Why or why not?
3. Did the seedlings grow better in some cartons than in others? Why or why not?
4. Using what you learned in this activity, explain why gardeners have to "thin out" seedlings.
5. What effect would weeds have on a garden?
6. Why would NASA researchers need to find the best spacing for plants in a garden on Mars?

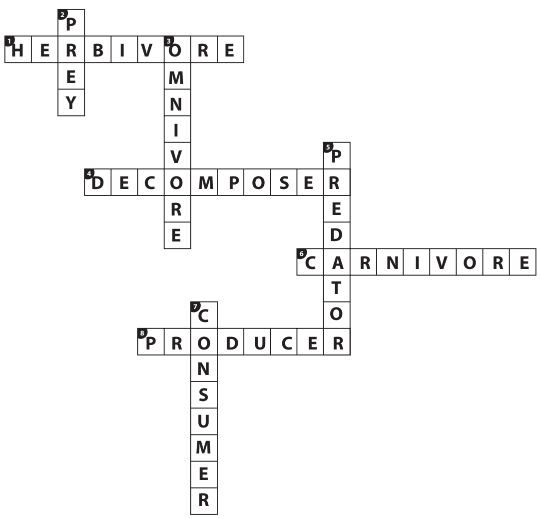
Answer Key

IN THE GUIDE

How Are We Related?

1. When you move one part of the environment, it causes other parts to collapse.
2. Answers will vary.
3. Answers will vary, but they should include factors that would meet the basic needs of human beings: food, air, water, and shelter.

Who Am I?



Chain Reaction

1. The shape of the beginning and ending food web is an upside down pyramid (or triangle).
2. Both the herbivores and the carnivores were affected by the destruction of the plants. When the plants died, the herbivores no longer had enough food to eat; therefore, some of them had to die. With fewer herbivores, the carnivores did not have enough to eat and some of them died.
3. Astronauts living on Mars would be very dependent on the food grown on Mars. If a crop failed, they might not survive. There would be no way for the astronauts to get more food because Earth is a long way away and there are no stores on Mars!
4. Answers will vary but might include such things as pollution, human settlements, destruction of the rain forests, irrigation of desert areas, and so on.

Sprouts to Grow

1. Most seeds will not sprout at the same time.
2. Not all seedlings will grow at the same rate.
3. The cartons with the fewest number of seeds should grow taller and healthier seedlings because there is less competition for the water, nutrients in the soil, and sunlight.
4. Gardeners need to thin out seedlings so that they can have strong healthy plants.
5. Weeds would compete for the nutrients in the soil, water, and light. This competition would make the plants in the garden not grow as well.
6. On Mars, there would be very limited space for gardens; therefore, researchers would need to know the least amount of space that can be placed between plants and still ensure healthy, productive plants.

ON THE WEB

Plot Your Population

1. Answers will vary with area examined.
2. Answers will vary.
3. Some factors that over time could affect the number of plants and animals in a given plot are rain, temperature, destruction by fire, insect invasion, fertilizer, and human development.

The NASA "Why?" Files
The Case of the
Inhabitable Habitat

Segment 3

Believing that they have finally found the solution to their habitat food problem, the tree house detectives begin to wonder if it is difficult to adapt to living in space. They visit Dr. D who helps them understand that organisms are constantly changing and adapting to their environment, and that it is not always as easy as it seems. The tree house detectives talk with Dominic Del Rosso at NASA Johnson Space Center to learn how astronauts use the KC-135, sometimes known as the Vomit Comet, to help them learn how to adapt to a space environment. Intrigued to know more about how and why astronauts train to work and live in space, the tree house detectives visit Anthony Uttley at the Sonny Carter Training Facility/Neutral Buoyancy Laboratory in Houston, Texas. Amazed at the intense training the astronauts go through, the tree house detectives decide that they might need to know a little more about the space suit that enables the astronauts to work in space. Amy Ross, at NASA Johnson Space Center, explains all the components that an astronaut must wear, even the MAG, maximum absorbency garment!

Objectives

The students will

- learn that gravity is a force that holds objects to the Earth's surface.
- learn that all organisms must be able to obtain and use resources, grow, and maintain stable internal conditions while living in a constantly changing external environment.
- understand that all organisms have unique adaptations to help them live in their environment.
- understand that regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required to survive.
- learn that behavior is one kind of response an organism can make to an internal or environmental stimulus.
- learn that human beings depend on their natural and constructed environments.

Vocabulary

adapt - to slowly evolve or change to fit the environment

adaptation - features of organisms that arise over time and enable the organisms to survive in a given environment

altitude - the vertical distance of an object above a given level (such as sea level)

elevation - the height above sea level

gravity - the mutual force of attraction between objects

neutral buoyancy - an object has the same tendency to sink as it does to float

orbital debris - small particles of matter that orbit the Earth

parabola - a plane curve formed by a point moving so that its distance from a fixed point is equal to its distance from a fixed line

sea level - the height of the surface of the sea midway between the average high and low tides

weightlessness - lacking apparent gravitational pull

Video Component

Implementation Strategy

The NASA "Why?" 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 Inhabitable Habitat,* 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 "Why?" Files web site and have students use it to sort the information learned thus 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 student's own research.
3. Revise and correct any misconceptions that may have been dispelled during Segment 2. Use tools located on the web, as 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 show to answer the questions.

View Segment 3 of the Video

For optimal educational benefit, view *The Case of the Inhabitable Habitat* in 15-minute segments and not in its entirety.

After Viewing

1. Lead students to reflect on the "What's Up?" questions asked at the end of the segment.
2. Have students work in small groups or as a class to discuss and list what new information they

have learned about Mars and habitats. Organize the information and determine if any of the students' questions from Segment 2 were answered. Decide what additional information is needed for the tree house detectives to continue designing their habitat for Mars. Have students conduct independent research or provide students with information as needed. Visit the NASA "Why?" Files web site for an additional list of resources for both students and educators.

