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Educational Product	
Educators	Grades 3–5

EG-2005-02-01-LARC

The NASA Sci Files™

The Case of the Zany Animal Antics

An Educator Guide with Activities in Mathematics, Science, and Technology

Illustrated by: René H. Peniza Jr.

The Case of the Zany Animal Antics educator guide is available in electronic format .
A PDF version of the educator guide for NASA SCI Files™ can be found at the NASA SCI Files™ web site:
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The NASA Science Files™ is produced by the NASA Center for Distance Learning, a component of the Office of Education at NASA's Langley Research Center, Hampton, VA. The NASA Center for Distance Learning is operated under cooperative agreement NCC-1-02039 with Christopher Newport University, Newport News, VA.
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An Educator Guide with Activities in Mathematics, Science, and Technology

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For additional information about the NASA SCI Files™, contact Shannon Ricles at (757) 864-5044 or **s.s.ricles@larc.nasa.gov**.

Production of the NASA SCI Files™ is made possible by the generous support provided by the Society of Women Engineers (SWE); Busch Gardens Williamsburg; Hampton City Public Schools; and the NASA Langley Research Center's Aerospace Vehicle Systems Technology Program Office.

Writers and Teacher Advisors: Shannon Ricles, Becky Jaramillo, Michelle Fargo, and Sharon Bowers.

Graphic Designer: René Peniza

Editor: Susan Hurd

Registered users of the NASA SCI Files™ may request a Society of Women Engineers (SWE) classroom mentor. For more information or to request a mentor, e-mail **kimlien.vu@swe.org** or visit the NASA SCI Files™ web site **http://scifiles.larc.nasa.gov**

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The NASA Sci Files™

Program Overview

Animals become the topic of the day when Catherine and Bianca encounter an injured animal while on an airboat ride in Orlando, Florida. Determined to learn more about animals and how to help and protect them, the tree house detectives decide to visit Mr. Rob Yordi, Zoological Manager at Busch Gardens Williamsburg. Mr. Yordi introduces Kali to the grey wolf while he explains how and why animals are classified. Next, Kali meets Dr. D at the Virginia Marine Science Museum in Virginia Beach, Virginia where Dr. D explains eight of the various phyla of invertebrates. Meanwhile, Catherine and Bianca head to NASA Kennedy Space Center (KSC) to meet Ms. Rebecca Smith, a wildlife ecologist. Ms. Smith describes five classes of vertebrates and explains why it is important for NASA to monitor the animals at KSC; she even introduces the girls to one of her reptile friends!

While at KSC, Catherine and Bianca stop by to see Mr. Mario Mota, a wildlife biologist who monitors the sea turtle population. Mr. Mota helps the tree house detectives understand animals' basic needs and the intricacy of the food chain and web. Just a few hours away, RJ is at an Adventure Camp at Busch Gardens Tampa where he meets Dr. D on the Serengeti Plain exhibit. While on "safari," Dr. D explains migration and the basic reasons animals migrate. After feeding Dolly, a female giraffe, RJ decides to see Ms. Kelly Diedring, a zookeeper at the park. Ms. Diedring explains mitosis and meiosis and the various ways that animals reproduce. Meanwhile, back at the tree house, the detectives have decided to put all their new knowledge to good use and help Kali with her Girl Scout badge. They also want to investigate building a wildlife preserve in Jacob's backyard. The detectives are not daunted by the challenges and continue their research.

Dr. D heads back to Virginia to meet Kali and help her build a bat house, which is one of the requirements for her wildlife badge. While constructing the bat house, Dr. D also explains differences in the various populations of species. To learn more about how to count animals in a population, the tree house detectives dial up Carol City Elementary School, a NASA Explorer School in Miami, Florida. The class has just finished learning how to use random sampling, and they explain why and how to use sampling to estimate a population. Next, they dial up Dr. Dave Breininger, a wildlife ecologist studying and monitoring the endangered scrub jays at KSC. Mr. Breininger helps the detectives understand habitats and how both nature and man can affect them.

Later, the tree house detectives dial up Mr. Doug Scheidt, the aquatics program lead at KSC, to learn more about endangered animals. Mr. Scheidt explains the levels of endangerment and various factors that can cause a species to become threatened or even extinct. The detectives are curious about when and how animals are rescued. Mr. Scheidt recommends that they visit Dr. Beth Chittick, a veterinarian at SeaWorld in Orlando, Florida to learn more about the rescue efforts for injured and sick animals. RJ heads to SeaWorld and while there he also visits Ms. Virginia (Ginny) Busch, who explains the efforts of the Busch Gardens, SeaWorld Conservation Fund and the role it and other partners play in protecting and preserving wildlife. Finally, the detectives visit Mr. Cutchin's backyard, which has been certified as an official backyard habitat. Dr. D meets the detectives at Mr. Cutchin's and they review all they have learned. They believe they are ready to turn Jacob's backyard into the perfect habitat, and they might even be able to help Kali with her final requirement for her Girl Scout wildlife badge.

National Science Standards (Grades K–4)

STANDARD	SEGMENT			
Unifying Concepts and Processes	**1**	**2**	**3**	**4**
Systems, orders, and organization	◆	◆	◆	◆
Evidence, models, and explanations	◆	◆	◆	◆
Change, constancy, and measurement	◆	◆	◆	◆
Evolution and equilibrium	◆	◆	◆	◆
Form and function	◆	◆	◆	◆
Science and Inquiry (A)				
Abilities necessary to do scientific inquiry	◆	◆	◆	◆
Understandings about scientific inquiry	◆	◆	◆	◆
Life Science (C)				
Characteristics of organisms	◆	◆	◆	◆
Life cycles of organisms		◆	◆	◆
Organisms and their environments	◆	◆	◆	◆
Science and Technology (E)				
Abilities of technological design	◆	◆	◆	◆
Understandings about science and technology	◆	◆	◆	◆
Abilities to distinguish between natural objects and objects made by humans	◆	◆	◆	◆
Science in Personal and Social Perspective (F)				
Characteristics and changes in populations	◆	◆	◆	◆
Types of resources	◆	◆	◆	◆
Changes in environment	◆	◆	◆	◆
Science and technology in local challenges	◆	◆	◆	◆

National Science Standards (Grades 5–8)

STANDARD	SEGMENT			
Unifying Concepts and Processes	**1**	**2**	**3**	**4**
Systems, order, and organization	◆	◆	◆	◆
Evidence, models, and explanations	◆	◆	◆	◆
Change, constancy, and measurement	◆	◆	◆	◆
Evolution and equilibrium	◆	◆	◆	◆
Form and function	◆	◆	◆	◆
Science as Inquiry (A)				
Abilities necessary to do scientific inquiry	◆	◆	◆	◆
Understandings about scientific inquiry	◆	◆	◆	◆
Life Science (C)				
Structure and function in living systems	◆	◆		
Reproduction and heredity		◆		◆
Regulation and behavior		◆	◆	◆
Populations and ecosystems	◆	◆	◆	◆
Diversity and adaptations of organisms	◆	◆	◆	◆
Science and Technology (E)				
Abilities of technological design	◆	◆	◆	◆
Understanding about science and technology	◆	◆	◆	◆
Science in Personal and Social Perspectives (F)				
Populations, resources, and environments		◆	◆	◆
Risks and benefits		◆	◆	◆
Science and technology in society		◆	◆	◆
History and Nature of Science (G)				
Science as a human endeavor	◆	◆	◆	◆
Nature of science	◆	◆	◆	◆
History of science	◆	◆	◆	◆

National Mathematics Standards for Grades 3–5

STANDARD	SEGMENT			
Number and Operations	1	2	3	4
Understand meanings of operations and how they relate to one another.	◆	◆	◆	◆
Compute fluently and make reasonable estimates.			◆	
Algebra				
Understand patterns, relations, and functions.			◆	
Use mathematical models to represent and understand quantitative relationships.			◆	
Measurement				
Understand measurable attributes of objects and the units, systems, and processes of measurement.	◆		◆	◆
Apply appropriate techniques, tools, and formulas to determine measurements.	◆		◆	◆
Data Analysis and Probability				
Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.	◆	◆	◆	◆
Select and use appropriate statistical methods to analyze data.	◆	◆	◆	◆
Develop and evaluate inferences and predictions that are based on data.	◆	◆	◆	◆
Problem Solving				
Build new mathematical knowledge through problem solving.	◆	◆	◆	◆
Solve problems that arise in mathematics and in other contexts.	◆	◆	◆	◆
Apply and adapt a variety of appropriate strategies to solve problems.	◆	◆	◆	◆
Monitor and reflect on the process of mathematical problem solving.	◆	◆	◆	◆
Communication				
Communicate mathematical thinking coherently and clearly to peers, teachers, and others.	◆	◆	◆	◆
Representation				
Create and use representations to organize, record, and communicate mathematical ideas.			◆	
Select, apply, and translate among mathematical representations to solve problems.			◆	
Use representations to model and interpret physical, social, and mathematical phenomena.			◆	

National Educational Technology Standards Performance Indicators for Technology-Literate Students Grades 3-5

STANDARD	SEGMENT			
Basic Operations and Concepts	**1**	**2**	**3**	**4**
Use keyboards and other common input and output devices efficiently and effectively.	◆	◆	◆	◆
Discuss common uses of technology in daily life and the advantages and disadvantages those uses provide.	◆	◆	◆	◆
Social, Ethical, and Human Issues				
Discuss common uses of technology in daily life and the advantages and disadvantages those uses provide.	◆	◆	◆	◆
Discuss basic issues related to responsible use of technology and information and describe personal consequences of inappropriate use.	◆	◆	◆	◆
Technology Productivity Tools				
Use technology tools for individual and collaborative writing, communication, and publishing activities to create knowledge products for audiences inside and outside the classroom.	◆	◆	◆	◆
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.	◆	◆	◆	◆
Use telecommunication efficiently and effectively to access remote information, communicate with others in support of direct and independent learning, and pursue personal interests.	◆	◆	◆	◆
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.	◆	◆	◆	◆
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.	◆	◆	◆	◆
Use technology resources for problem solving, self-directed learning, and extended learning activities.	◆	◆	◆	◆
Determine when technology is useful and select the appropriate tools and technology resources to address a variety of tasks and problems.	◆	◆	◆	◆
Technology Problem-Solving and Decision-Making Tools				
Use technology resources for problem solving, self-directed learning, and extended learning activities.	◆	◆	◆	◆
Determine when technology is useful and select the appropriate tools and technology resources to address a variety of tasks and problems.	◆	◆	◆	◆

International Technology Education Association Standards for Technological Literacy Grades 3–5

STANDARD	SEGMENT			
The Nature of Technology	**1**	**2**	**3**	**4**
Standard 1: Students will develop an understanding of the characteristics and scope of technology.	◆	◆	◆	◆
Standard 2: Students will develop an understanding of the core concepts of technology.	◆	◆	◆	◆
Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.	◆	◆	◆	◆
Technology and Society				
Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.		◆	◆	◆
Standard 5: Students will develop an understanding of the effects of technology on the environment.		◆	◆	◆
Standard 6: Students will develop an understanding of the role of society in the development and use of technology.		◆	◆	◆
Design				
Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.	◆	◆	◆	◆
Abilities for a Technological World				
Standard 11: Students will develop the abilities to apply the design process.				◆
The Designed World				
Standard 15: Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.	◆	◆	◆	◆

National Geography Standards

STANDARD	SEGMENT			
The geographically informed person knows and understands:	**1**	**2**	**3**	**4**
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			◆	
How to use mental maps to organize information about people, places, and environments in a spatial context			◆	
Places and Regions				
The physical and human characteristics of places		◆	◆	◆
Physical Systems				
The physical and human characteristics of places	◆	◆	◆	◆
Human Systems				
The processes patterns, and functions of human settlement		◆		◆
Environment and Society				
How human actions modify the physical environment	◆	◆	◆	◆
How physical systems affect human systems	◆	◆	◆	◆
How changes occur in the meaning, use, distribution, and importance of resources	◆	◆	◆	◆

The NASA SCI Files™

The Case of the Zany Animal Antics

Segment 1

Animals become the topic of the day when Catherine and Bianca encounter an injured animal while on an airboat ride in Orlando, Florida. Determined to learn more about animals and how to help and protect them, the tree house detectives decide to visit Mr. Rob Yordi, Zoological Manager at Busch Gardens Williamsburg. Mr. Yordi introduces Kali to the grey wolf while he explains how and why animals are classified. Next, Kali meets Dr. D at the Virginia Marine Science Museum in Virginia Beach, Virginia where he explains eight of the various phyla of invertebrates. Meanwhile, Catherine and Bianca head to NASA Kennedy Space Center (KSC) to meet Ms. Rebecca Smith, a wildlife ecologist. Ms. Smith describes five classes of vertebrates and explains why it is important for NASA to monitor the animals at KSC, and she even introduces the girls to one of her reptile friends!

Objectives

Students will

- learn how animals are classified.
- differentiate between invertebrates and vertebrates.
- identify various characteristics of invertebrates.
- understand how to use a dichotomous key.
- recognize differences between warm (endothermic) and cold (ectothermic) blooded animals.
- identify various characteristics of the five classes of vertebrate animals.

Vocabulary

amphibian—an ectothermic (cold-blooded) vertebrate that spends some time on land but must breed and develop into an adult in water. Frogs, salamanders, and toads are examples of amphibians.

Annelida—(segmented worms)—any of various worms having segmented bodies separated by internal partitions

Arthropoda—(arthropod)—any of a phylum of animals without backbones (such as insects, arachnids, and crustaceans) having a segmented body, jointed limbs, and a chitin shell that is shed periodically

bioluminescence—emission of visible light by living organisms such as the firefly and various fish, fungi, and bacteria

bird—a member of the class Aves, including endothermic (warm-blooded), egg-laying, feathered vertebrates with forelimbs modified to form wings

Chordata (chordates)—an animal that has a dorsal hollow nerve cord, notochord, pharyngeal pouches, and a muscular tail during at least part of development

class—a group of similar orders whose members have at least one characteristic in common

classify—to arrange in or assign to classes

cnidaria (cnidarians)—aquatic animals such as jellyfish and coral that are mostly carnivorous, with two layers of true tissues, radial symmetry, and tentacles bearing stinging cells

dichotomous key—a series of pairs of phrases or descriptions that are used to classify a group of living things by making choices between the sets of traits and characters described in each pair

Echinodermata (echinoderms)—any of a phylum of marine animals (such as starfish and sea urchins) that have a number of similar body parts (as the arms of a starfish) arranged around a central axis, often a calcium-containing outer skeleton, and a water-vascular system

ectotherm—an animal that maintains its body temperature by absorbing heat from its environment. All animals other than birds and mammals are ectotherms.

endoskeleton—the internal skeleton of an animal, especially of a vertebrate

endotherm—an animal that is able to maintain a constant body temperature despite changes in the temperature of its environment

fish—an ectothermic (cold-blooded) vertebrate that lives and breathes in water and has a typically long, scaly tapering body, limbs that develop as fins, and a vertical tail fin

invertebrate—an animal that does not have a backbone or vertebral column

Kingdom—one of the main taxonomic groups consisting of closely related phyla

mammal—any of a class of endothermic (warm-blooded) vertebrates that include human beings and all other animals that nourish their young with milk produced by mammary glands and have skin usually more or less covered with hair

metamorphosis—a complete or marked change in the form of an animal as it develops into an adult, for example, the change from tadpole to frog or from caterpillar to butterfly

Mollusca (mollusks)—any of a large phylum of invertebrate animals (such as snails, clams, and octopuses) with soft bodies lacking segments and usually enclosed in a shell containing calcium

***Nematoda* (nematode or roundworm)**—any of various worms having unsegmented threadlike bodies, many of which, such as the hookworm, are parasitic

phylum—group of closely related classes sharing one or more major characteristics that set them apart from other animals or plants

Platyhelminthes (flatworms)—any of various free-living or parasitic worms having three layers of tissues and bilateral symmetry

Porifera (sponges)—aquatic filter feeders with an internal skeleton made up of spongin and/or spicules of calcium carbonate or silica but that lack true tissues and organs

reptiles—any of a group of ectothermic (cold-blooded) air-breathing vertebrates (such as snakes, lizards, turtles, and alligators) that usually lay eggs and have skin covered with scales or bony plates

vertebrates—animals that have a vertebral column or backbone

Video Component

Implementation Strategy

The NASA SCI Files™ is designed to enhance and enrich 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. Before viewing Segment 1 of *The Case of the Zany Animal Antics*, read the program overview to the students. List and discuss questions and preconceptions that students may have about how oceans are formed, the tides and currents in oceans, and what causes ocean waves.
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 better understand the problem. To locate the following tools on the NASA SCI Files™ web site, select **Educators** from the menu bar, click on **Tools**, and then select **Instructional Tools**. You will find them listed under the **Problem-Based Learning** tab.

