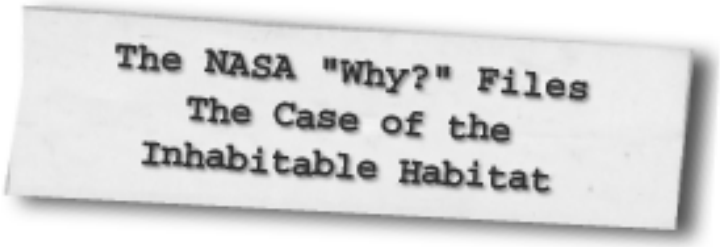


Segment 2

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

How Are We Related?

Problem

To simulate the interaction and relationship among organisms and their environment

Materials

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

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.

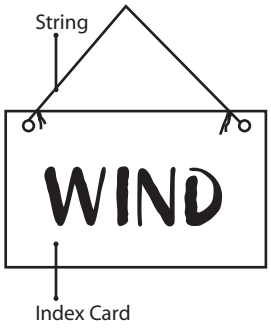
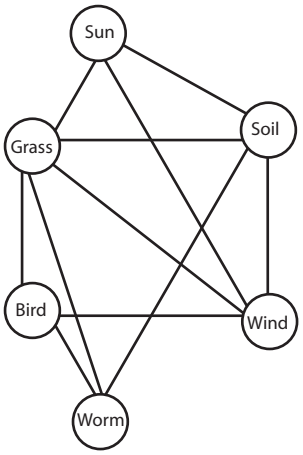


Diagram 1



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

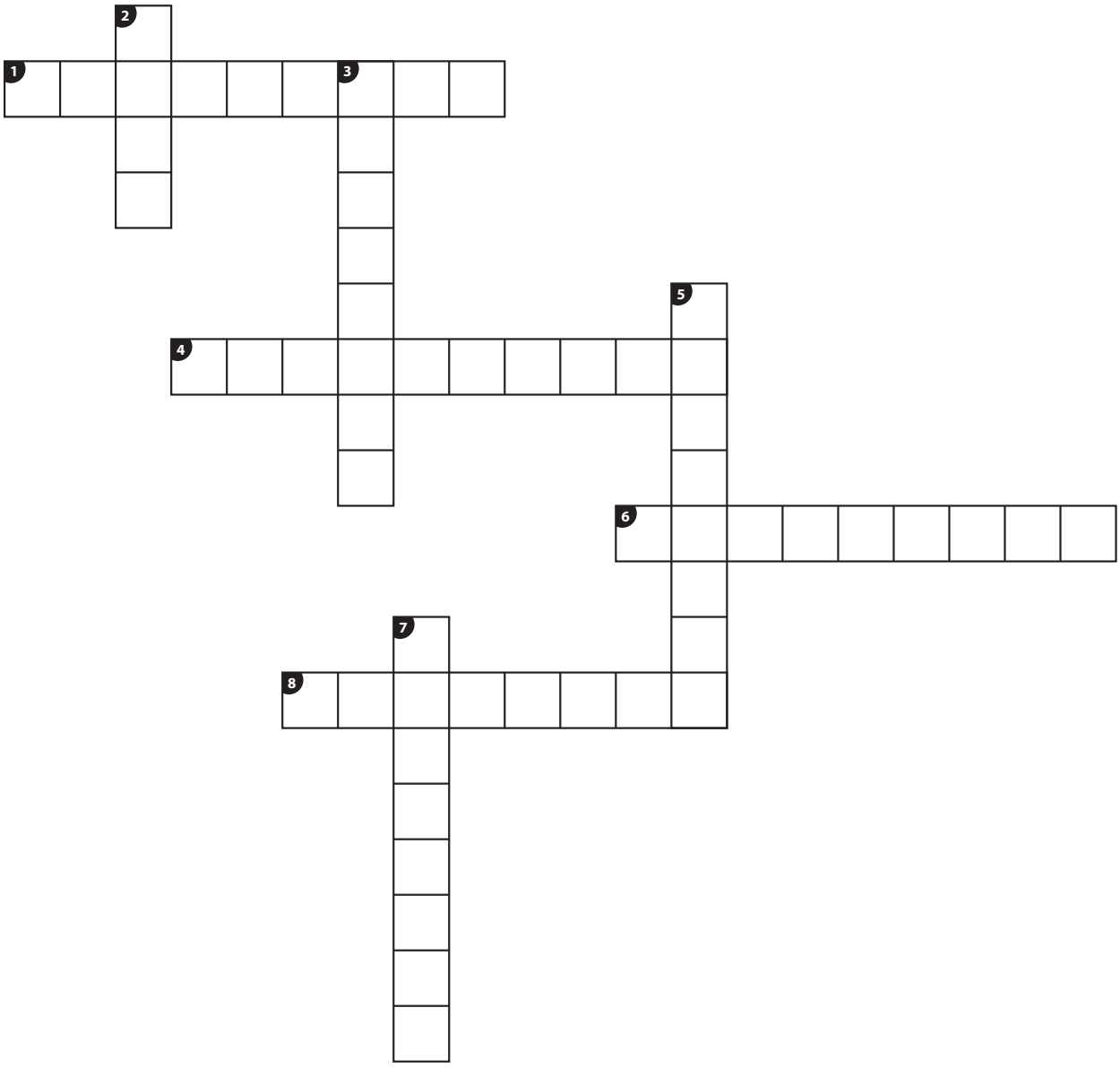
Complete the crossword puzzle by using words from the word bank:

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

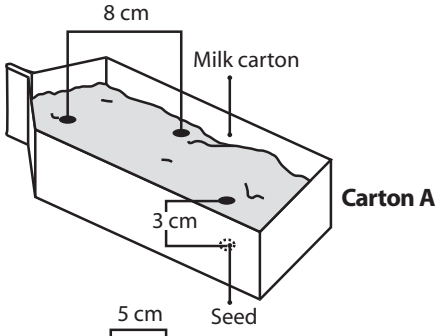
To learn how different degrees of competition among plants affect their growth and survival

Materials

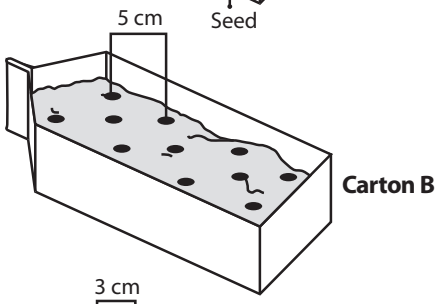
4 clean half-gallon milk cartons
dried beans
soil
large plastic or foil tray
scissors
marker
metric ruler
science journal
spray bottle (optional)

Procedure

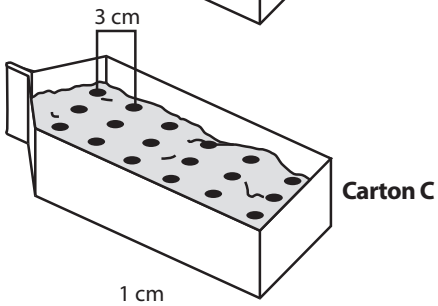
1. Using the scissors, cut off the spout side of each milk carton.
2. On the opposite side, use the scissors to punch three or four small holes for drainage.
3. Using the marker, label each carton A, B, C, or D.
4. Fill each carton about two-thirds full of soil.
5. In carton A, use your finger to poke 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.



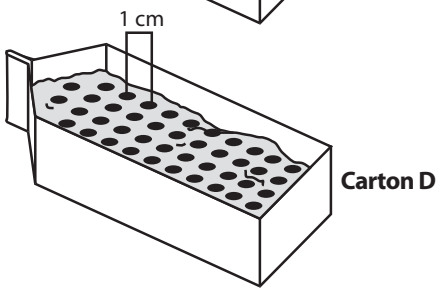
Carton A



Carton B



Carton C



Carton D

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?

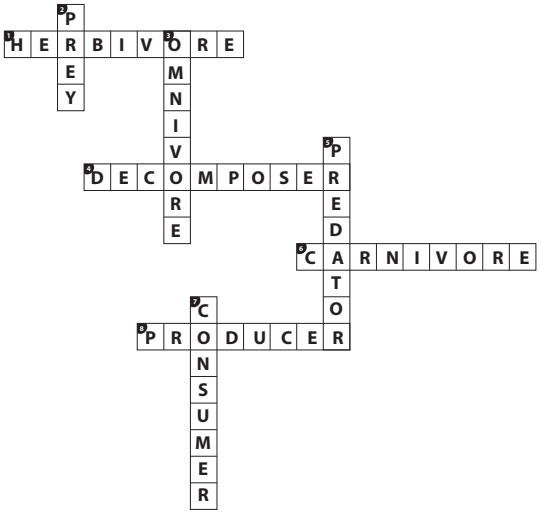
Answer Key

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.