Careers

pilot
diver
astronaut
payload specialist
engineer
space suit designer

3. If students are designing their own Mars habitat, have them share their designs thus far and have the class comment on each design by asking questions and offering suggestions.
4. Choose activities from the educator guide and web site to reinforce the concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced and use activities to aid students' understanding in those areas.
5. If time did not permit you to begin the web activity at the conclusion of Segment 1 or 2, refer to number 5 under "After Viewing" on page 13 and begin the Problem-Based Learning activity on the NASA "Why?" Files web site. If the web activity was begun, monitor students as they research within their selected role, 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

   Dr. D's Lab - interactive activities and simulations

   Media Zone - interviews with experts from this segment
6. Have students write in their journal what they have learned from this segment and their own experimentation and research. If needed, give students specific questions to reflect upon.
7. Continue to assess the students' learning, as appropriate by using their journal writings, checklists, rubrics, and other tools that can be found at the NASA "Why?" Files web site in the "Tools" section of the educators' area.

Resources

Books

Hare, Tony: *Animal Habitats: Discovering How Animals Live in the Wild.* Checkmark Book Publishing, 2001, ISBN: 0816045941.

Kozloski, Lillian: *US Space Gear: Outfitting the Astronauts.* Smithsonian Institute, 1994, ISBN: 087474598.

Center for Marine Conservation: *The Ocean Book: Aquarium and Seaside Activities and Ideas for All Ages.* John Wiley & Sons, 1989, ISBN: 0471620785.

Web Sites

Wardrobe for Space
See the latest fashions astronauts wear and learn why space suits are a must if you leave Earth's atmosphere!
http://www.jsc.nasa.gov/pao/factsheets/nasapubs/wardrobe.html

NASA Student Glove Box
Create a glove box to use in the classroom with this NASA Educator Guide. The guide contains instructions for assembly, information about the parts and their functions, as well as a lesson plan for an inquiry-based activity. Artwork for this guide can be obtained for a nominal fee through NASA CORE <http://core.nasa.gov>
http://spacelink.nasa.gov/Instructional.Materials/NASA.Educational.Products/NASA.Student.Glovebox/Student.Glovebox.pdf

Send Your Name to Mars
NASA invites you to send your name to Mars on the next Mars Exploration Rover 2003 mission. The project is for people of all ages and is free!
http://spacekids.hq.nasa.gov/2003/

Living in Space
This section of NASA's Human Space Flight Web site includes information on how astronauts eat, sleep, work, and play in space.
http://spaceflight.nasa.gov/living/index.htm

How Stuff Works: How Weightlessness Works
Learn how the human body responds to weightlessness and how astronauts train to overcome many side effects of microgravity.
http://www.howstuffworks.com/weightlessness.htm

How Stuff Works: How Space Suits Work
Great site that takes an in-depth look at past, present, and future space suits, how they work, and what components create the ultimate space suit.
http://www.howstuffworks.com/space-suit.htm

Activities and Worksheets

In the Guide

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Animal Adaptations
A game to learn how animals adapt to their environment

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Design a unique animal with adaptations that will enable it to survive in a specific environment

All You Do Is Train!
Research how people train to live in harsh environments and develop your own training plan

Creating Microgravity
Try this experiment to better understand microgravity

Newton Would Have Understood the GRAVITY of the Situation

Mass is a measure of the amount of matter in an object, and it depends on the number and kinds of atoms that make up an object. Weight is a term that is sometimes used (incorrectly) interchangeably for mass, but weight is actually a measure of gravitational force on a given mass. Gravitational force is an attractive force that exists between all objects with mass and will vary depending on the mass and distance between objects. The gravitational attraction weakens with greater distance and increases with greater mass. For example, the Moon has much less mass than the Earth, so the Moon has less gravity than the Earth at its surface. A scale measures the force of Earth's gravitational pull on your mass. If you were to weigh yourself on the Moon, the scale would read less than it does on Earth.

To determine your weight when visiting a neighboring planet or the Moon, multiply your current weight in pounds rounded to the nearest 10 by the gravity on each planet.

PLANET	GRAVITY	YOUR WEIGHT
Mercury	0.39	
Venus	0.91	
Earth	1.00	
Earth's Moon	0.16	
Mars	0.38	
Jupiter	2.60	
Saturn	1.07	
Uranus	0.90	
Neptune	1.15	
Pluto	0.05	

Conclusion

1. On which planet did you weigh the least? ________________ the most? ___________________
2. How would knowing the gravity of a planet benefit astronauts before they visit the planet?

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Leaf the Wax On

Problem

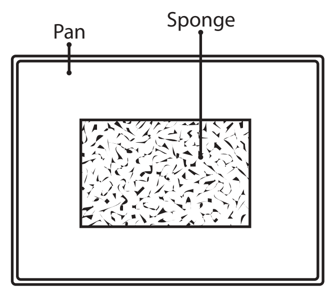
To learn how some coniferous trees adapt to a dry season

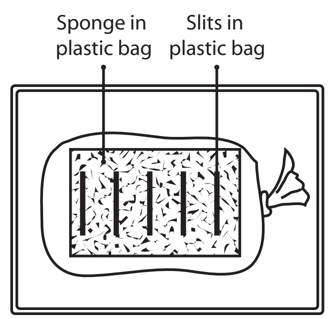
Materials

various leaves from deciduous and coniferous trees
2 sponges
water
plastic bag
scissors
2 shallow pans
science journal

Procedure

1. Observe various leaves from deciduous trees (trees that lose their leaves each winter). Record your observations in your science journal.
2. Observe various leaves from coniferous trees (trees that stay green all year). Record your observations in your science journal.
3. Using your observations, compare and contrast the deciduous and coniferous leaves.
4. To simulate how leaves adapt to a dry environment, perform the following activity. The sponge represents leaves, and the bag represents a waxy coating found on some leaves.
5. Using the scissors, make five small cuts in the plastic bag.
6. Soak each sponge in water and put one sponge in the plastic bag.
7. To seal the bag, tie a knot in the end.
8. Place the bag with cut side up in a shallow pan.
9. Place the uncovered sponge in the other shallow pan.
10. Put both pans in a sunny, warm place.
11. Predict what you think will happen to each sponge after 24 and 48 hours and record in the chart below.
12. Check the sponges each day for three days and record your observations in the chart below.