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

Guiding Questions for Problem Solving—Questions for students to use while conducting research

Problem Log and Rubric—Students' printable log with the stages of the problem-solving process

Brainstorming Map—Graphic representation of key concepts and their relationships

The Scientific Method and Flowchart—Chart that describes the scientific method process

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

Careers

animal curator
aviculturist
biologist
wildlife ecologist
zoological manager

View Segment 1 of the Video

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

After Viewing

1. Have students reflect on the "What's Up?" Questions asked at the end of the segment.
2. Discuss the Focus Questions.
3. Students should work in groups or as a class to discuss and list what they know about the oceans of the world. Have the students conduct research on the difference between currents, tides, and waves. Brainstorm ideas about how the tennis shoes may have ended up on the beach. As a class, reach a consensus on what additional information is needed. Have the students conduct independent research or provide them with the information needed.
4. Have the students complete **Action Plans**, which can be printed from the **Educators** area or the tree house **Problem Board** area in the **Problem-Solving Tools** section of the web site for the current online investigation. Students should then conduct independent or group research by using books and Internet sites noted in the **Research Rack** section of the **Problem Board** in the **Tree House**. Educators can also search for resources by topic, episode, and media type under the **Educators** main menu option **Resources**.
5. Choose activities from the **Educator Guide** and web site to reinforce concepts discussed in the segment. The variety of activities is designed to enrich and enhance your curriculum. Activities may also be used to help students "solve" the problem along with the tree house detectives.
6. For related activities from previous programs, download the **Educator Guide**. On the NASA SCI Files™ home page, select **Educators**. Click on **Episodes** in the menu bar at the top. Scroll down to the 2003–2004 Season and click on *The Case of the Prize-Winning Plant* In the green box, click on **Download the Educator Guide**.

a. In the **Educator Guide** you will find

a. **Segment 1** – *Classic Classifying*

7. Have the students work individually, in pairs, or in small groups on the problem-based learning (PBL) activity on the NASA SCI Files™ web site. To locate the PBL activity, click on **Tree House** and then the **Problem Board**. Choose the 2004–2005 Season and click on *Mystery Animals of KSC*.
   - To begin the PBL activity, read the scenario *(Here's the Situation)* to the students.
   - Read and discuss the various roles involved in the investigation.
   - Print the criteria for the investigation and distribute.
   - Have students begin their investigation by using the **Research Rack** and the **Problem-Solving Tools** located on the bottom menu bar for the PBL activity. The **Research Rack** is also located in the **Tree House**.
8. Having students reflect in their journals what they have learned from this segment and from their own experimentation and research is one way to assess student progress. In the beginning, students may have difficulty reflecting. To help them, ask specific questions that are related to the concepts.
9. Have students complete a **Reflection Journal**, which can be found in the **Problem-Solving Tools** section of the online PBL investigation or in the **Instructional Tools** section under **Educators**.
10. The NASA SCI Files™ web site provides educators with general and specific evaluation tools for cooperative learning, scientific investigation, and the problem-solving process.

Resources *(additional resources located on web site)*

Books

Doris, Ellen: *Real Kid, Real Science Books: Entomology, Marine Biology, and Invertebrate Zoology*. Thames and Hudson, 1994, ISBN: 0500190054.

Farndon, John: *1000 Facts on Animals.* Backpack Books, 2003, ISBN: 0760737495.

Feeley, Kathleen: *Invertebrates.* Gareth Stevens Publishing, 2002, ISBN: 0836832167.

Kalman, Bobbie and Nickles, Greg: *What is the Animal Kingdom?* Crabtree Publishing, 1997, ISBN: 086505889X.

Pringle, Laurence: *Scholastic Encyclopedia of Animals.* Scholastic, Inc., 2001, ISBN: 0590522531.

Schaefer, Lola and Saunders-Smith, Gail: *What Is an Amphibian? Vol. 1.* Capstone Press, 2001, ISBN: 0736808639. *(Note: This is the first volume in a series of What Is books, including What Is a Bird, Reptile, Mammal, and Insect.)*

Smithyman, Kathryn: *What Is an Arthropod?* Crabtree Publishing, 2002, ISBN: 0865059683.

Taylor, Barbara: *Animal Kingdom.* Silver Dolphin Books, 2000, ISBN: 1571454446.

Whyman, Kathryn: *Animal Kingdom: A Guide to Vertebrate Classification and Biodiversity.* Raintree Publishers, ISBN: 081725885X.

Video

Disney Channel: *Invertebrates (Bill Nye the Science Guy)*
Grades 3–8

Disney Channel: *Mammals (Bill Nye the Science Guy)*
Grades 3–8

Schlessinger Media: *Animal Life in Action: Animal Classification*
Grades 5–8

Web Sites

NASA Kennedy Space Center: Alligators and Rocket Ships
Come learn how NASA Kennedy Space Center, located on Merritt Island off the east coast of Florida, shares its home with manatees, alligators, sea turtles, and an array of animals. Find out how NASA is working to protect this national wildlife refuge.
http://www.nasa.gov/centers/kennedy/shuttleoperations/alligators/kscovrv.html

ProTeacher! Animal Lesson Plans
This site has lesson plans for grades K–5, including endangered species activities, programs and thematic units, web quests, coloring pages, and much more.
http://www.proteacher.com/110006.shtml

DiscoverySchool.com – The Secret of the Bones
A paleontologist has discovered some animal bones. Help figure out what species the animal is through this interactive game.
http://school.discovery.com/sciencefaircentral/dysc/virtuallabs/bones/index.html

Cool Cosmos – Infrared Zoo Gallery
Ever wonder what the difference is between warm and cold-blooded animals? Visit the Infrared Zoo Gallery and use infrared light to see how different animals look.
http://coolcosmos.ipac.caltech.edu/image_galleries/ir_zoo/

Classifying Critters
The Howard Hughes Medical Institute web site helps children learn animal classification through its interactive site.
http://www.hhmi.org/coolscience/critters/index.html

Kidport Think-and-Learn: The Animal Kingdom
Visit this web site to learn about animal classification. There are specific links to vertebrates and invertebrates.
http://www.kidport.com/RefLib/Science/Animals/Animals.htm

Animal Diversity Web
On this University of Michigan Museum of Zoology web site you can learn more about specific classes of animals. Find detailed information about a class, including pictures, sound clips, specimens, and classifications.
http://animaldiversity.ummz.umich.edu/site/index.html

Animal Classifications – Vertebrates
This web site offers a wealth of information about vertebrates, including specific links to other vertebrate web sites for particular animals.
http://falcon.jmu.edu/~ramseyil/vertebrates.htm

Invertebrates
Third and fourth graders in the United Kingdom did a superb job creating this site. Learn interesting facts, see some cool pictures, and learn more about invertebrates. You might also be inspired to create your own classroom web site!
http://atschool.eduweb.co.uk/sirrobhitch.suffolk/invert/inverteb.htm

Activities and Worksheets

In the Guide

Alike or Different?
Become part of a human sorting game as you and other students determine which characteristics to use to sort yourselves into groups. 19

The Involution of an Invertebrate
Use what you have learned about invertebrates and create your own. 20

Animal Antics
Play this animal game created by AIMS Education Foundation to learn how animals are classified. 21

Di Means Two
Use a dichotomous key to identify various beans. 30

Cold-Blooded Bananas
Make some banana animals to learn about cold-blooded (ectothermic) animals. 32

Answer Key
. 34

On the Web

The Many Phyla of Invertebrates
Conduct research on the Internet or use reference books to make a class set of booklets telling about the various phyla of invertebrates.

A Subphylum with Class
Conduct research on the Internet or use reference books to make a class set of booklets telling about the various classes of vertebrates.

Alike or Different?

Segment 1

Purpose

To understand how to use various characteristics to classify objects

Materials

2–4 groups of 4–5 students each

Background

We classify things everyday to organize and better understand them. To classify an object, we look at the characteristics or features that differentiate it from other objects and divide objects into groups based on these characteristics. For example, if given a box of toys, you might sort them by toys for boys and toys for girls and then further sort them by type of toy.

Procedure

1. In your group, list possible characteristics you can use to sort each student into one of two groups. For example, if everyone in your group has either blonde or brown hair, you might want to use hair color as the characteristic for sorting. Decide on 1–3 characteristics and be sure not to let the other groups know the characteristic(s) you are using!
2. Once you have decided on the characteristic(s), determine who is in which group.
3. When it is your group's turn, stand in front of the class in your sorted groups and have the other students try to figure out which sorting characteristic(s) you used. Of course, the more characteristics you use, the harder it will be for them! For example, depending on your group, you could use gender, hair color, and the absence or presence of shoelaces in group members' shoes.
4. Be creative choosing the sorting characteristics and try to use your imagination when guessing the other groups' characteristics too!

Conclusion

1. Was it difficult to find common characteristics in your group? Why or why not?
2. How did you determine which characteristics other groups used? Were they obvious or difficult to determine?
3. What do you think is the greatest challenge in classifying animals?

Extension

Collect an assortment of animal pictures and determine which characteristics you can use to classify them. How are they alike? How are they different? Sort the pictures into two groups, making sure that in each group there is something the same about all the animals in that group and that no animal in the other group has that particular characteristic. Have other students look at your groupings and try to guess why you grouped the animals the way you did.

The Involution of an Invertebrate

Segment 1

Purpose

To create an imaginary invertebrate based on characteristics of real invertebrates

Teacher Note: Prior to this activity, have the students conduct the activity, The Many Phyla of Invertebrates, or a similar activity to learn about the characteristics of the various invertebrate phyla. This activity and others can be found on the NASA SCI Files™ web site *http://scifiles.larc.nasa.gov* in the **Educators** area. In the tool bar at the top of the **Educators** area, click on **Activities and Worksheets** and then click on the **2004–2005 Season**. Scroll down to *The Case of the Zany Animal Antics* and click.

Materials

paper
colored pencils
booklets from The Many Phyla of Invertebrates (optional)
reference books for invertebrates

Background

Many of the most frightening "monsters" dreamed up for science-fiction movies, books, and even games are often actually based on bits and pieces of anatomy (body parts) and behavior of real invertebrates.

Sample Sketch

Procedure

1. Choose a habitat. It might be a dessert, a rain forest, a coral reef, or even the inside of another animal.
2. Describe the characteristics of the habitat. For example, does the habitat get a lot of rain or is it dry most of the year? Is it hot or cold? Note: If you're not sure of the characteristics of your habitat, conduct research.
3. Using the habitat's characteristics, define the environmental challenges that an invertebrate will have to overcome in the habitat.
4. After defining all the challenges, look over the characteristics of all the invertebrate phyla you have studied and pick the body systems (endoskeleton, wings, tentacles, and so on) that are best for your chosen habitat. They don't all have to be in the same phylum. Be creative!
5. Assemble (draw) the body systems you have chosen into an imaginary animal. Make sure that everything works well together. For example, you cannot expect an animal to breathe through its skin if it has an impermeable exoskeleton covering its entire body.
6. Label the diagram with the names of the real-life invertebrate systems. If necessary, draw a cutaway diagram showing the inside of your animal.
7. Color and name your new imaginary invertebrate.
8. On the back of your drawing, write a short description of your invertebrate, describe its features, and tell how it overcame the challenges of the habitat.
9. Share your imaginary invertebrate with your group and/or class.

Extension

1. Write a science fiction story about your new invertebrate.
2. Brainstorm for a list of science fiction "monsters" that have been created from invertebrates. Describe their body parts and systems and tell which real-life invertebrate each came from.

Animal Antics*

Segment 1

Purpose

To understand how scientists classify animals

Teacher Note: This activity deals with classification on an elementary level and is not intended to be complete but rather to expose students to the idea of classifying animals into groups according to attributes they have in common.

Materials

Per Student
animal book pages (p. 24)
Data Chart (p. 27)
Graphing Sheet (p. 28)
#19 rubber bands

Per Group
animal bags
Classification Chart (p. 25-26)
scissors
tape
Animal Picture Sheet (p. 29)

Teacher Prep

1. Assemble one bag of animals for each group of students. The bag should contain several of the pictures from the Animal Picture Sheet (page 29).
2. Bags may be supplemented with some or all of the following: animal cookies, crackers that look like fish, candy shaped like worms, or plastic bugs, spiders, snakes, and lizards. No two bags should be the same.
3. Each group will need one copy of the two-page classification chart cut along the dashed line and taped together to form one large page.

Background

The animal kingdom can be classified into two groups—the vertebrates and the invertebrates. Vertebrates are animals with backbones and can be classified into five subgroups: mammals, birds, fish (four classes), reptiles, and amphibians. The invertebrates are classified into many groups but for this activity will only be sorted into four subgroups: ringed worms, arthropods (insects, spiders, crabs), mollusks (slugs, squid, snails), and echinoderms (spiny-skinned animals like sea stars, sea urchins, and sand dollars).

Procedure

1. Begin assembly of the animal book pages by folding each page in half. See diagram 1.
2. Fold each page in half again. See diagram 2.
3. Look at the bottom of each page for the page numbers in the lower corners and nest the two folded pages together so that page one is on top and page 3 nests inside. See diagram 3.
4. Open the booklet to pages 4 and 5 and slip the rubber band over the book until it is in the center of the fold. See diagram 4.
5. In your team or as a class, read the information and discuss.
6. Open your bag and look through the animals in your bag for 5–10 minutes. Note any characteristics of the animals that might help you identify them.
7. Return the animals to the bag.
8. The object of this game is to correctly identify as many animals as possible. Use the animal booklet to help you determine how to classify each animal in the bag.

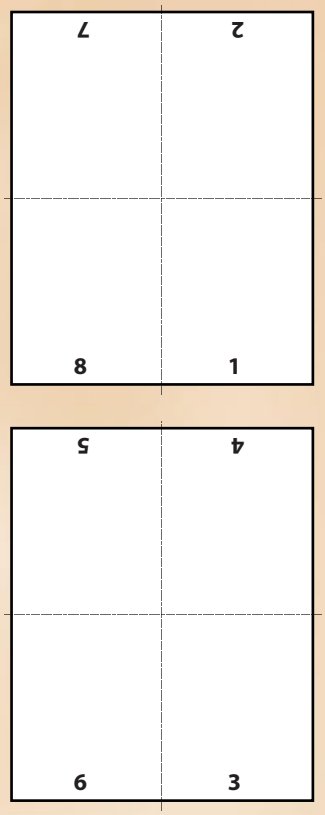


Diagram 1

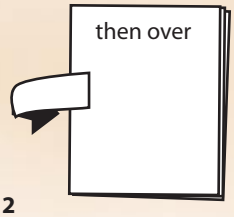
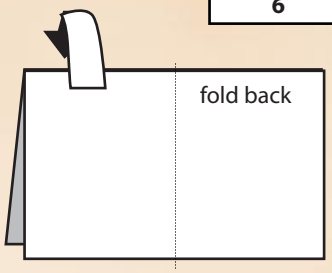


Diagram 2



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Animal Antics*

Segment 1

9. Assemble the Classification Chart by cutting along the dashed line and taping it into place after aligning the pages correctly.
10. Look at the Classification Chart and note the number of points given for each class.
11. Predict how many points your group will get and record your prediction on the Data Chart.
12. Empty the bag of animals and place them in the center of the Classification Chart in the space labeled "All Animals."
13. Count the number of animals and record this value on the data chart.
14. Begin classification of the animals by dividing them into vertebrates and invertebrates.
15. Once the teacher has checked your groupings, give your team one point for each correct placement.
16. Record the point values on the data chart for the number of correct vertebrates and invertebrates.
17. Continue sorting animals into the categories listed on the Classification Chart.
18. When your team is finished, have the teacher check for correct placement.
19. Determine the total number of correctly placed animals for each group. Multiply the total by the number of points that group is worth. For example, if you correctly classified three reptiles, multiple 3 (total number correctly classified) by 4 (point value for reptiles) for a total of 12 points.
20. Record your points for each group of animals on the data sheet.
21. Determine the Team Total and record.
22. Share your score with the other teams in the class, and as they share their scores, record them in the spaces provided on the Graphing Sheet.
23. Graph each team's score and declare a winning team.