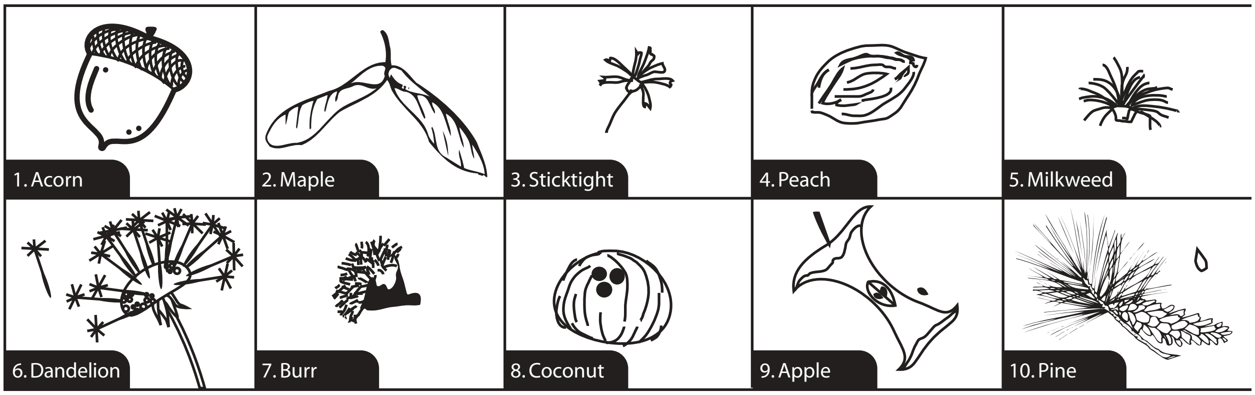
Conclusion

1. Which sponge lost the least amount of water? Why?
2. How might leaves with a wax covering help plants adapt to a dry environment?
3. In your observations of leaves from deciduous and coniferous trees, which ones had a waxy covering?
4. Conduct research to determine which season of the year is the driest, and then explain why coniferous trees might benefit from a waxy covering.

	Prediction 24 hours	Observations 24 hours	Prediction 48 hours	Observations 48 hours
Sponge in Bag				
Uncovered Sponge				

Have Seed Will Travel

Over time, living things make adaptations to survive in their surroundings. If all seeds from a plant fell under the same plant from which they grew, the area would become too crowded and many would not survive. Study the pictures of the seeds below and notice the shapes of the seeds. Think about how the adapted shapes of the seeds might help them to find a new place to grow. List possible ways each seed might travel by using its adaptation. The first one is done for you.



1. acorn an acorn has a hard outer coating that helps it "keep" for a long time. It also tastes good to a squirrel, and squirrels bury acorns in the ground. Lots of times they forget where they buried them, and then the acorn will sprout into a new tree in the spring.

2. maple ______________________________

3. sticktight ______________________________

4. peach ______________________________

5. milkweed ______________________________

6. dandelion ______________________________

7. burr ______________________________

8. coconut ______________________________

9. apple ______________________________

10. pine ______________________________

Star Training

Problem

To learn how difficult it is to adapt to a foreign environment

Procedure

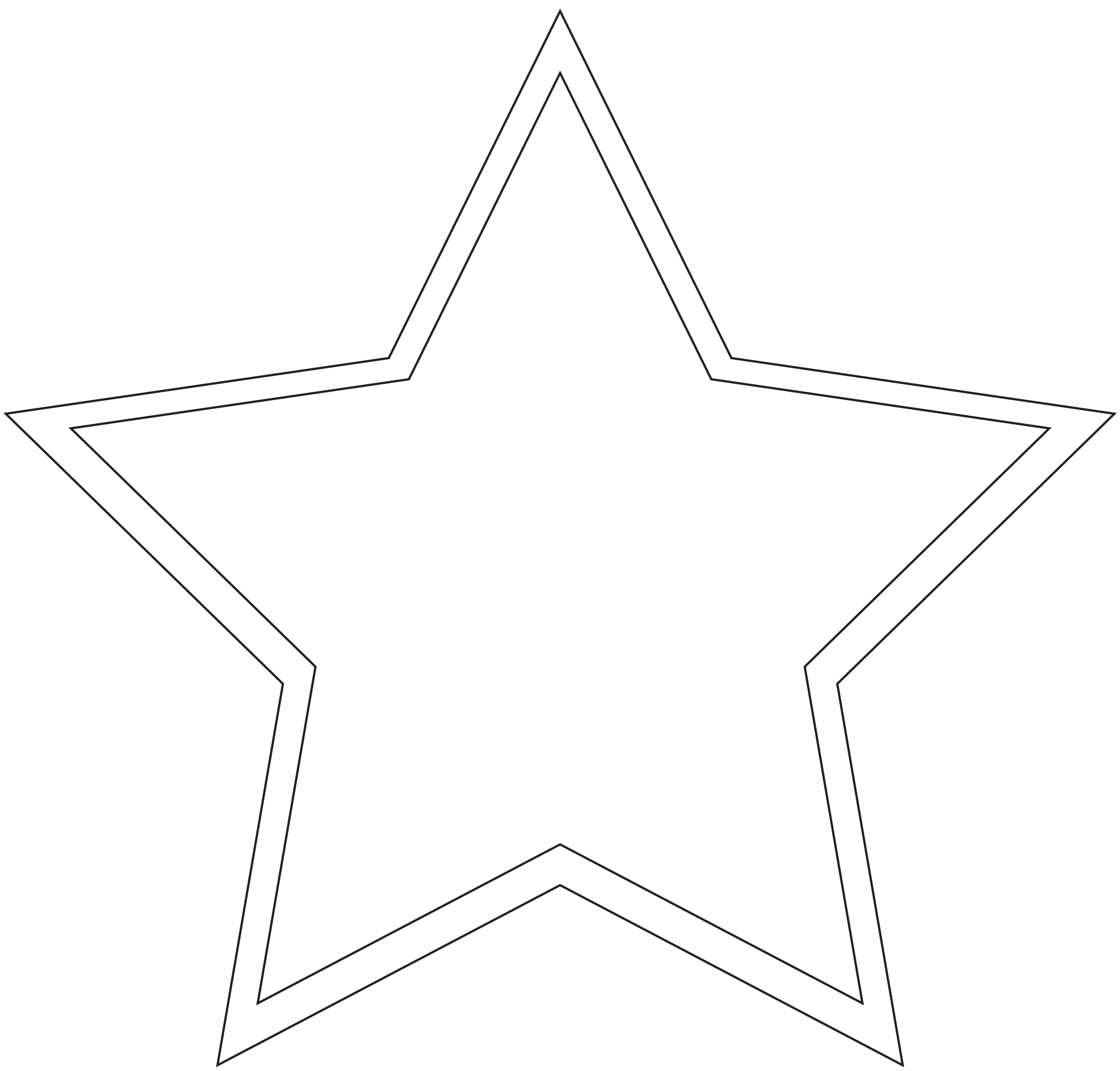
1. Hold the mirror next to the star so that you can see the reflection of the star in the mirror.
2. Take a pencil and try to trace the star by only using the mirror to guide you. Don’t look at the paper or your hand.
3. After everyone has had a turn trying to trace the star, discuss what was difficult and what was easy about this exercise.

Materials

small hand-held mirror
pencil

Conclusion

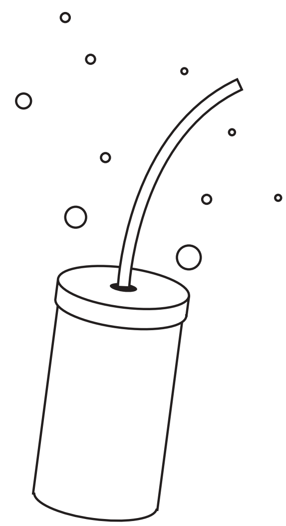
1. Would you get better with practice?
2. Discuss why it is important for astronauts to train and practice their space “work” for many months before going on a mission.



Float or Sink? Neutral Buoyancy

Astronauts simulate microgravity for space suit training in a deep swimming pool (the Sonny Carter Training Facility/Neutral Buoyancy Laboratory). Their space suits are specially weighted to produce neutral buoyancy. Use the two activities below to investigate neutral buoyancy.

Dive, Dive, Dive!



Materials

plastic film canister (submarine)
aquarium tubing
pennies
hot glue (adult supervision required)
scissors or sharp, pointed item (adult supervision required)
large bowl, sink, or aquarium full of water

1. With adult supervision, use the scissors to punch two holes in the base of the canister and a hole in the lid.
2. Have an adult hot glue one end of the aquarium tube into the hole in the lid.
3. Add several pennies to the canister and check to see if the canister floats in the water. If not, take a penny out and test the canister again.
4. Place the lid on the canister and put your submarine into the water.
5. Suck the air out of the tube and observe. What happened? Why?
6. Blow air into the canister and observe. What happened? Why?
7. Try to fill the canister with just enough air so that it can "hover" halfway from the bottom to the surface.

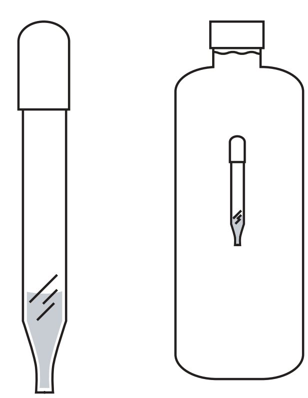
Diver, Stand Your Mark

Materials

plastic 2-liter soft drink bottle
water
eyedropper (diver)

1. Fill the bottle with water.
2. Fill the eyedropper about 2/3 full of water.
3. Insert the partially filled eyedropper into the bottle and cap the bottle.
4. Squeeze the bottle's sides and observe the diver. What happened? Why?
5. Let go of the bottle and observe. What happened? Why?
6. Try to make the diver "hover" midway in the bottle.

   *Note: The diver may not dive if filled with too much water. Adjust the amount of water in the diver for success.



Vomit Comet

Materials

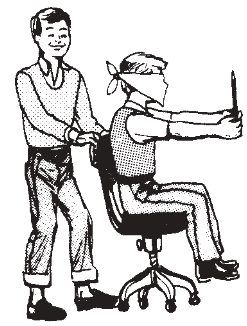
swivel chair
blindfold
pencil

Problem

To learn that motion can cause disorientation
To understand why astronauts train to live and work in space

Procedure

1. Have your partner sit in the swivel chair and put on a blindfold.
2. Ask your partner to place his arms out in front of his/her body while holding a pencil in an upright position. See the diagram.
3. Have your partner point the pencil in the direction of rotation as you turn the chair.
4. Observe the pencil.
5. Slowly stop the chair and then turn it in the opposite direction.
6. Observe the pencil.
7. Repeat steps 3-5, turning the chair in the opposite direction.
8. Remove the blindfold and let your partner sit for a few minutes to regain orientation.
9. Change places with your partner and repeat the experiment.



Conclusion

1. In what direction did your partner point the pencil after the first rotation? When the chair stopped? After the second rotation?
2. How do our senses help orient us in space?
3. When living and working in space, should astronauts trust their eyes or their sense of motion?

Extension

1. Sit in the swivel chair and have your partner spin you for about thirty seconds. Once the chair comes to a stop, try tossing a ball into a wastepaper basket placed 1.5 meters away. Describe what happened and how you felt.
2. Stand facing a friend. Turn around five times fast and face the friend again. Close your eyes. How do you feel? Do you feel like you are still moving? Open your eyes and find out.

** Note: A stirred pot of liquid continues to spin even after the spoon is removed. The fluid in the inner ears also keeps spinning even after your body stops spinning. In free fall, the effect is even more noticeable.

Bending Under Pressure

Problem

To learn how space suits are made mobile

Materials (per group)

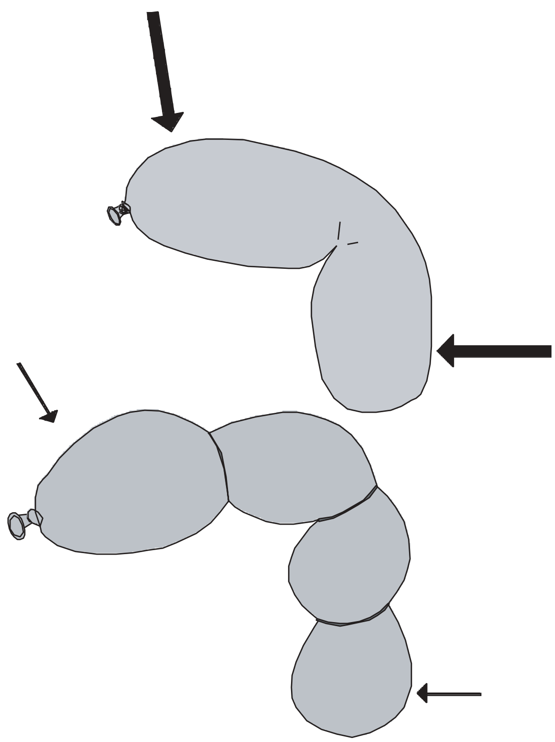
2 long balloons
3 metal craft rings or plastic bracelets

Procedure

1. Inflate one balloon fully and tie off the end. The balloon represents the pressure bladder of a space suit arm.
2. Try bending the balloon.
3. Begin to inflate the second balloon, but while inflating, slide on the craft rings over the balloon so that the balloon looks like sausage links.
4. Observe and record observations in your science journal.
5. Try bending the second balloon with the metal craft rings.
6. Observe and record observations in your science journal.
7. Discuss your observations.
8. Compare and contrast the two balloons.