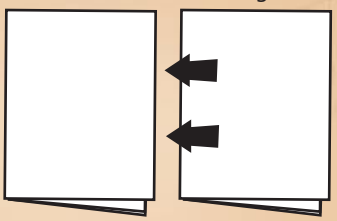


Diagram 3

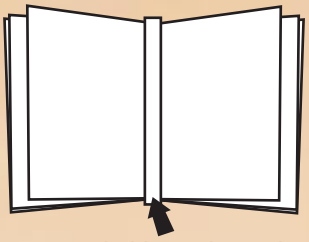


Diagram 4

Conclusion

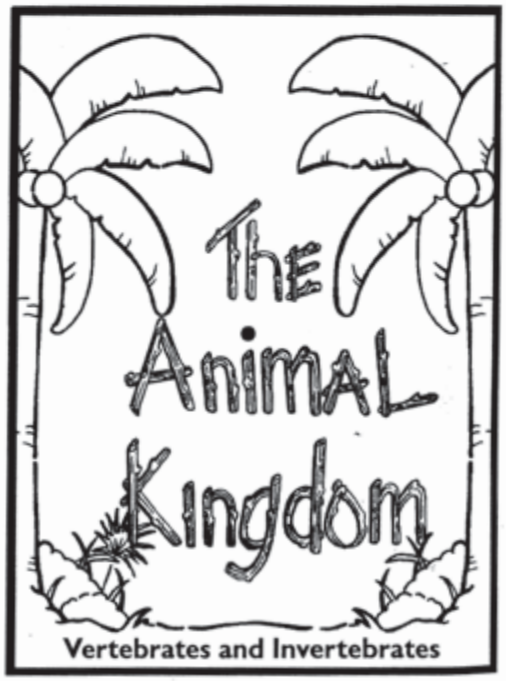
1. Was your team's predicted score close to your actual score? Why or why not?
2. How do common characteristics help you classify animals?
3. How would you sort the mammals into smaller categories?
4. Can you devise an animal classification system that is different from the one given on the chart? Explain.
5. What animals would you like to add to the chart? Where would they fit?
6. Think of another animal to add to each group.

Extension

1. Find the ratios or percents of animals in each category.
2. Color the cut-out animals and make a zoo collage.
3. Read Rudyard Kipling's Just So Stories and write your own animal story to explain how an animal got its unique features.
4. Create a classroom classification chart on butcher paper and paste animal pictures on the chart in the appropriate places.
5. Research the other four classes of fish and the other classes of invertebrates that were not included in the chart.

Animal Antics*

Segment 1



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Animals can be classified into two groups. The *vertebrates* are animals with backbones. The *invertebrates* are animals without backbones. Run your hand down your back. Do you feel the bumpy bones? That is your backbone.

You are a vertebrate. Only about 5% of all the animals on Earth are vertebrates.

There are many groups of invertebrates. Here are four of the main ones:

- **Annelids:** cold-blooded animals that have soft bodies with sections
- **Echinoderms:** cold-blooded animals that have bodies with rough skin and sharp spines
- **Molluscks:** cold-blooded animals with a soft body and sometimes a hard shell
- **Arthropods:** cold-blooded animals with jointed legs

Animal Antics*

Segment 1

Animals

Vertebrates

mammals
humans
dogs
rabbits
lions
cats
whales

fish
trout
bass
eels

reptiles
turtles
snakes
lizards
alligators

birds
eagles
turkeys
sparrows

amphibians
frogs
toads
salamanders

4

Invertebrates

mollusks
clams
oysters
snails
octopuses
squid

arthropods
spiders
insects
crabs
lobsters

echinoderms
sea star
sea urchins
sand dollars

annelids
earthworms
clamworms
leeches

5

Invertebrates are far more numerous than vertebrates. Of all the animals that have been discovered on Earth, about 95% are invertebrates. The largest group of invertebrates is the arthropods, which includes insects. Insects make up about 75% of all known animal species.

6

There are five groups of vertebrates:

- **Mammals:** warm-blooded animals that have hair or fur and are born alive
- **Birds:** warm-blooded animals that have feathers and lay eggs
- **Fish:** cold-blooded animals that have scales, gills, and fins and lay eggs
- **Reptiles:** cold-blooded animals that have scales and lungs and lay eggs
- **Amphibians:** cold-blooded animals that have smooth skin and can live on land or in water

Warm-blooded animals have constant body temperatures. Cold-blooded animals have body temperatures that adjust to the temperatures of their environments.

3

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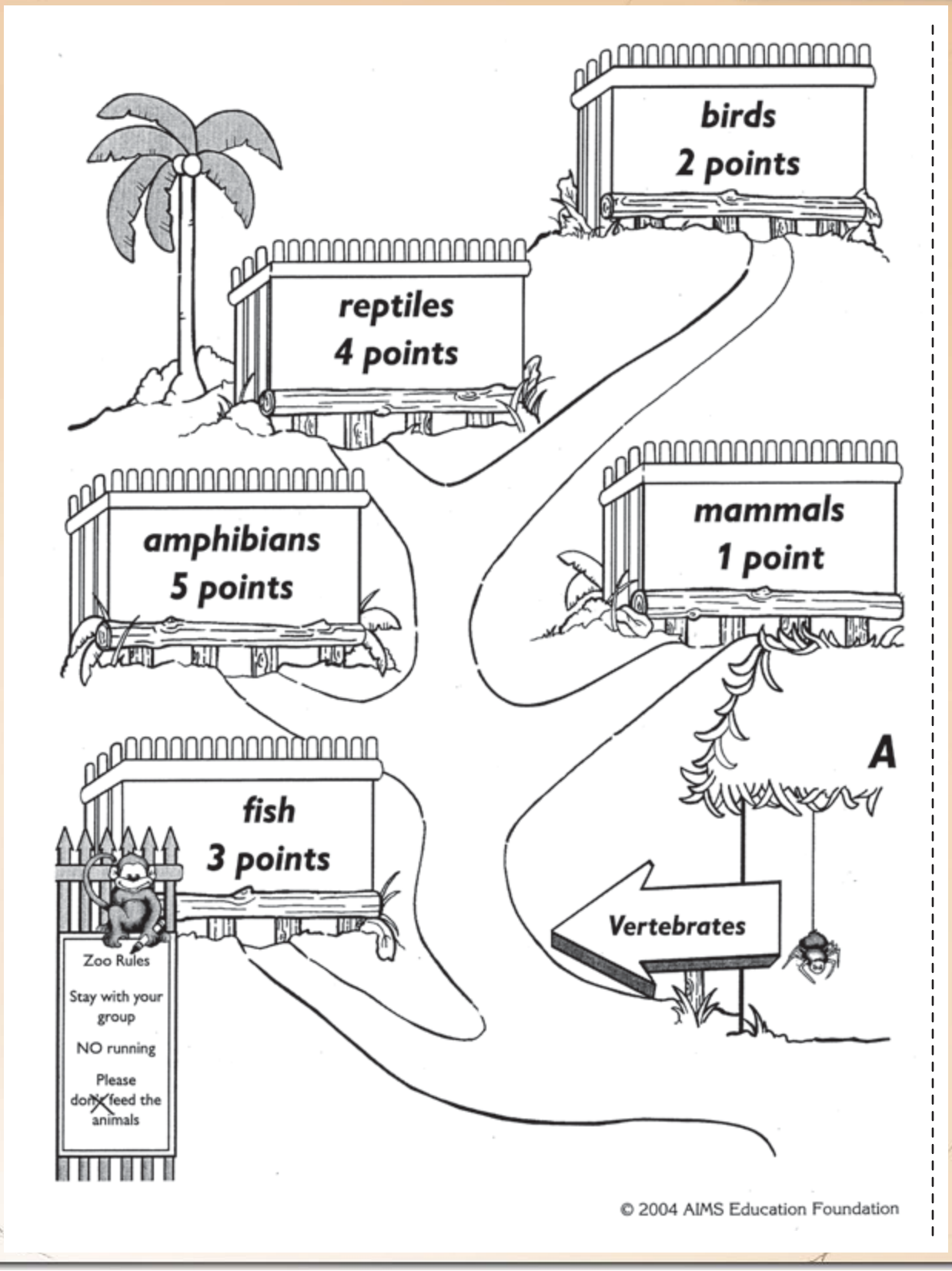
Classification Chart



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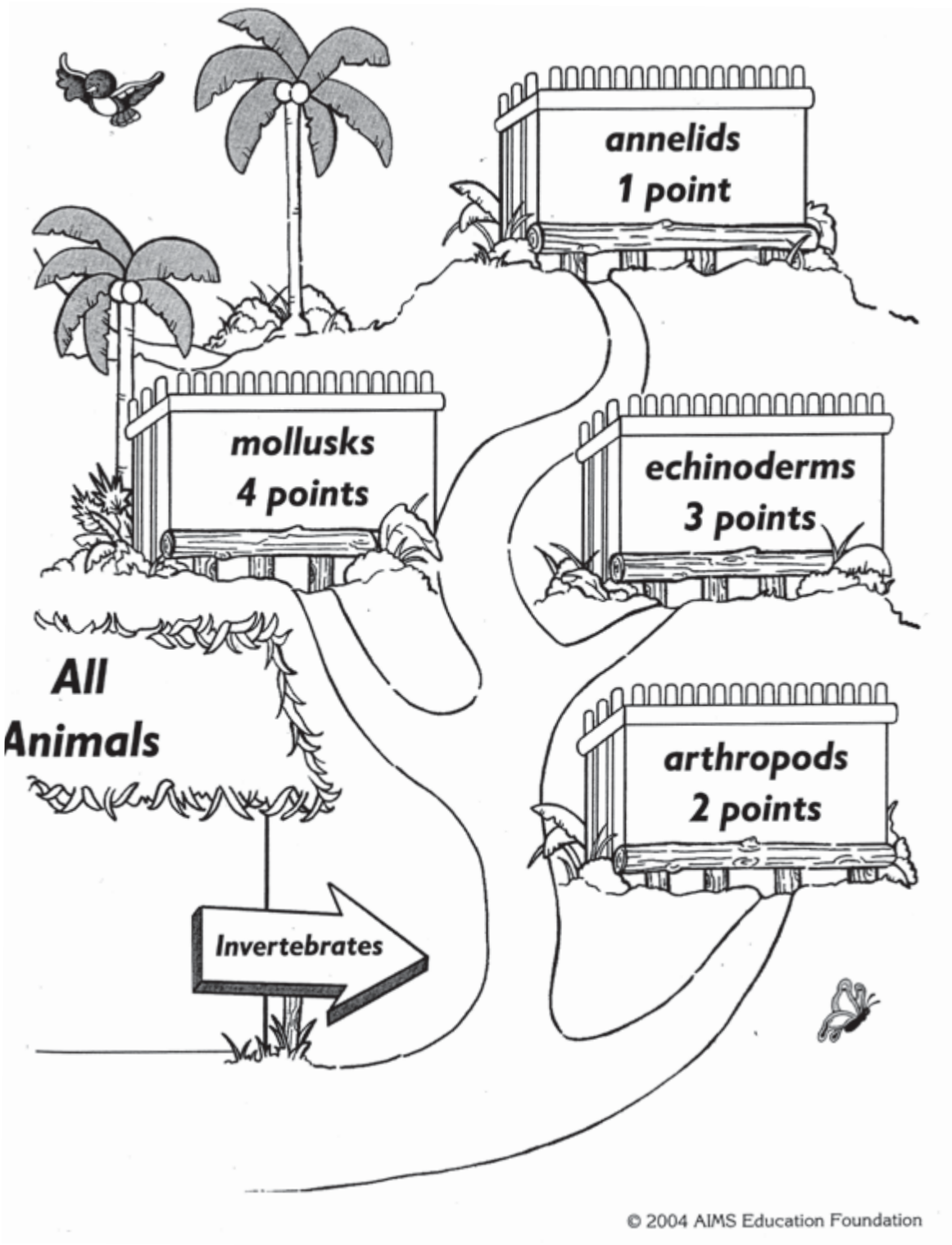
Classification Chart



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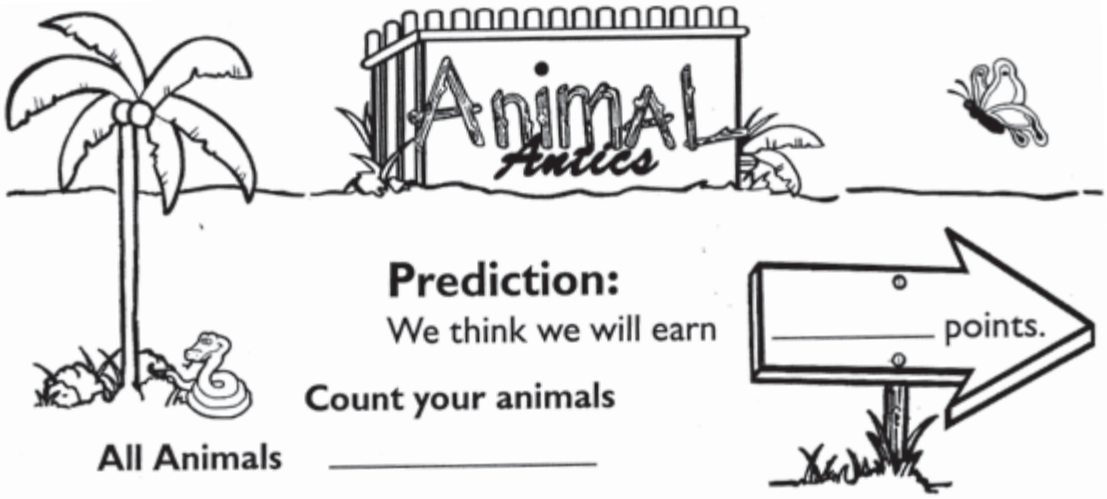
Data Chart



Prediction:
We think we will earn _____ points.