Conclusion

1. Why is it important to maintain proper pressure inside a space suit?
2. What would happen if there were too much pressure in a space suit?
3. How did the craft rings make the balloon bend more easily?



Properly Gloved

Problem

To experience the difficulty of performing fine motor tasks in space

Materials (per group)

thick, insulated ski gloves or heavy rubber work gloves
miscellaneous tools and other items such as needle-nose pliers, socket wrenches, small machine screws and nuts, Tinker Toys™, Legos™, screwdriver, paper, and pencil

Procedure

1. Put on a pair of the gloves and flex your fingers to get adjusted to the feel.
2. Using the various objects, try to perform several tasks such as writing your name and address, placing a nut on the end of a machine screw, or creating an object with Legos™.
3. Perform the same tasks without gloves.
4. Compare and contrast performing the tasks with and without gloves.
5. Discuss how to design future tools to make the astronauts work in space easier.
6. Illustrate your new designs.

Background

Space suit gloves can be stiff and hard to work in. The gloves worn by Apollo astronauts on the Moon caused much finger fatigue and abrasion during long Moon walks. Designers for the Shuttle space suit have placed special emphasis on making pressurized gloves more flexible and easy to wear. Designing flexible gloves is not easy because, when inflated, gloves become stiff just like an inflated balloon. Designers have used finger joints, metal bands, and lacings to make gloves easier to use. However, even with very flexible spacesuit gloves, small parts and conventional tools can be difficult to manipulate.

Extension

Put on a pair of thin latex gloves and try performing the same task. Compare the ease of performing the tasks with thin gloves, heavy gloves, and without gloves.

Answer Key

Leaf the Wax On

1. Because the water was able to evaporated more easily, the uncovered sponge had the least amount of water.
2. A wax covering on a leaf would help the leaf to lose less moisture, and this is beneficial during the dry season when there is not a lot of rainfall.
3. Many coniferous trees have a wax covering on their leaves.
4. Typically, the driest season is winter. In most areas, there is not only less sunlight, but there is also less rainfall during the winter months. Less rainfall makes it more difficult for a tree to survive and support any growth activity during winter. Coniferous trees do not drop their leaves and go dormant during the winter months like deciduous trees. They have to develop ways of adapting to the drier winter months. One adaptation is the waxy covering on their leaves.

Have Seed Will Travel

1. Completed on activity sheet (p. 41).
2. This seed has "wings" that let it "fly" away on the wind from its parent plant.
3. This seed is a hitchhiker. It has burr-like fruit that attaches itself to animals by sticking to clothing, hair, or fur and is carried from place to place.
4. This seed is inside a fruit that is eaten by animals. The animal digests the fruit but not the seeds. They pass through the animal and are deposited in various places away from the parent plant.
5. This seed has a tiny parachute attached to it. It can be carried a long way by the wind.
6. Same as 5.
7. Same as 3.
8. This seed may look heavy, but it has a hollow center surrounded by a tough, waterproof coating that enables it to float and be carried to other parts of the coastline or even to other islands.
9. Same as 4.
10. Same as 2.

Star Training

Tracing the star was difficult because you only used the mirror and that made things "backwards" and unfamiliar. With practice you would get better at tracing the star. Practice is important in astronaut training so that the job they have to perform is familiar, making it easier for them to perform the task. Months of practice keeps mistakes to a minimum when an astronaut is in space working on millions and sometimes billions of dollars worth of equipment!

Vomit Comet

1. Answers will vary.
2. Our senses help orient us to our environment. If one sense is not capable of being used, the other senses will become more acute. However, in a space environment, the sense of movement cannot always be trusted!
3. Astronauts should trust their eyes!

Bending Under Pressure

1. It is important to maintain proper pressure inside a space suit so that an astronaut's blood does not boil.
2. Too much pressure in a space suit stiffens the walls and makes it hard to bend. It would be impossible for an astronaut to function effectively in a stiff suit.
3. The craft rings provide breaking points that help make the suit more bendable. The breaking points help form joints that bend more easily than materials that are not jointed.

Neutral Buoyancy

Dive, Dive, Dive: When you sucked the air out of the canister, it caused it to sink because you no longer had an air bubble trapped to help the canister float. When you blew air back into the canister, you created the air bubble necessary for flotation.

Diver, Stand Your Mark: When you squeezed the sides of the bottle, you increased the pressure inside the bottle. The air trapped inside the eyedropper also compressed and created more space in the dropper for water - the more water added, the more weight inside the dropper. It sank. By releasing the sides of the bottle, you released the pressure, causing it to go back to its original state.

The NASA "Why?" Files
The Case of the
Inhabitable Habitat

Segment 4

As the tree house detectives put the final touches on their habitat model, they realize that the tree house has become a little messy. Looking at the mess, they wonder what they should do with trash in space. They contact Lisa Polanski, a researcher at NASA Johnson Space Center in Houston, Texas, who explains how astronauts follow the 3 R's in space and what happens to the trash that cannot be recycled or reused. Kali continues on her search for the answer to the fish problem and contacts a classroom at Burbank Middle School in Houston, Texas to learn about the migration patterns of sea turtles. The class explains the Signals of Spring project, and they direct Kali to her next contact. As the tree house detectives visit Dr. D to show off their model, Kali contacts the Virginia Marine Science Museum in Norfolk, Virginia and finally discovers the answer to the fish problem. Once again, Jacob and Kali are back on the beach fishing, but Jacob thinks the fish still haven't returned. After looking at Kali's full stringer, he decides that his just got away!

Objectives

The students will

- learn how trash is disposed of in space.
- understand that recycling is important both in space and on Earth.
- understand the migration of animals.
- understand the significance of a harmful algal bloom.

Vocabulary

algal bloom - a naturally-occurring, higher than normal concentration of the microscopic algae Karenia brevis, that produces a toxin that affects the central nervous system of fish so that they're paralyzed and can't breathe

equilibrium - a state of balance between opposing forces or actions

migration - to pass from one region or climate to another, usually on a regular schedule for feeding or breeding

toxic - relating to or caused by a poison or toxin

toxin - a complicated substance produced by a living organism that is very poisonous when it directly enters the tissues

Video Component

Implementation Stratey

The NASA "Why?" 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 Inhabitable Habitat*, 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 "Why?" Files web site and have students use it to sort the information learned thus 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 student's own research.
3. Revise and correct any misconceptions that may have been dispelled during Segment 3. Use tools located on the web, as 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 show so they can answer the questions.

View Segment 4 of the Video

For optimal educational benefit, view *The Case of the Inhabitable Habitat* in 15-minute segments and not in its entirety.

After Viewing

1. At the end of Segment 4, lead students in a discussion of the focus questions for Segment 4 and record answers.
2. Have students discuss and reflect upon the process that the tree house detectives used to learn about Mars and creating a habitat.
3. Choose activities from the educator guide and web site to reinforce concepts presented in the segment. The variety of activities is designed to enrich and enhance your curriculum.
4. Discuss the tree house detectives' final habitat model and create a list of any suggestions for changes or ideas for inclusions. Determine if the tree house detectives needed to research an area or topic more thoroughly before they created their final design. Discuss the suggestions.
5. Complete the Problem-Based Learning activity on the web site.
6. Have students write in their journals what they have learned about Mars, habitats, and/or scientific inquiry.

7. If a class habitat contest was held, have students present their final product. Invite parents and other classes to view the displays and models. You may want to invite engineers, science teachers, or other professionals to judge the habitats to determine a winner. For additional help, visit the NASA "Why?" Files web site for information on the mentoring program offered by AIAA.

Resources

Books

Cole, Joanna: *The Magic School Bus on the Ocean Floor.* Scholastic, Inc., 1992, ISBN: 0590414313.

Gazlay, Suzy: *Field Detectives: Investigating Playground Habitats.* AIMS Education Foundation, 1998, ISBN: 1881431746.

Mercier, Sheryl and Evalyn Hoover: *Exploring Environments.* AIMS Education Foundation, 1999, ISBN: 1881431770

National Wildlife Federation: *Diving into Oceans (Ranger Rick's Nature Scope).* Learning Triangle Press, 1998, ISBN: 0070470979.

Web Sites

The Bridge: Ocean Sciences Education Teacher Resource Center
This resource from the Virginia Institute of Marine Science provides teachers with a selection of the best online resources for marine science education. Discover how marine scientists track fish and link to real time data that can be used in your own investigations.
http://www.vims.edu/bridge/

Signals of Spring
Meet the turtle watch scientist, view real time data from NASA and NOAA, learn how to participate in one of the migratory projects, and link to hundreds of web sites on everything from phytoplankton to ospreys.
http://www.signalsofspring.com/

Sea Turtle Survival League
At this web site, you can learn about current sea turtle tracking projects, discover more about sea turtles, and even adopt one of your own. There are great educational materials, games, and even a free educator's guide.
http://www.cccturtle.org/sat1.htm

NASA Johnson Space Center Kids Shortcuts
Come browse through the various links to learn more about working, living, and exploring space.
http://www.jsc.nasa.gov/pao/students/

NASA's Human Space Flight Web
This comprehensive web site features current and historical information about NASA's human space flight program.
http://spaceflight.nasa.gov/

NASA Kids Liftoff to Space Exploration
This comprehensive web site has everything you need to learn about space. Discover how astronauts live and travel in space. See a simulation and explanation of a shuttle launch, play games, download coloring pages, and join scientists by participating in real science projects! It even has a teacher section for some great resources.
http://kids.msfc.nasa.gov/

The Harmful Algae Page
Learn what causes algae to bloom and why they are toxic to fish, other sea animals, and even to people.
http://www.redtide.whoi.edu/hab/

Texas Parks and Wildlife: FAQ About Red Tide
Great explanations to those frequently asked questions about a red tide. Learn if it is safe to swim in a red tide and whether or not you should eat the fish caught during a red tide. A link to a Spanish translation is also provided.
http://www.tpwd.state.tx.us/fish/recreat/redtide.htm

Careers

ichthyologist
marine biologist
aquarium curator
underwater filmmaker
baykeeper
environmental lawyer
chemical oceanographer
aquatic chemist
wildlife biologist
ecologist
exobiologist

Activities and Worksheets

In the Guide

Trash that Survey
Conduct a survey of family and friends to find out what is in their garbage. 53

Where Have All the Turtles Gone?
Use data to track a sea turtle and learn about migration. 54

Fishing for Fish
Observe fish and track their movements to discover where fish "hang out." 55

Bloomin' Algae
Discover what effect fertilizer has on organisms in ponds, lakes, and rivers. 56

Tracking Fishy Words
A word search for the fishiest of terms. 57

Answer Key
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On the Web

Garbage Anyone?
Create a landfill and discover why it is important to use the 3Rs.

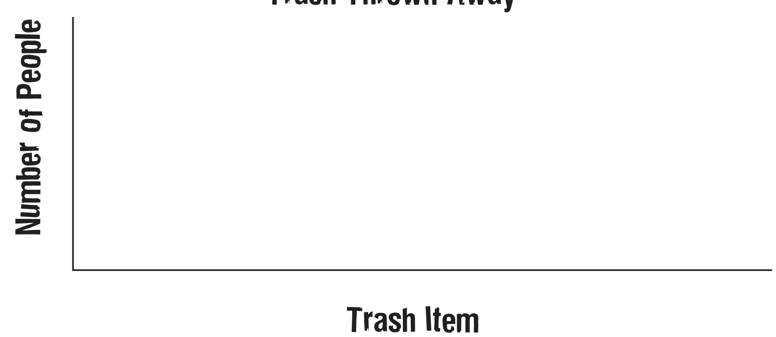
Trash That Survey

Approximately 160 million tons of trash are generated by society each year. That is a lot of garbage! The average family produces three to four pounds of garbage each day. That is a 100 pounds a week or over 5,200 pounds each year. Ninety percent of that is simply dumped into landfills, but over 50 percent of the garbage we create is recyclable. The cost alone of creating, opening, and closing just one landfill is approximately one million dollars. Not only are landfills expensive to operate, but the trash that goes into them takes a long time to biodegrade or decay. For example, if the Pilgrims had used aluminum cans at the first Thanksgiving, the cans would still be around today! An aluminum can will litter the Earth for up to 500 years!