Count your animals

All Animals _____

Vertebrates _____

Invertebrates _____

Kind of Animal	# of Animals		Points Earned
mammals	_____	x 1 =	_____
fish	_____	x 3 =	_____
birds	_____	x 2 =	_____
reptiles	_____	x 4 =	_____
amphibians	_____	x 5 =	_____
annelids	_____	x 1 =	_____
mollusks	_____	x 4 =	_____
arthropods	_____	x 2 =	_____
echinoderms	_____	x 3 =	_____

Team Total _____

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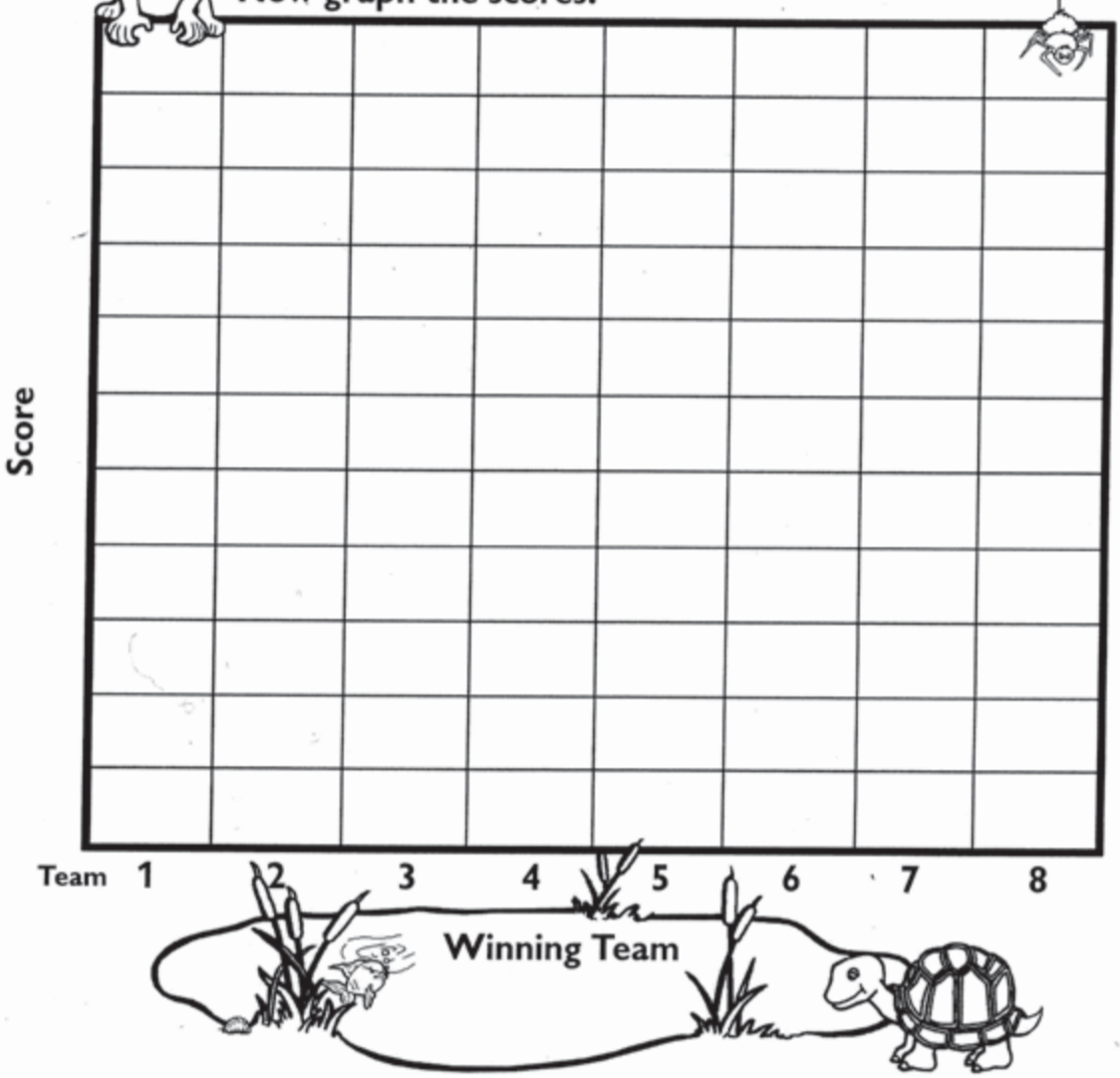
Animal Antics*

Graphing Sheet

Record the scores:

Team	1	2	3	4	5	6	7	8
Score								

Now graph the scores:



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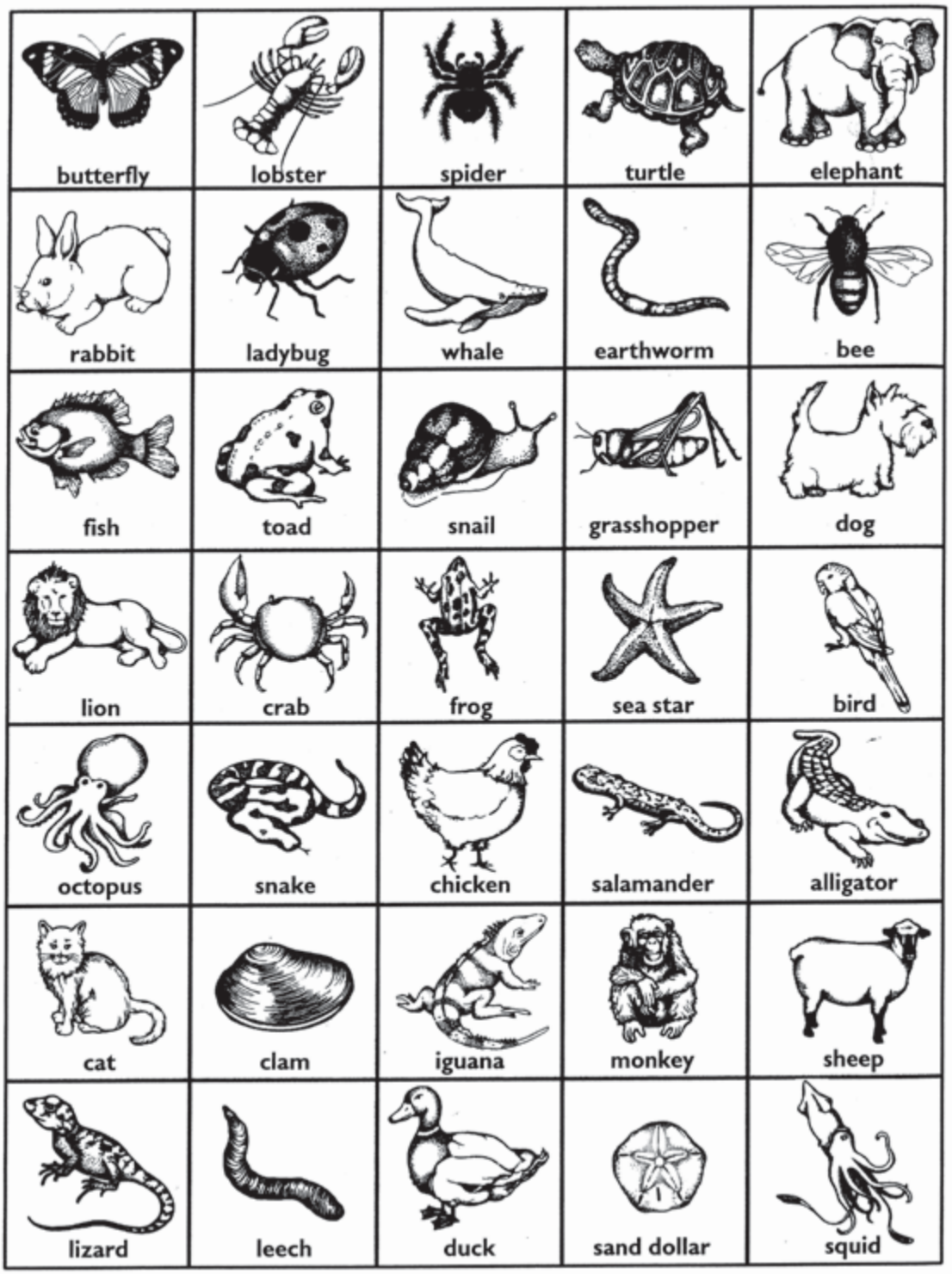
Animal Antics*

Animal Picture Sheet



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Di Means Two

Segment 1

Purpose

To learn how to use a dichotomous key

Background

Scientists can greatly simplify the identification of organisms by using a dichotomous key, an organized set of couplets that have mutually exclusive characteristics. You simply compare the characteristics of an unknown organism against an appropriate dichotomous key. These keys will begin with general characteristics and lead to more specific ones. If the organism falls into one category, you go to the next indicated couplet. By following the key and making the correct choices, you should be able to identify the organism. Couplets can be organized in several forms. Present the couplets by using numbers or letters (numeric key). You can also present them together or grouped by relationships (alphabetical key). There is no apparent uniformity in presentation for dichotomous keys.

Materials

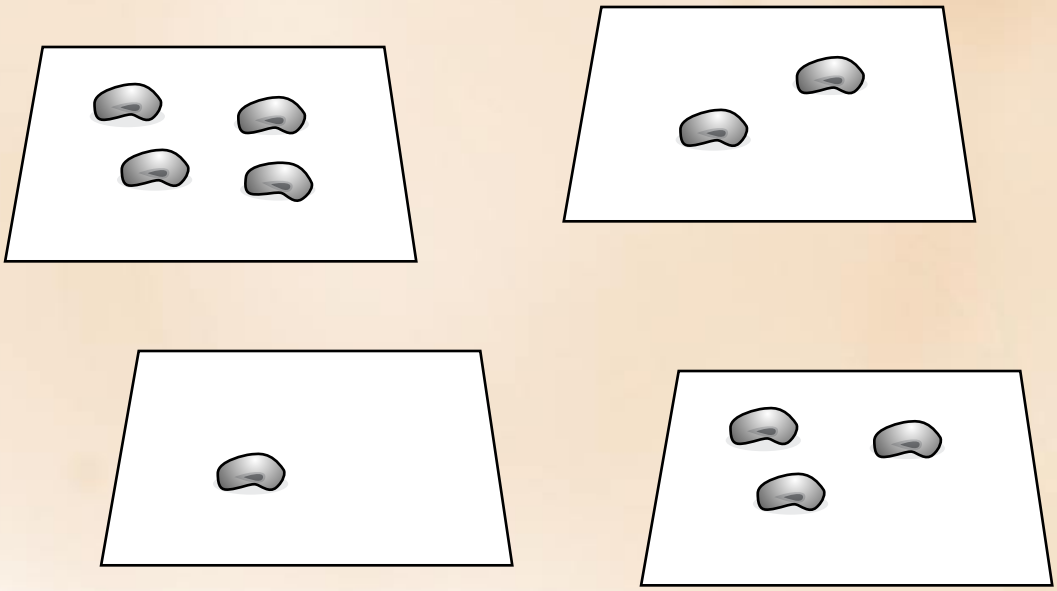
Per group

10 beans of each:
- kidney beans
- white northern beans
- pinto beans
- black beans

garbanzo beans
bowl
4 index cards
glue
marker

Procedure

1. Place five beans of each type in a bowl.
2. Choose one bean at a time and use the numeric key to identify the type of bean.
3. Go through the couplets by answering the questions correctly and proceeding to the next indicated couplet.
4. When you have correctly identified the bean, place it on an index card. Use a different index card for each type of bean.
5. Once all the beans have been identified, glue them onto the index cards and label each card with the correct name of the bean.
6. When you have finished, repeat the activity by using the remaining beans and the alphabetical key.



Di Means Two

Segment 1

Numeric Key

1a. Bean (round)	**garbanzo bean**
1b. Bean (elliptical or oblong)	Go to 2
2a. Bean (white)	**white northern**
2b. Bean (with dark pigments)	Go to 3
3a. Bean (evenly pigmented)	Go to 4
3b. Bean (pigmentation mottled)	**pinto bean**
4a. Bean (black)	**black bean**
4b. Bean (reddish-brown)	**kidney bean**

Alphabetical Key

A. Bean (elliptical or oblong)	Go to B
B. Bean has dark pigments	Go to C
C. Bean color is solid	Go to D
C. Bean color is mottled	**pinto bean**
D. Bean is black	**black bean**
D. Bean is reddish-brown	**kidney bean**
B. Bean is white	**white northern**
A. Bean is round	**garbanzo bean**

Conclusion

1. Which key was easier for you to use? Explain.
2. Why is it important to start out with general characteristics?
3. Why was it important for you to read both choices in a couplet before identifying the bean?
4. Were there any terms you didn't understand in either key? If so, what would you recommend?

Extension

Use household objects and create your own dichotomous key.

Cold-Blooded Bananas*

Segment 1

Purpose

To understand what it means to be cold-blooded

Teacher Note: To create a warm place in the room, use direct sunlight, a heater vent, sunlamp, or other available device. To create a cold place in the room, use a refrigerator, tub of ice, air conditioner, or other available device.

Materials

banana
2 identical thermometers
plastic knife or craft stick
hot area
cold area
Banana Data Sheet (p. 33)
toothpicks (optional)

Background

Cold-blooded (ectothermic) animals have no internal way of regulating their body temperatures. They are cool when their surroundings are cool and warm when their surroundings are warm. To maintain their body temperature within a range they can tolerate, cold-blooded animals may move to a warmer or cooler place. When their bodies are in contact with warmer or cooler surfaces, heat is transferred and their temperatures rise and fall. In extreme heat or cold, some animals burrow underground where the temperature is usually more moderate. Almost all animals are cold-blooded except for mammals and birds. Warm-blooded (endothermic) animals have a built-in automatic control system enabling them to have a consistent body temperature.

Procedure

1. Look at the thermometers and note the increments used to measure temperature. In the space provided on the side of the first banana graph on the Banana Data Sheet, write in the increments to "calibrate" or align the graph to the thermometer.
2. Use the plastic knife or craft stick to cut the banana into three pieces as equal in size as possible.
3. If toothpicks are provided, give each banana piece legs to create banana animals.
4. Use one thermometer to measure the room temperature.
5. Record the room temperature on the Banana Data Sheet by shading in the correct number of increments.
6. Insert the other thermometer into one of your banana animals and wait five minutes.
7. Record the temperature of the banana animal on the Banana Data Sheet.
8. Place one of the three banana pieces in a hot place and another in a cold place.
9. Wait one hour and then measure and record the room (air) temperature of the hot place.
10. Measure and record the temperature of the hot banana piece.
11. Repeat steps 9–10 with the cold banana piece.
12. Discuss your results.

Conclusion

1. Did the temperature of the banana pieces exactly match the surrounding air temperature? Why or why not?
2. Do you think cold-blooded (ectothermic) animals are having a harder time keeping warm or keeping cool today? Why? What might they be doing to meet their needs?
3. Would it make a difference if you kept the peel on the banana? Explain. How could you find out for sure?
4. What do aquatic (water) animals do to survive in a lake that freezes over?
5. What do desert animals do to survive the extreme heat?
6. Do you have any cold-blooded pets at home? If so, what are they and how do they regulate their body temperatures?