Survey your parents, grandparents, and friends to find out what goes into their garbage cans each week. Put a tally mark beside each item that is thrown away. Add the tally marks and graph your results

TRASH	TALLY MARKS	TRASH	TALLY MARKS
Newspaper		Egg carton	
Glass jars/bottles		Paper bags	
Plastic containers		Styrofoam®	
Disposable diapers		Food waste	
Cardboard		Aluminum foil	
Aluminum cans		Tin cans	
Old clothes		Yard waste	

Trash Thrown Away



Conclusion

1. Which of the above items could be recycled?
2. If everyone recycled all possible items, how would it help our Earth?

Extensions

1. Research composting and start a compost pile.
2. Look at several items bought from a store and discuss the way they are packaged. Is there a better way that will create less trash?
3. Read *Just a Dream* by Chris Van Allsburg and discuss what makes Walter change his wasteful ways.
4. Learn more about Earth Day and plan a celebration of your own.
5. Create a "trash creature" using various items found in your garbage.
6. Conduct research on landfills and present a report.

Where Have All the Turtles Gone?

Materials

map
8 colored pencils
turtle data

Problem

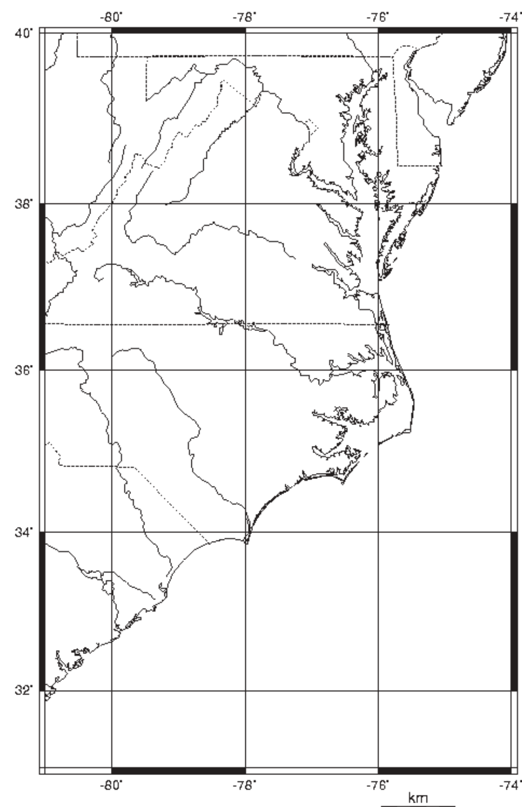
To understand that animals migrate

Procedure

1. Review latitude and longitude and how to plot coordinates.
2. Review the turtle data and assign a different colored pencil for each month of data given.
3. Color in map key to correspond to the colors chosen.
4. Using the appropriate color, plot the coordinates for that month.
5. After plotting all the points, look at the path the turtle traveled. What conclusions can you draw about the migratory patterns of this turtle?
6. Research information on the ocean currents. Use maps and other reference sources to locate the position of ocean currents in this area and lightly color them on the map.

Sea Turtle Data

Date	Latitude	Longitude
7/15	33.2 N	79.1 W
7/28	33.4 N	78.3 W
8/1	33.7 N	77.5 W
8/1	33.6 N	77.2 W
8/3	33.7 N	77 W
8/5	33.9 N	76.5 W
8/9	35.0 N	75.5 W
8/10	35.2 N	75.9 W
9/14	38.9 N	74.7 W
11/9	34.0 N	76.7 W
11/30	32.5 N	78.8 W
12/3	32.0 N	79.3 W
12/6	31.6 N	79.6 W
12/11	31.5 N	79.7 W
12/12	31.6 N	79.6 W
1/3	31.5 N	79.7 W
1/17	31.2 N	79.4 W
1/23	32.0 N	79.3 W
2/15	31.8 N	79.4 W
2/21	31.4 N	79.7 W
3/21	32.1 N	79.4 W



Provided by the Sea Turtle Survival League

Key

July ☐ Dec. ☐
Aug. ☐ Jan. ☐
Sept. ☐ Feb. ☐
Nov. ☐ Mar. ☐

Fishing for Fish

Problem

To observe and track the movement of fish in an aquarium

Materials

10 gal aquarium with 3-4 different fish
clear plastic or acetate
different colored dot stickers or
different colored permanent markers
scissors
metric ruler
timer or clock with second hand
science journal
clear tape

Procedure

1. Measure the length, width, and height of the aquarium's front glass wall and record in your science journal.
2. Using these measurements, cut 3-5 sheets of acetate or clear plastic.
3. Place one of the sheets over the glass wall of the aquarium and secure in place with clear tape. See diagram 1.
4. Assign a different colored dot or colored marker for each fish.
5. In your science journal, create a key denoting the colors.
6. Focus on the fish and watch their movements for a few minutes.
7. Set the timer for 5 minutes, and every 30 seconds mark the position of each fish with the coordinating dot or marker. See diagram 2.
8. At the end of the 5 minutes, take the sheet of plastic off the aquarium and write the date and time on the sheet in the left corner. Set it aside.
9. At the same time each day for 4 days repeat steps 3-8.
10. At the end of your observations on the fifth day, lay each sheet on top of the other in order of date, with the first day on the top.
11. Compare all the sheets to see how the paths of the fish differ each day.

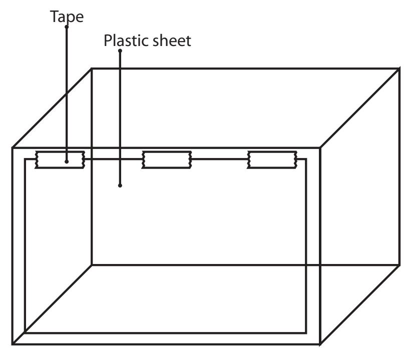


Diagram 1

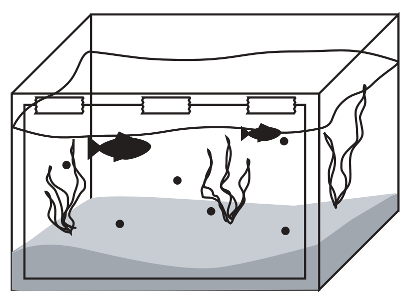


Diagram 2

Conclusion

1. Did the fish in the aquarium seem to hang out in certain places?
2. If so, why did they do that?
3. What variables were you able to control in this experiment? What variables were you unable to control? Would control of variables make a difference in your results?
4. Is there another way you could more accurately track your fish?

Bloomin' Algae

Problem

To learn the effect that fertilizer has on algae population in ponds and lakes

Materials

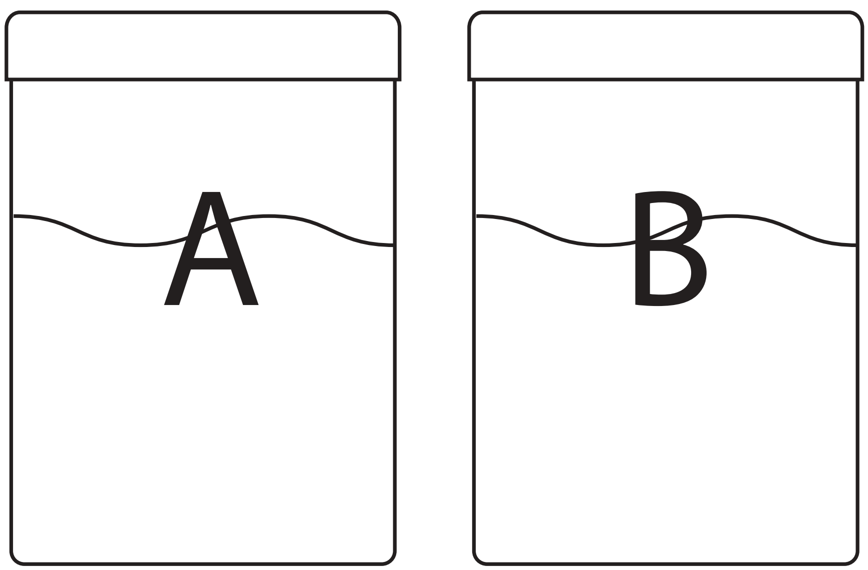
2 glass jars with lids
aged tap water
aquarium or pond water
graduated cylinder
liquid fertilizer
permanent marker
science journal

Procedure

1. Using the permanent marker, label the two jars A and B.
2. Fill each jar half full with tap water that has been allowed to stand for 3-5 days.
3. Add aquarium water to each jar until the jars are three-fourths full.
4. To jar A, add 5 ml of liquid fertilizer.
5. Place the lids on the jars and place them in an area where they can receive direct sunlight.
6. Each day for two weeks, observe the jars and record your observations in your science journal.
7. Compare the color of the water in each jar and record your observations.
8. Color the water in the picture below to match the color of the water in your jar.

Conclusion

1. In which jar did more algae grow? How can you tell?
2. What was the purpose of jar B in this experiment?
3. How would fertilizer get into lakes, ponds, or rivers?
4. What would happen if a large amount of fertilizer went into a lake or pond?
5. How would an algal bloom in a lake or pond kill the fish? Is it the same as an ocean algal bloom?



Tracking Fishy Words

Using the word bank, find each word and circle or highlight the word once found.

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

Word Bank

migration
algae
bloom
fish
habitat
food web
sea turtles
food chain
fertilizer
loggerhead
ocean
Gulf Stream

Answer Key

Trash that Survey

1. All the items are recyclable, but most communities only recycle glass, aluminum, paper, plastic, and tin. Clothes can also be donated to a charity so that they can be worn by someone else.
2. Recycling would greatly reduce the number of landfills we would need. It would also reduce pollution, and save the Earth's natural resources.

Fishing for Fish

1. Answers will vary, but sometimes fish do have certain places they like better than others.
2. Some areas of the tank may offer more safety for the fish or it could be a warm or cold spot in the tank that the fish prefers.
3. Answers will vary but might include observing the fish at the same time each day and keeping the temperature of the water constant with an aquarium heater. Yes, because variables that are not controlled and held constant can invalidate an experiment.
4. Answers will vary.

Bloomin' Algae

1. Jar A because of the color of the water.
2. Jar B was the control jar for the experiment.
3. To make crops and yards grow greener and more plentiful, farmers and homeowners use fertilizer. However, when it rains the fertilizer washes off, and the fertilized water then runs into ponds, streams, or rivers. The rivers then carry the water into the lakes.
4. It would provide food for the algae and the algae would begin a rapid period of growth.
5. The fertilizer acts as a food source for the algae, and with extra food, the algae population explodes. If the increase in algae is very large, it can be harmful to fish because the algae will use many important nutrients and oxygen that the fish need. In the ocean, Alexandrium cysts can cause a harmful algal bloom. These cysts can lay dormant on the ocean floor for many years. Once these are stirred up and the conditions are right (warmer weather with lots of sunlight), the cysts begin to germinate. These are toxic to fish and many fish may die.

Tracking Fishy Words

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

ON THE WEB

Garbage Anyone?

1. Answers will vary depending on the trash selected.
2. Various items will decompose or biodegrade at different rates. For example, aluminum cans, glass bottles, disposable diapers, and plastic containers can take up to 500 years, but some paper will decay after only 4 weeks. Tin cans take only 100 years to decompose.
3. One reason is because we are running out of space for landfills so the less trash we have to bury, the longer the current landfills will last. Landfills can also pose a harmful threat to our ground water supply; therefore, we want as few as possible.
4. It could be, but it would not be very cost effective. It would be very expensive to bring dirt into space to bury trash!
5. As astronauts go into space for longer periods of time, trash becomes an important issue. NASA must find ways to reduce and eliminate trash because they won't have room to store much of it, and it cannot be "thrown" out the door into space!