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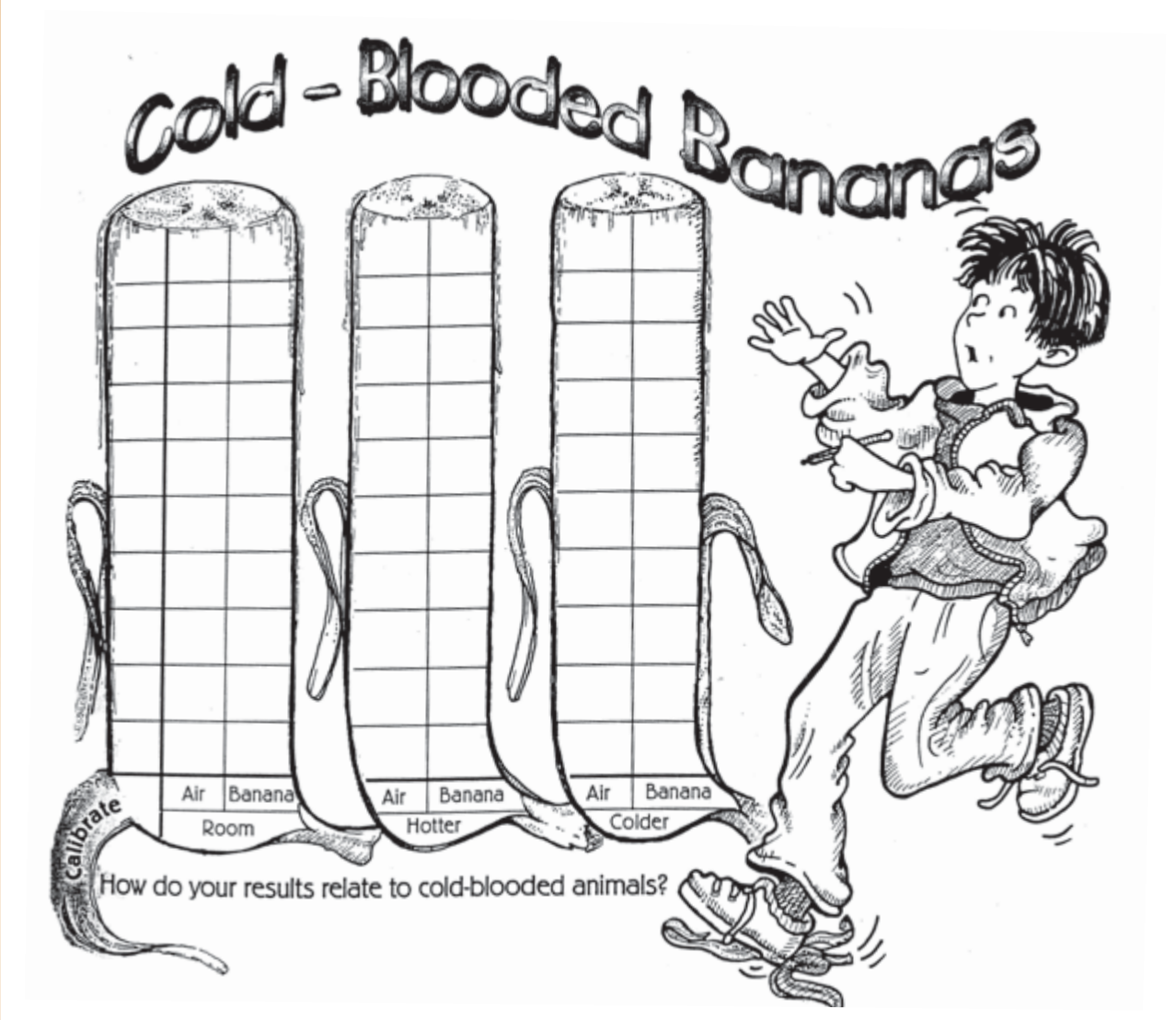
Cold-Blooded Bananas*

Segment 1



On a seperate sheet of paper, write number sentences to compare your data.

Example: The banana in the heat is _____ degrees warmer than the banana at room temperature.

Answer Key

Segment 1

Alike or Different?

1. Answers will vary.
2. Answers will vary.
3. Answers will vary but might include that one of the greatest challenges is the enormous diversity of animals.

Animal Antics

1-6. Answers will vary

Di Means Two

1. Answers will vary.
2. It is important to begin with general characteristics because it is easier to narrow the identification as you progress through the key and use more specific characteristics.
3. Although the first description may seem to fit your sample, the second one may apply even better.
4. Answers will vary. If students encounter difficulty using the terms in a dichotomous key, provide a glossary to avoid mistakes in identification.

Cold-Blooded Bananas

1. Answers will vary, but the temperature of the banana piece should have been close to the air temperature.
2. Answers will vary depending on the weather.
3. Yes, it might make a difference if the peel were kept on the banana. The peel can act as a type of insulation. To find out for sure, repeat the experiment, leaving the peel on the banana pieces.
4. Aquatic animals might stay in the somewhat warmer levels of the water or mud at the bottom.
5. Desert animals are usually active at night when it is cooler and stay sheltered during the day.
6. Answers will vary.

The NASA SCI Files™

The Case of the Zany Animal Antics

Segment 2

While at NASA Kennedy Space Center (KSC), Catherine and Bianca stop by to see Mr. Mario Mota, a wildlife biologist who monitors the sea turtle population. Mr. Mota helps the tree house detectives understand animals' basic needs and the intricacy of the food chain. Just a few hours away, RJ is at an Adventure Camp at Busch Gardens Tampa where he meets Dr. D on the Serengeti Plain exhibit. While on "safari," Dr. D explains migration and the basic reasons animals migrate. After feeding Dolly, a female giraffe, RJ decides to see Ms. Kelly Diedring, a zookeeper at the park. Ms. Diedring explains mitosis and meiosis and the various ways that animals reproduce. Meanwhile, back at the tree house, the detectives have decided to put all their new knowledge to good use and help Kali with her Girl Scout badge. They also want to investigate building a wildlife preserve in Jacob's backyard. The detectives are not daunted by the challenges and continue their research.

Objectives

Students will

- summarize the basic needs of animals.
- understand the hierarchy of a food chain.
- describe how a food chain differs from a food web.
- learn how and why animals migrate.
- compare sexual and asexual reproduction.
- compare and contrast mitosis and meiosis.
- understand the importance of genetic diversity in a species.

Vocabulary

asexual reproduction—the production of offspring from one parent cell; reproduction without the fusion of male and female sex cells

carnivore—an animal that eats other animals

cell—the smallest independently functioning unit in the structure of an organism, usually consisting of one or more nuclei surrounded by cytoplasm and enclosed by a membrane

consumer—an organism that relies on other organisms for its energy and food supply

decomposer—an organism that breaks down and obtains energy from dead organic matter

food chain—series of steps in an ecosystem in which organisms transfer energy by eating and being eaten

food web—network of complex interactions formed by the feeding relationships among the various organisms in an ecosystem

genetics—scientific study of heredity

habitat—the natural conditions and environment in which a plant or animal lives

herbivore—an organism that obtains its energy by eating only plants

meiosis—a method of cell division in which sex cells are produced

migration—moving from one country, place, or locality to another; the movement of animals over the same route in the same season each year

mitosis—the process in which a cell's nucleus divides, forming two new cells with identical genetic material

omnivore—an organism that obtains energy by eating both plants and animals

producers—organisms that can capture energy from sunlight or chemicals and use it to produce food from inorganic compounds

reproduce—to produce offspring or new individuals through a sexual or asexual process

Serengeti Plain—an area of northern Tanzania bordering Kenya and Lake Victoria that is well known for its extensive wildlife preserve

sexual reproduction—the production of offspring by using sex cells

zygote—a fertilized egg

Video Component

Implementation Strategy

The NASA SCI Files™ is designed to enhance and enrich 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 Zany Animal Antics*, discuss the previous segment to review the problem and reaffirm what the tree house detectives have learned thus far. Download a copy of the **Problem Board** from the NASA SCI Files™ web site, select **Educators**, and click on the **Tools** section. The **Problem Board** is also in the **Problem-Solving Tools** section of the latest online investigation. Have students use it to sort the information learned so far.
2. Review the list of questions and issues that the students created prior to viewing Segment 1 and determine which, if any, were answered in the video or in the students' own research.
3. Revise and correct any misconceptions that may have been dispelled during Segment 1. Use tools located on the Web, as was previously mentioned in Segment 1.
4. Review the list of ideas and additional questions that were created after viewing Segment 1.
5. Read the Overview for Segment 2 and have students add any questions to their lists that will help them better understand the problem.
6. **Focus Questions**—Print the questions from the web site ahead of time for students to copy into their science journals. Encourage students to take notes while viewing the program to help them answer the

questions. An icon will appear when the answer is near.

7. **"What's Up?" Questions**—These questions at the end of the segment help students predict what actions the tree house detectives should take next in the investigation process and how the information learned will affect the case. They can be printed from the web site ahead of time for students to copy into their science journals.

View Segment 2 of the Video

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

After Viewing

1. Have students reflect on the "What's Up?" Questions asked at the end of the segment.

Careers
animal trainer
behaviorist
geneticist

2. Discuss the Focus Questions.
3. Have students work in small groups or as a class to discuss and list what new information they have learned about animals' basic needs, habitats, migration patterns, and reproduction.
4. Organize the information and determine whether any of the students' questions from the previous segments were answered.
5. Decide what additional information is needed for the tree house detectives to build a healthy backyard habitat. Have students conduct independent research or provide students with information as needed. Visit the NASA SCI Files™ web site for an additional list of resources for both students and educators.
6. Choose activities from the **Educator Guide** and web site to reinforce concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced and use activities to aid student understanding in those areas.
7. For related activities from previous programs, download the **Educator Guide**. On the NASA SCI Files™ home page, select **Educators**. Click on **Episodes** in the menu bar at the top. Scroll down to the 2002–2003 Season and click on *The Case of the Inhabitable Habitat*. In the green box, click on **Download the Educator Guide**.

   a. In the **Educator Guide** you will find

   b. **Segment 1** – *Biomes, Welcome to My Habitat, Don't Burst My Bubble, and How Does Your Garden Grow*

   c. **Segment 2**—*How Are We Related? A Community Connected, Chain Reaction, and Sprouts To Grow*

   d. **Segment 4**—*Where Have All the Turtles Gone? Fishing for Fish, and Bloomin' Algae*

   Close the PDF window and return to the Educators page. Click on **Episodes** in the menu bar at the top. Scroll down to the 2002–2003 Season and click on *The Case of the Biological Biosphere*. In the green box, click on **Download the Educator Guide.**

   a. In the **Educator Guide** you will find

      a. **Segment 2** – *Going Cellular*

      b. **Segment 4** – *Biologically Speaking*

   Close the PDF window and return to the Educators page. Click on **Episodes** in the menu bar at the top. Scroll down to the 2003–2004 Season and click on *The Case of the Prize-Winning Plants*. In the green box, click on **Download the Educator Guide**.

   b. In the **Educator Guide** you will find

      a. **Segment 4** – *Teenage-Mutant Corn?*
8. If time did not permit you to begin the web activity at the conclusion of Segment 1, refer to number 6 under **After Viewing** on page 15 and begin the Problem-Based Learning activity on the NASA SCI Files™ web site. If the web activity was begun, monitor students as they research within their selected roles, review criteria as needed, and encourage the use of the following portions of the online, Problem-Based Learning activity:

   Research Rack—books, Internet sites, and research tools

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

   Dr. D's Lab—interactive activities and simulations

   Media Zone—interviews with experts from this segment

   Expert's Corner—listing of Ask-An-Expert sites and biographies of experts featured in the broadcast
9. Have students write in their journals what they have learned from this segment and from their own experimentation and research. If needed, give students specific questions to reflect upon as suggested on the **PBL Facilitator Prompting Questions** instructional tool found by selecting **Educators** on the web site.
10. Continue to assess the students' learning, as appropriate, by using their journal writings, problem logs, scientific investigation logs, and other tools that can be found on the web site. For more assessment ideas and tools, go to **Educators** and click on **Instructional Tools** in the menu bar.

Resources *(additional resources located on web site)*

Books

Bash, Barbara: *Urban Roosts: Where Birds Nest in the City*. Little, Brown, and Company, 1992, ISBN: 0316083127.

Capeci, Anne: *Food Chain Frenzy*. Scholastic, 2004, ISBN: 0439560500.

Cherry, Lynne: *Flute's Journey*. Harcourt, 1997, ISBN: 0152928537.

Chinery, Michael: *Predators and Prey*. Crabtree Publishing, 2000, ISBN: 0778702278.

Cole, Joanna: *Magic School Bus Goes Upstream: A Book about Salmon Migration*. Sagebrush Education Resources, 1997, ISBN: 0613027388.

Durand, Stephane: *Winged Migration: The Junior Edition*. Editions du Seuil, 2004, ISBN: 2020633493.

Hammerslough, Jane: *Owl Puke: Book and Owl Pellet*. Workman, 2004, ISBN: 0761131868.

Kalman, Bobbie: *What Are Food Chains and Webs?* Crabtree Publishing, 1998, ISBN: 0865058881.

Kalman, Bobbie: *What Is a Life Cycle?* Crabtree Publishing Company, 1998, ISBN: 0865058865.

Kalman, Bobbie: *The Life Cycle of a Sea Turtle*. Crabtree Publishing Company, 2001, ISBN: 0778706826. (Note: This author has completed an extensive collection of life cycle books including earthworm, honeybee, seahorse, bird, snake, whale, wolf, and spider.)

Knight, Tim: *Incredible Life Cycle*. Heinemann Library, 2003, ISBN: 1403411484.

McDonnell, Janet: *Animal Migration*. Child's World, Inc., 1997, ISBN: 1567664024.

Phinney, Margaret Yatsevitch: *Exploring Underground Habitats*. Mondo Publishing, 1999, ISBN: 1572551615.

Riha, Susanna: *Animal Journeys: Life Cycles and Migrations*. Blackbirch Press, 1999, ISBN: 1567114261.

Video

Disney Channel: *Food Web (Bill Nye the Science Guy)*
Grades 3–8

Disney Channel: *Life Cycles (Bill Nye the Science Guy)*
Grades 3–8

Schlessinger Media: *Animal Life for Children: All About Animal Life Cycles*
Grades K–4

Schlessinger Media: *Animal Life for Children: All About Food Chains*
Grades K–4

Web Sites

NASA Imagers: The Adventures of Amelia the Pigeon
This NASA web site teaches children about habitats and offers an interactive web site with a multimedia adventure game and web activities.
http://imagers.gsfc.nasa.gov/amelia/index.html

Busch Gardens® Tampa Bay
Visit this site to learn about the unique educational opportunities and resources available for teachers and students, with free downloads of educator guides on such topics as "Arctic Animals" and "Diversity of Life." Explore various careers and learn more about Busch Gardens® Adventure Camps.
http://www.buschgardens.com/buschgardens/fla/educational_resources.aspx

Animal Homes
Click and drag the animals to their appropriate habitat in this interactive animal homes game.
http://games.funschool.com/game.php?g=ank_ds2,f&8&54

National Geographic Kids—The Fantastic Forest
In this interactive virtual forest, you'll encounter a variety of habitats—places perfectly suited for particular plants and animals that are important parts of the forest and our environment.
http://www.nationalgeographic.com/forest/index.html

Africam
Visit Africam, the world's first virtual game reserve to see the live web cams set up at game reserves across the world. You can see the various habitats animals live in.
http://www.africam.com/

Animal Migration
Visit the Franklin Institute's web site to learn about the migratory patterns of birds, butterflies, whales, and many other animals.
http://sln.fi.edu/qa96/spotlight4/spotlight4.html

US Geological Survey—Children's Butterfly Site
Learn about the life cycle of a butterfly on this US Geological Survey web site. There are coloring pages, pictures, links to other web sites, and a frequently asked questions area.
http://www.mesc.usgs.gov/resources/education/butterfly/bfly_intro.asp

The Circle of Life: Life Cycles
Visit this web site to learn about the life cycles of frogs, dogs, butterflies, fish, turtles, chickens, grasshoppers, and plants. There are also fun games to play after you have learned some of the life cycles.
http://www.promotega.org/vsu30015/

Ecosystems, Biomes, and Habitats
The Franklin Institute's web site has a wide variety of information on animal habitats and biomes.
http://www.fi.edu/tfi/units/life/habitat/habitat.html

Living and Non-Living Things
This Open Door Web Site provides information on the differences between living and non-living things.
http://www.saburchill.com/chapters/chap0001.html

Marshmallow Meiosis
Explore genetics by raising reebops in the classroom. Reebops are imaginary organisms that are prolific and require minimal care. Made from marshmallows and other everyday common household items, they are a fun-filled way to teach meiosis.
http://www.iloveteaching.com/writesci/Rebops/

Activities and Worksheets

In the Guide

Just the Basics
In this game, simulate a population to learn more about the basic needs of animals. 40

"Vore"-acious Eaters
Play a game using fruit looped cereal to learn about the basic needs of animals.. 43

Chain Games
Use wadded-up paper to learn how the Sun is the source of all energy in the food chain. 47

Misdirected Migrations
Play a unique game of hopscotch to learn about animal migration. 52

Answer Key
..... 54

On the Web

The Critter Connection: Food Chains
Create a reference book to learn more about the food chain.

Mitosis and Meiosis
Conduct research to learn more about mitosis and meiosis to create a poster explaining the processes.

Just the Basics

Segment 2

Purpose

To identify and describe four essential components of a healthy habitat

Materials

duct tape or string
large, open area (outside is best)
Data Sheet (p. 42)

Teacher Prep

1. Using tape or string, mark off two 15-meter parallel lines on the floor or playground that are about 10–20 meters apart.
2. Have students count off in fours.
3. Discuss the basic needs of animals with the students and do steps 1 and 2 prior to playing the game.

Procedure

1. In your group, discuss what animals need to survive and without which they would die. Consider what you need each day to survive.
2. Reach a consensus of the four most important things for survival and write your prediction below:
   a. _____ is an essential habitat component for animals to survive.
   b. _____ is an essential habitat component for animals to survive.
   c. _____ is an essential habitat component for animals to survive.
   d. _____ is an essential habitat component for animals to survive.

Game

1. To play the game, the students who are number 1 are deer and will stand behind one line.
2. All other students (2, 3, and 4) will stand behind the other line.
3. Use the following signals
   a. food: place hands over stomach
   b. water: place hands over mouth
   c. shelter: clasp hands over head
   d. space: hold arms straight out
4. Both groups should stand in a straight line next to their designated lines on the ground with their backs to the other group. See diagram 1.

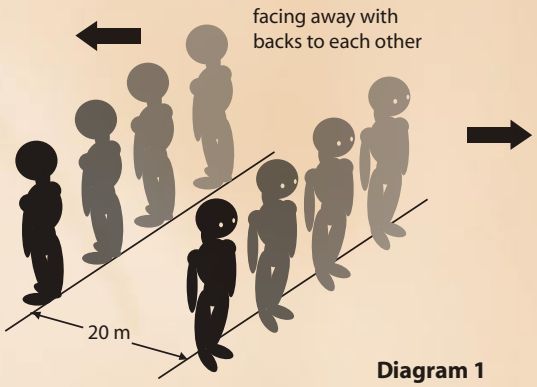


Diagram 1

5. When the teacher or leader indicates that the game is about to begin, everyone chooses an essential habitat component (food, water, shelter, or space) and displays that signal as indicated in step 3.
6. When the teacher or leader counts to three, turn and face the other group.
7. The "deer" will run to find and capture a student on the other side that has signaled the same habitat component that they did. For example, if a deer chooses food by placing his hands over his stomach, he would need to capture a person on the other side that also chose food.
8. If a deer captures the needed habitat component, they both return to the deer's side of the line. The deer has now successfully reproduced, and a new deer has been added to the group.
9. Any deer that fails to find the habitat component it was seeking dies and becomes part of the habitat, joining the students on the habitat side.

Just the Basics

Segment 2

10. Count the number of deer remaining after the first round and record it in the data sheet.
11. Count the number of habitat components remaining and record in the data sheet.
12. Continue playing the game for 14 more rounds.
13. Using the recorded data, create a graph showing the number of deer after each round.
14. Create a graph showing the number of habitat components after each round.
15. Compare the two graphs. Note: To more easily compare the two graphs, you can create one graph using one color to represent deer and another color to represent habitat components.

Conclusion

1. What are the basic needs of animals?
2. Explain what happened as the game progressed.
3. What are some factors that could limit a population?
4. How do human beings limit a population's growth?

Extension

Play the game again but introduce limiting factors that would deplete the habitat components. Graph the results and compare. There have to be at least two deer left or the deer are extinct.

Just the Basics

Segment 2

DATA SHEET

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Deer															
Habitat Components															

KEY

"Vore"-acious Eaters*

Segment 2

Purpose

To identify how to meet the need for water and food in an environment

To use data to determine if an animal can survive in an environment

To describe the food needs of carnivores, herbivores, and omnivores

Background

Organisms' needs must be met for them to survive in a specific environment. Organisms need food, water, shelter, and space.

One way that animals are grouped is by the food they eat. Carnivores eat only meat, herbivores eat only plants, and omnivores eat both meat and plants.

Teacher Prep

1. Using card stock, make enough copies of the Animal Needs Cards (p. 45) so that each student receives one. Cut apart the cards and laminate them if desired. Note: Cards are to be passed out to the students after they have graphed their results.
2. Shortly before beginning this activity, distribute the multicolored cereal loops over a large area (outdoors works best) that is free from objects that students might trip over.

Materials

per Class
box of multicolored loop cereal
Animal Needs Cards (p. 45)
timer or watch
large, open area (outside is best)

Per Student
small piece of clay
6 long coffee stirrers
colored pencils or crayons
small lunch bag
Graphing Sheet (p. 46)

Diagram 1

Procedure

1. Make a list of all the foods you ate for your last meal.
2. Classify each type of food as either coming from a plant or animal. Some foods, such as a pizza, might be classified as both.
3. Determine whether you are an omnivore, herbivore, or carnivore based on your last meal.
4. Make a list of the reasons why these foods are important to your survival.
5. Discuss your rationale with your group or class.
6. When it's time to play the game, take the lunch bag and go to the area designated by your teacher.
7. When the teacher gives the signal to begin, you will have three minutes to collect as many cereal loops as you can and place them in the lunch bag.
8. When the teacher gives the signal to stop, return to the classroom.
9. Divide the small piece of clay into six equal parts and roll each into a ball.
10. Insert a coffee stirrer into each ball of clay. See diagram 1.
11. Place the balls of clay with the stirrers onto the Graphing Sheet at the bottom. Place one ball with stirrer on top of each letter.
12. Note the letter and the color it represents: R—red, O—orange, Y—yellow, G—green, B—blue, and P—purple.
13. To create a three-dimensional bar graph, sort the multicolored cereal loops by placing each loop on the correct stirrer designated for that color.
14. On the left side of the Graphing Sheet, record the increments by numbering the lines (0, 1, 2…) from the bottom upward.
15. Record the results from your three-dimensional bar graph onto the Graphing Sheet.
16. When your teacher gives you an Animal Needs Card, read the criteria given and determine whether your water and food needs were met. If so, you survived!

*** This activity is modified and used with the permission of the AIMS Education Foundation, http://AIMSedu.org**

"Vore"-acious Eaters*

Segment 2

Conclusions

1. What are the two needs that this activity helped you understand organisms must have to survive?
2. Is it important that all animals survive in an environment? Why or why not?
3. Which type of animal (omnivore, carnivore, or herbivore) had the best chance of surviving? Why?
4. What types of food were represented by the orange, red, green, and yellow loops?
5. Were you able to use all your loops for food? Why or why not?
6. Would too much food in an environment be a problem? Explain.

"Vore"-acious Eaters*

Animal Needs Cards

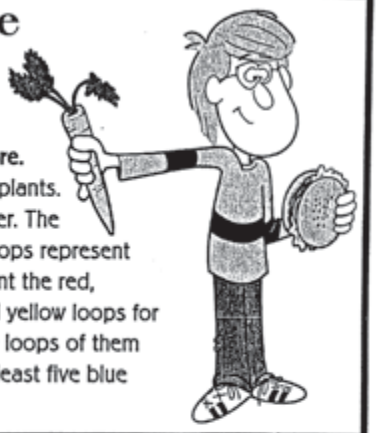
"Vore"-acious Eaters

Animal Needs Cards

Omnivore

You are an **omnivore.** You eat meat and plants. You also need water. The purple and blue loops represent water. You can count the red, orange, green, and yellow loops for food. You need 20 loops of them to survive, plus at least five blue and purple loops.

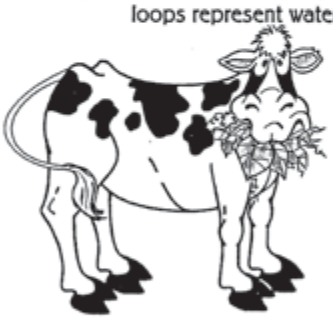
Omnivore



You are an **omnivore.** You eat meat and plants. You also need water. The purple and blue loops represent water. You can count the red, orange, green, and yellow loops for food. You need 20 loops of them to survive, plus at least five blue and purple loops.

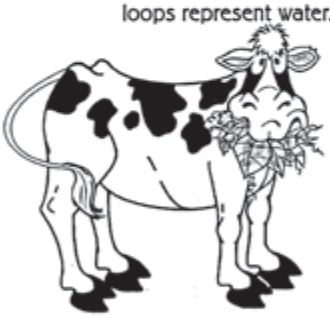
Herbivore

You are an **herbivore.** You only eat plants. You also need water. The purple and blue loops represent water. The only loops you can count for food are the green- and yellow-colored loops. To survive, you need 20 green and yellow loops and an even number of blue and purple loops.



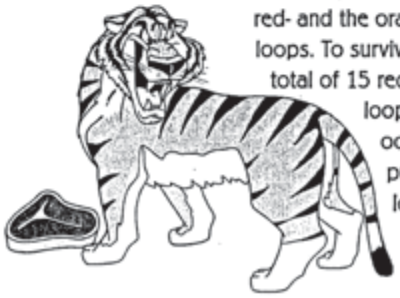
Herbivore

You are an **herbivore.** You only eat plants. You also need water. The purple and blue loops represent water. The only loops you can count for food are the green- and yellow-colored loops. To survive, you need 20 green and yellow loops and an even number of blue and purple loops.



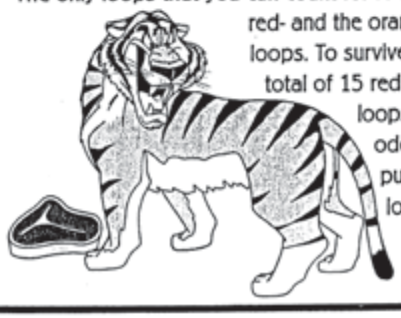
Carnivore

You are a **carnivore.** You only eat meat. You also need water. The purple and blue loops represent water. The only loops that you can count for food are the red- and the orange-colored loops. To survive, you need a total of 15 red and orange loops and an odd number of purple and blue loops.



Carnivore

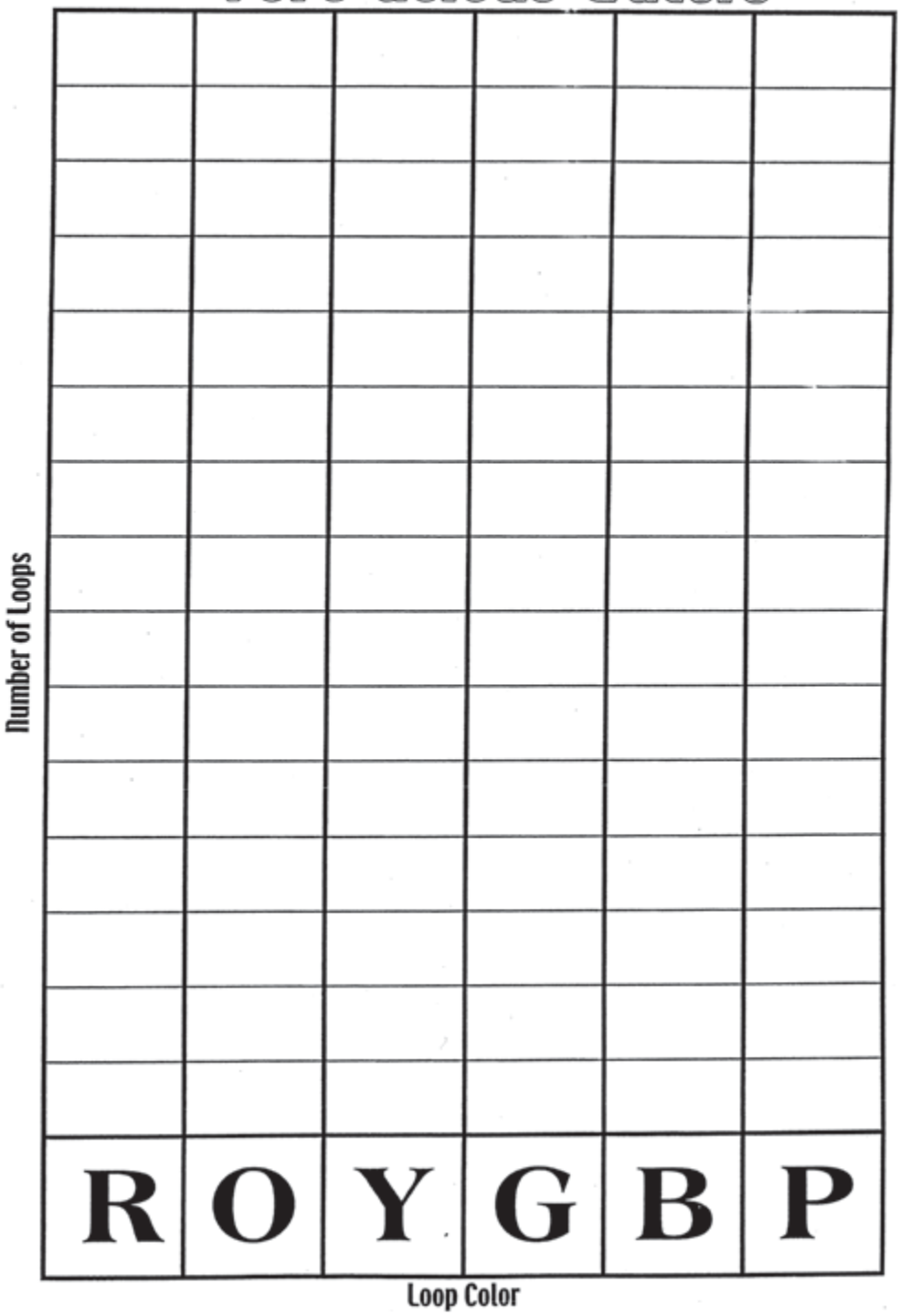
You are a **carnivore.** You only eat meat. You also need water. The purple and blue loops represent water. The only loops that you can count for food are the red- and the orange-colored loops. To survive, you need a total of 15 red and orange loops and an odd number of purple and blue loops.



"Vore"-acious Eaters*

Graphing Sheet

"Vore"-acious Eaters



Chain Games*

Segment 2

Purpose

To learn that plants are the main source of energy entering most food chains

Materials

labels
Chain Game Cards (p. 50)
Food Chain Key (p. 51)
scissors
wadded ball of paper (energy)

Background

Food chains exist in all habitats and can be used to demonstrate the complexity and energy flow in an ecosystem. Producers capture the Sun's energy to make their own food in plant form, while consumers rely on other consumers or on eating those plants to get their energy. When an animal eats a plant, it only receives 10% of the energy that the plant got from Sun. Likewise, when an animal eats another animal, it only receives 10% of the energy the animal got from the plants or other things it ate. This 90% energy loss at each level of a food chain is the reason there are so many low-level (primary) consumers and so few top-level consumers.

Teacher Prep

1. Make enough copies of the Chain Game Cards (p. 49-50) for each group of four students to have a set.
2. Make a set of labels for each group of four on paper or index cards that say Sun, Grass, Deer, Wolf.
3. Make a ball of wadded paper (four pieces of paper per ball) for each group by wadding one piece of paper and then wadding another piece over the first ball until you have created four layers.

Procedure Part 1

1. In a small group of four, discuss the tasks that you have done today. Did you complete a math assignment, run on the playground, sing a song, or just breathe?
2. Discuss and make a list of where you found the energy to accomplish these tasks.
3. Look at the ball of wadded paper. This ball represents energy.
4. Lay face down the four labels that say Sun, Grass, Deer, and Wolf.
5. Have each member of the group choose one label.
6. The Sun holds the ball of energy and begins the game by passing it to Grass.
7. Grass removes one layer of paper from the ball. What does removing the paper represent?
8. Grass passes the ball to Deer.
9. Deer removes one piece of paper and passes it to Wolf.
10. Wolf removes one piece of paper. What is left?
11. Explain what happens to the energy as it moves along the food chain.

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Chain Games*

Segment 2

Procedure Part 2

1. Using scissors, cut apart the Chain Game cards.
2. Shuffle the cards and lay them face down in ordered rows and columns.
3. Determine which player will go first (youngest).
4. The first player will turn over two cards face up.

   a. If either of these cards begins or continues a food chain, the player takes the card(s). For example, if a player turns over a Sun, he/she will take that card because the Sun is at the beginning of a food chain.

   b. All food chains must begin with the Sun, followed by a producer.

   c. If the player can use only one of the two cards, the unusable card is turned face down in the same location from which it was taken.

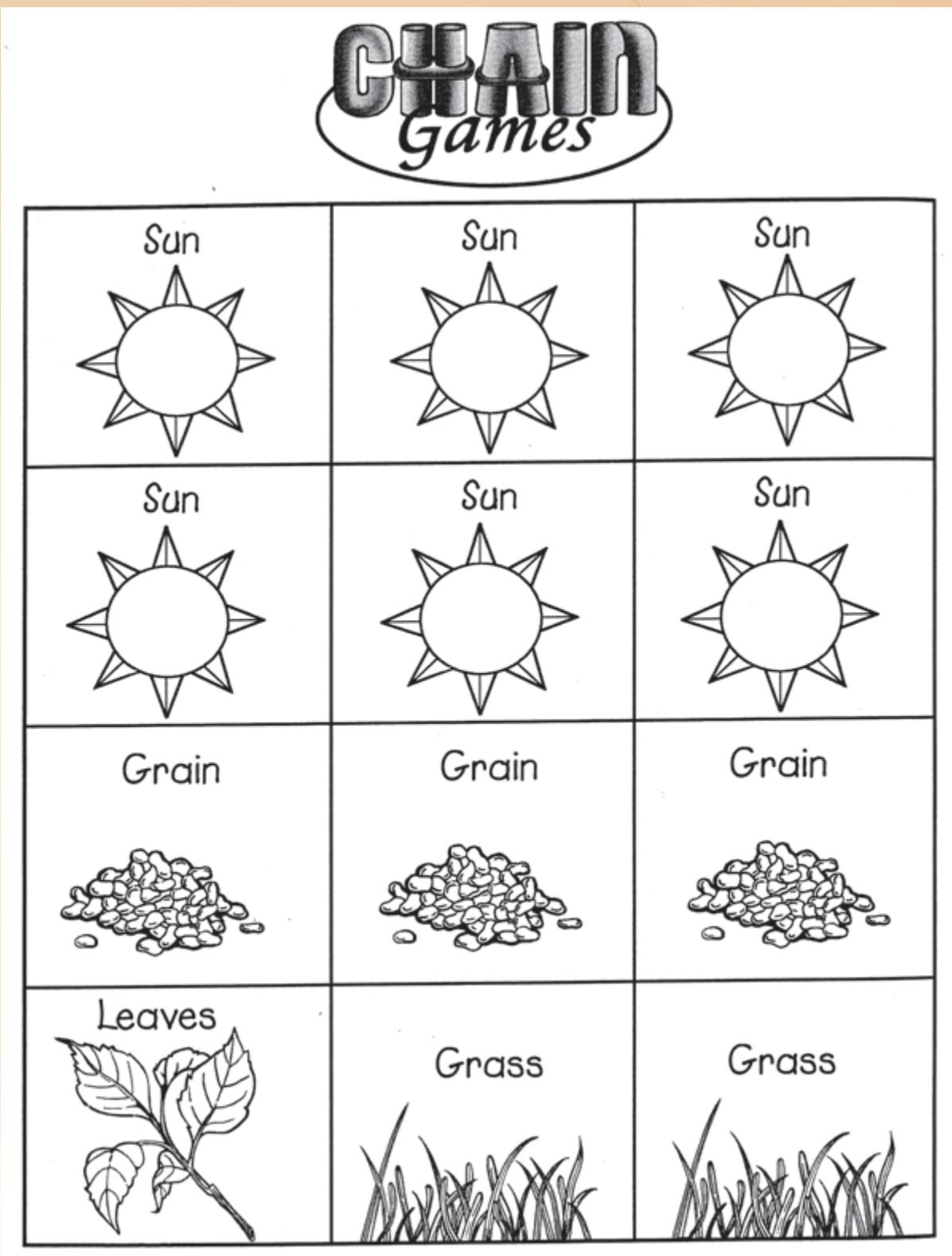
   d. If a player can use both cards, he/she continues to turn cards over, one at a time until a card that he/she cannot use is turned over. The unusable card is replaced face down.
5. The player to the left of the first player now takes his/her turn and the game continues by repeating steps 4 and 5.
6. Players may have multiple food chains going at the same time.
7. The game ends when there are no more food chains that can be created with the remaining cards.
8. Use the Food Chain Key to verify that food chains have been correctly linked.

Conclusion

1. Could plants ever be anywhere in the food chain except at the beginning? Explain.
2. Could animals ever be at the beginning of a food chain? Why or why not?
3. What is the source of all energy?

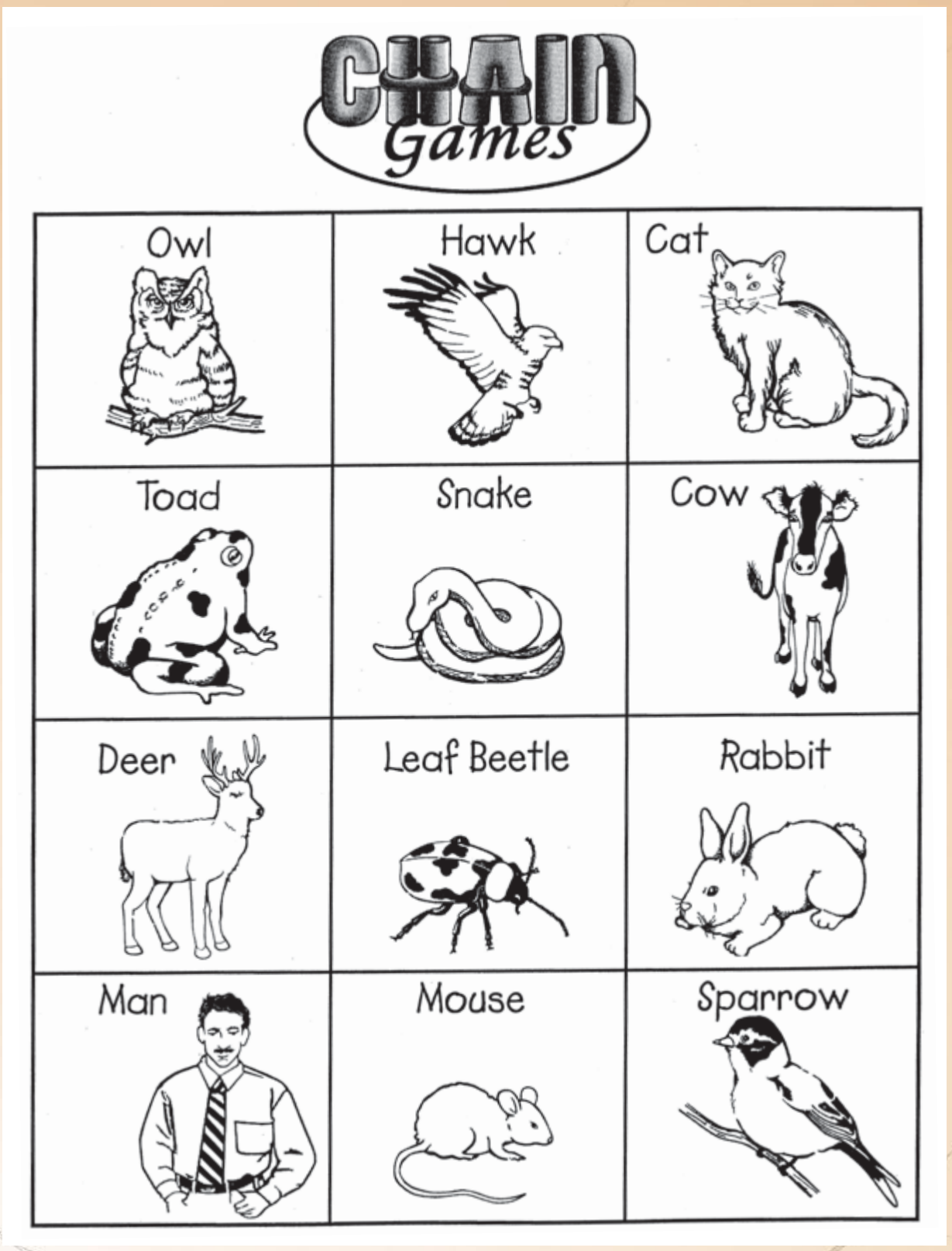
Chain Games*

Chain Game Cards



Chain Games*

Chain Game Cards



Chain Games*

Food Chain Key

CHAIN Games

Food Chain Key

Owl	**What it eats:** Frog Sparrow Snake Mouse	Hawk	**What it eats:** Snake Sparrow Mouse Frog Rabbit	Cat	**What it eats:** Frog Snake Sparrow Rabbit Mouse
Toad	**What it eats:** Leaf beetle	Snake	**What it eats:** Frog Mouse	Cow	**What it eats:** Grain Grass
Deer	**What it eats:** Grain Leaves Grass	Leaf Beetle	**What it eats:** Leaves	Rabbit	**What it eats:** Grain Grass Leaves
Man	**What it eats:** Cow Rabbit Deer Grain	Mouse	**What it eats:** Grain	Sparrow	**What it eats:** Grain Leaf beetle

Misdirected Migrations

Segment 2

Purpose

To understand how animals migrate and factors that affect their migration

Background

Migration is the movement of animals over the same route in the same season each year. There are several reasons that animals migrate. In the northern and southern hemispheres, there are several months each year when the areas are covered by snow and ice. In such harsh conditions, plant growth decreases, making it difficult for animals to find food. Some animals will travel from the winter place where food is scarce to a warmer place where food is more plentiful. Some animals will stay behind and make the best of the situation, while others will become dormant or inactive to save energy.

In other parts of the world, such as Africa, springbok, wildebeests, zebras, and other large African mammals travel long distances from dry areas to wet regions where new plants are growing. These journeys are often less predictable than seasonal north-south migrations, but they involve some of he largest mass movements of animals on Earth.

Some ocean mammals, such as right whales and fur seals, migrate to find warmer water, locate food, and give birth to their young. Fish usually migrate to breed.

There are many factors that ensure the success of migration. For example, birds need ponds, lakes, and marshes to provide food and shelter as they travel. Without these areas, such as wetlands, birds would not have the energy to make the long journey. At the time our country was first settled in the 1600s there were 215 million acres of wetlands. Today there are less than 100 million acres.

Teacher Prep

1. Use chalk or duct tape to create a large hopscotch course, as depicted in diagram 1, page 53.
2. Reduce the number of squares by one after all students complete the course. Reduce them in this order: square 3, square 5, square 7, square 6, square 8.

Procedure

1. You are a bird trying to migrate from Florida to Maine. Each square represents a wetland where you stop along your journey to rest, get food, and find shelter.
2. Start in squares 1 and 2 and complete the hopscotch course.
3. After all students have completed the course, discuss how difficult it was to complete.
4. Unfortunately, an area of wetland along your route has been destroyed due to a new building addition to the community. Note: Teacher will mark off square 3.
5. Complete the hopscotch course, not using square 3.
6. Repeat step 3.
7. Areas continue to be destroyed each year you make the journey. Repeat steps 4–6 until all designated areas are destroyed.
8. In your science journal, write about the experience and describe when you failed to make the migration.

Misdirected Migrations

Segment 2

Conclusion

1. Explain why some birds died earlier than others.
2. Why did all the birds eventually die even though some wetlands remained?
3. Is it important to save wetlands? Why or why not?
4. It is often necessary to develop new areas for business, subdivisions, and industry as communities grow. What could be done to balance growth with preserving our wetlands and other vital habitats?

Extension

1. Investigate your community and local areas to see whether there are any threatened wetlands.
2. Use field guides or other resources to find any birds that migrate to and from your community.
3. Research the migration patterns of the animals on the Serengeti Plain. Use a map of Africa to show the patterns of their migrations.
4. Research ocean marine animals and draw their migration patterns on a world map.

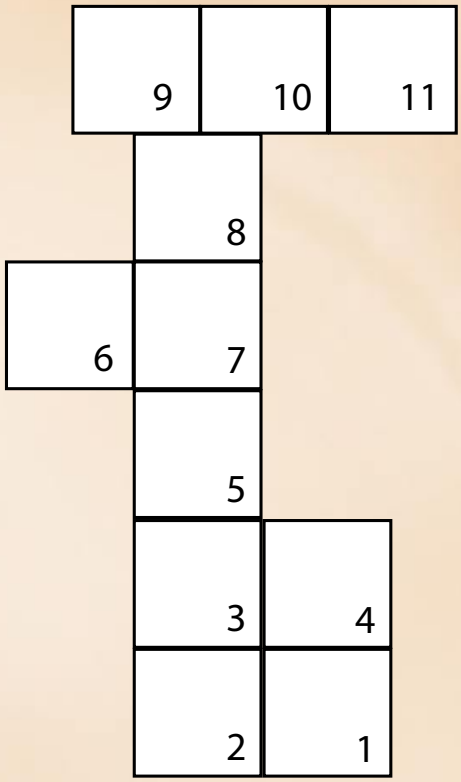


Diagram 1

Answer Key

Segment 1

Just the Basics

1. Food, water, shelter, and space.
2. The herd grows in the beginning, then some die as the habitat is depleted. This fluctuation is a natural process unless factors, which limit the population, become excessive.
3. Answers will vary but might include drought, fires, deforestation, industrial development, storms, and uncontrolled hunting.
4. Human beings develop areas for housing and industry. Each time an area is developed with buildings, streets, and other factors, there is less area of usable habitat for the animals that live there.

"Vore"-acious Eaters

1. Food and water.
2. No, the environment would eventually become overpopulated and there would not be enough resources to meet their needs.
3. Omnivores would have the best chance to survive because by eating both plants and animals, they have many more options for food.
4. Orange and red represented meat and yellow and green represented plants.
5. Answers will vary, but most students who were herbivores and carnivores would not have been able to use all cereal loops. If a student was a carnivore and got yellow and green loops (plants), he/she would not have been able to use them. It would be just the opposite for an herbivore.
6. Answers will vary, but too much food might pose a problem. Animals might have the tendency to overeat, which might cause problems with their ability to run fast and escape predators. Too much food might also create a population explosion and overcrowd the environment.

Chain Game

1. No, because they make their own food, they can only get their energy directly from the Sun.
2. No, animals are not able to make their own food, so they have to get their energy by eating a plant or other animal.
3. The Sun is the source of all energy.

Misdirected Migrations

1. Answers will vary but might include that some birds may have died earlier than others because they were not as strong as the others (unable to hop as far).
2. All the birds eventually died because there were not enough wetlands left to provide food, shelter, and water along their journey. Even though some wetland areas were left, their locations did not help them during their journey. The birds would have had to fly too long to get there and would not have had enough energy for such a long distance.
3. Answers will vary.
4. Answers will vary, but might include that studies should be done to make sure that an area is not a wetland or an endangered species habitat, and alternate locations might be considered.

The NASA SCI Files™

The Case of the Zany Animal Antics

Segment 3

Dr. D heads back to Virginia to meet Kali and help her build a bat house, which is one of the requirements for her Girl Scout wildlife badge. While constructing the bat house, Dr. D also explains differences in the various species populations. To learn more about how to count animals in a population, the tree house detectives dial up Carol City Elementary School, a NASA Explorer School in Miami, Florida. The class has just finished learning how to use random sampling, and they explain why and how to use sampling to estimate a population. Next, they dial up Dr. Dave Breininger, a wildlife ecologist studying and monitoring the endangered scrub jays at NASA Kennedy Space Center. Mr. Breininger helps the detectives understand habitats and how both nature and man can affect them.

Objectives

Students will

- learn about populations and factors that limit populations.
- identify the biotic potential and carrying capacity of various populations.
- use random sampling to collect and analyze data.
- identify the needs supplied by a habitat.
- learn about limiting factors, both natural and man-made, which affect populations within a habitat.

Vocabulary

biotic potential—the rate a population will grow under ideal conditions

carrying capacity—the maximum number of living things a habitat can support

equilibrium—a state of balance between opposing forces; when talking about populations, a time when the number of births equals the number of deaths

estimate—to determine roughly the size or amount

extinction—when a species no longer exists

habitat—an area that supplies food, shelter, water, and space for living things

high density—many items packed into a small space; when talking about populations, many living things in a small area

population—a group of organisms of the same species that live in a particular area

random sampling—to select a small portion to help estimate the entire amount

territorial—a specific place living things claim as their own; an area living things will defend and protect

Video Component

Implementation Strategy

The NASA SCI Files™ is designed to enhance and enrich 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. Before viewing Segment 3 of *The Case of the Zany Animal Antics*, read the segment overview to the students. List and discuss questions and preconceptions that students may have about animals, their basic needs, habitats, reproduction, and how they are classified.
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 better understand the problem. To locate the following tools on the NASA SCI Files™ web site, select **Educators** from the menu bar, click on **Tools**, and then select I**nstructional Tools**. You will find them listed under the **Problem-Based Learning** tab.

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

   Guiding Questions for Problem Solving—Questions for students to use while conducting research

   Problem Log and Rubric—Students' printable log with the stages of the problem-solving process

   Brainstorming Map—Graphic representation of key concepts and their relationships

   The Scientific Method and Flowchart—Chart that describes the scientific method process
3. **Focus Questions**—These questions at the beginning of each segment help students focus on a reason for viewing. They can be printed ahead of time from the **Educators** area of the web site in the **Activities/ Worksheet** section under **Worksheets** for the current episode. Students should copy these questions into their science journals prior to viewing the program. Encourage students to take notes while viewing the program to help them answer the questions. An icon will appear when the answer is near.
4. **"What's Up?" Questions**—These questions at the end of the segment help students predict what actions the tree house detectives should take next in the investigation process and how the information learned will affect the case. You can print them by selecting **Educators** on the web site in the **Activities/Worksheet** section under **Worksheets** for the current episode.

Careers
education director
marine science instructor
veterinarian

View Segment 3 of the Video

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

After Viewing

1. Have students reflect on the "What's Up?" Questions asked at the end of the segment.
2. Discuss the Focus Questions.
3. Students should work in groups or as a class to discuss and list what they know about animal populations, estimating populations, and habitats. Have the students conduct research on animal populations, including biotic potential, high density, carrying capacity, random sampling, and habitats. Brainstorm any new ideas on what it will take to create a good habitat for animals in Jacob's backyard. As a class, reach a consensus on what additional information is needed. Have the students conduct independent research or provide them with the necessary information.
4. Have the students complete **Action Plans**, which can be printed from the **Educators** area or the tree house **Problem Board** area in the **Problem-Solving Tools** section of the web site for the current online investigation. Students should then conduct independent or group research by using books and Internet sites noted in the **Research Rack** section of the **Problem Board** in the Tree House. Educators can also search for resources by topic, episode, and media type under the **Educators** main menu option **Resources**.
5. Choose activities from the **Educator Guide** and web site to reinforce concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced and use activities to aid student understanding in those areas.
6. For related activities from previous programs, download the **Educator Guide**. On the NASA SCI Files™ home page, select **Educators**. Click on **Episodes** in the menu bar at the top. Scroll down to the 2003–2004 Season and click on *The Case of the Prize-Winning Plants*. In the green box, click on **Download the Educator Guide**.

a. In the **Educator Guide** you will find

a. **Segment 2** – *Adapting for the Future*

Close the PDF window to return to the **Educator Guide** page. Click on **Episodes** in the menu bar at the top. Scroll down to the 2001–2002 Season and click on *The The Case of the Inhabitable Habitat*. In the green box, click on **Activities/Worksheets**.

a. **Segment 1** – *Biomes, Welcome to My Habitat, and Don't Burst My Bubble*

7. Have the students work individually, in pairs, or in small groups on the problem-based learning (PBL) activity on the NASA SCI Files™ web site. To locate the PBL activity, click on Tree House and then the Problem Board. Choose the 2004–2005 Season and click on *Mystery Animals of KSC*.

- To begin the PBL activity, read the scenario *(Here's the Situation)* to the students.
- Read and discuss the various roles involved in the investigation.
- Print the criteria for the investigation and distribute.
- Have students begin their investigation by using the **Research Rack** and the **Problem-Solving Tools** located on the bottom menu bar for the PBL activity. The **Research Rack** is also located in the **Tree House**.

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

Resources *(additional resources located on web site)*

Books

Bruchac, Joseph: *Keepers of the Animals: Native American Stories and Wildlife Activities for Children.* Fulcrum Publishing, 1997, ISBN: 1555913865.

Hines, James Gary: *Friendships in Nature.* Creative Publishing, 2002, ISBN: 1559717912.

Kalman, Bobbie: *What Is a Biome?* Crabtree Publishing Company, 1998, ISBN: 0865058873.

Sachidhanandam, Uma: *Threatened Habitats.* Raintree Publishers, 2004, ISBN: 0739870157.

Smith, Sue: *Exploring Saltwater Habitats.* Mondo Publishing, 1995, ISBN: 1879531461.

Snowball, Diane: *Exploring Freshwater Habitats.* Mondo Publishing, 1995, ISBN: 1879531453.

Video

Disney Channel: *Populations (Bill Nye the Science Guy)*
Grades 3–8

Web Sites

National Geographic Kids
National Geographic Kids web site is full of games, stories, news, and pictures about animals.
http://www.nationalgeographic.com/kids/

Yahooligans! Animals
Visit this web site to learn about the different types of animals, to play games, to learn animal jokes, and to learn cool facts about animals.
http://yahooligans.yahoo.com/content/animals/

World Almanac for Kids
Visit this web site to learn amazing animal facts.
http://www.worldalmanacforkids.com/explore/animals.html

National Wildlife Federation Kidzone
National Wildlife Federation Kidzone lets the user pick the appropriate age group to learn all about animals. There are games, activities, resources, recipes, and many other fun things for kids to do.
http://www.nwf.org/kids/

Smithsonian National Zoological Park
The National Zoo is home to thousands of animals from all over the world. Learn about the exhibits, the wonderful species in the collection, science and conservation efforts in the wild and at the Zoo, and education resources. You can also take a virtual tour by watching many of the animals on web cams and viewing the photo galleries.
http://nationalzoo.si.edu/Animals/

Girl Scouts of the USA
Girl Scouts of the USA is the world's largest organization dedicated to helping all girls everywhere build character and gain skills for success in the real world.
http://www.girlscouts.org/

NASA Kennedy Space Center
The web site for NASA Kennedy Space Center in Florida can tell you all about the current space launches and landings as well as new space technologies.
http://www.ksc.nasa.gov/

Bats
Visit this site to learn about a bat's environment, how bats fly, echolocation, and much more. This site is a great thematic resource for teachers and students.
http://intergate.cccoe.k12.ca.us/bats/welcome.html

The Bug Club
Join the Bug Club and become a junior entomologist. Learn how to identify bugs by using a dichotomous key and care for bug pets. Visit the "Ask an Expert" corner to get answers to all your bug questions.
http://www.ex.ac.uk/bugclub/welcome.html

Activities and Worksheets

In the Guide

The Bumper Corn Crop
Plant corn seeds to determine the germination rate and biotic potential of corn. 60

Census Takers
Learn to estimate a population of critters. 62

Hungry Cougars
Become a cougar hunting prey to understand what factors affect carrying capacity. 66

A Habitat Sit-In
Experience the interdependence of food, shelter, water, and space in a habitat. 68

I Need My Space
Compete for space in a pre-designed habitat. 69

The Endangered Hoppit
Experience how it feels to be on the verge of extinction. 70

Answer Key
. 71

On the Web

Family Sense
Simulate the ways a mother bat finds her pup in a high-density bat nursery.

The Bumper Corn Crop*

Segment 3

Purpose

To determine the germination rate of corn to help predict its biotic potential

Teacher Note: You'll need both ears of corn and seed corn for this experiment. Decorative ears of corn may be used. You will need seed corn from a seed store or garden center for the planting part of this activity.

Divide the class into five or six groups prior to starting this activity.

Materials

Per group

1 ear of corn
100 corn seeds
a paper box, like a shoebox lined with plastic (garbage bag)
soil or dirt for the boxes
Data Sheet (p. 61)
science journal
balance
calculator (optional)

Background

This activity looks at the germination rate of corn. Using this knowledge, you'll be able to predict the biotic potential for corn. The biotic potential is how much corn could be produced if nothing hindered its growth. It is rare to reach the biotic potential in nature. Competition from other plants and animals, weather conditions, disease, and changes in habitat are just a few things that limit growth.

Procedure

1. Husk the ears of corn, if necessary, to expose all the kernels. Without counting, estimate the number of rows and kernels in your ear of corn. In your science journal record the total.
2. Count the number of kernels in a sample row and multiply this number by the number of rows. This process is called a random sampling. Record the total in your science journal.
3. Plant your seeds according to the package directions. A regular pattern will make it easier to observe the results.
4. Be sure to water the soil with the same amount of water as the other groups and put the planted seeds in an area where they'll receive maximum sunlight.
5. Observe and record any observations each day. It will probably take five or more days for seeds to sprout.
6. At the end of a week, count how many seeds have sprouted and record on the Data Sheet.
7. Using the assumptions listed on the data sheet, calculate the number of ears produced for each generation.
8. Based on the results in step 2 (random sampling of the ear of corn), calculate how many kernels will be produced for each generation. Hint: Multiply the number of ears by the total kernels in the sampling.
9. Shuck at least 50 kernels from the ear of corn.
10. Using a balance, find the mass of the 50 kernels.
11. Use the total mass of the 50 kernels to find the mass of kernels produced for each generation. Hint: Divide the total kernels by 50 and multiply that number by the mass found in step 10.

Conclusion

1. How many seeds sprouted by the end of the week?
2. What percentage of seeds sprouted?
3. What factors influenced the time required for seeds to germinate?
4. What factors keep corn from reaching its biotic potential?
5. Complete the "Bumper Corn Crop" worksheet to compute the biotic potential of the corn seeds.
6. How many ears of corn would be produced in the fourth generation?

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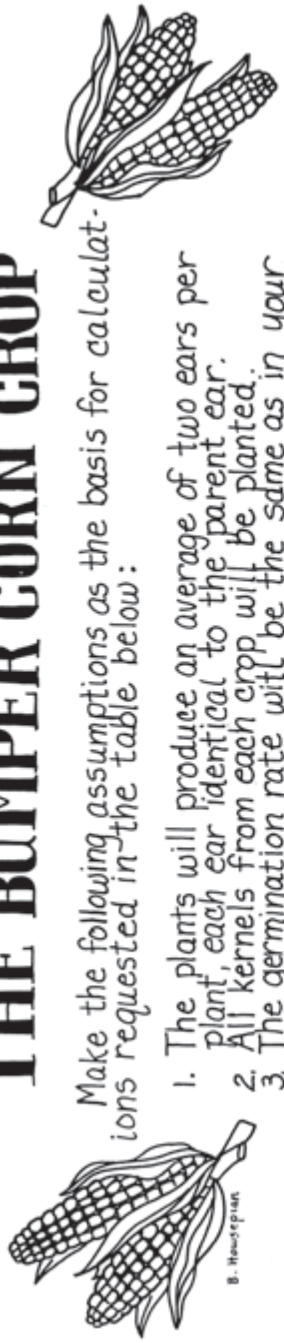
The Bumper Corn Crop*

Data Sheet

Extension

1. Vary the soil composition among the seedbeds to see the effect of soil quality on the rate of germination. Control all other variables.
2. Vary the amount of water you use with the seedbeds to see the effect of water on the rate of germination. Control all other variables.

THE BUMPER CORN CROP



Make the following assumptions as the basis for calculations requested in the table below:

1. The plants will produce an average of two ears per plant, each ear identical to the parent ear.
2. All kernels from each crop will be planted.
3. The germination rate will be the same as in your investigation.

Biotic Potential Prediction Table

Description	First Generation	Second Generation	Third Generation
Number of seeds planted			
Number of seeds sprouting/ plants produced			
Number of ears produced			
Number of kernels produced			
Mass of kernels produced			
Volume of kernels produced			

How many ears of corn would be produced in the fourth generation?

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Census Takers*

Segment 3

Purpose

To understand how scientists estimate the population of a large number of animals

Materials

Census Takers Worksheet (p. 64)
Critters Page (p. 65)
1-m yarn or string
scissors
highlighter
science journal
hand lens

Background

Knowing an organism population is important when studying it. Many times it is very difficult or impossible to count a large population of organisms. To estimate the total organism population, scientists determine the area the organism occupies and then count the number of organisms in random, small sections of the larger area. The numbers of organisms in the samples are then averaged to find the average number of organisms living in a unit area. This unit area varies with the size and range of the organism being studied. For large organisms with a big range, the unit might be square kilometers; for smaller organisms, the unit could be square meters; and for even smaller organisms, square centimeters or millimeters. When the average number of organisms per unit area is found, it is used to estimate the total population by multiplying the average number of organisms in the unit area by the total area an organism occupies. This method gives scientists a fairly accurate population estimate for a given organism.

Procedure: Pre-Activity

1. In your group, discuss the population of students in your school and brainstorm for ideas of how best to estimate the number of students without counting them.
2. Choose one method discussed and estimate the number of students in your school.
3. Share your results with the class and compare your answers with the actual count from the school's office.
4. Look at the Critters Page and predict the total number of critters on the page. Write your prediction on the *Census Takers Worksheet*.
5. Discuss how to sample the population of critters and brainstorm for some ideas of different ways to sample.
6. Using one of the methods discussed, take a sample of the critters population. Share and compare methods with other groups in class. Discuss what was difficult about sampling and what you would do differently.

Activity

7. One way to sample a population is a random sampling technique. To sample by using this technique, cut out the sampling square at the bottom of the *Census Takers Worksheet*.
8. Randomly drop the square onto the *Critters page*. Use a highlighter to trace around the outer edges of the square.
9. Count the number of critters within the square and record it on the *Census Takers Worksheet*.
10. Repeat steps 6–7 for four more trials.
11. Calculate the total number of critters and record.
12. Find the average number of critters per square unit by dividing the total number of critters by 5.
13. Look at the *Critters Page* and calculate the total number of square units. (Count the numbers of squares down and across and multiply.)
14. Multiply the average number of critters per square unit by the total number of squares and record.
15. This number is your population estimate. Record it on the *Census Takers Worksheet*.
16. On the *Census Takers Worksheet*, compare your estimate to the actual number and calculate the difference.

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Census Takers*

Segment 3

17. Brainstorm for ideas of how to best take an actual count of the critters on the page.
18. Choose one method and count the critters. Compare answers in your group and determine the actual number of critters.
19. Compare your prediction with the actual number of critters.
20. Using the group estimates, find the class average of the population estimates and compare it to the actual count.

Post Activity

21. To sample some real critters, go to a large, grassy area and mark off an area 20 meters by 20 meters.
22. Standing within the area, use a ball or small object to toss randomly in the air. Using string and golf tees, create a sampling square that is 1 square meter (1 m x 1 m) where the ball lands.
23. Repeat 4 more times, making sure that the sampling squares do not overlap.
24. Using graph paper, draw the sampling area and show the location of each square. Label each square on your graph paper A, B, C, D, and E.
25. Carefully observe one of the sampling squares and choose a critter to count.
26. Count the number of that kind of critter in the circle and record for that square.
27. Continue to sample the other circles.
28. Continue to find the average number of critters and an estimate of their population.
29. Compare and contrast this activity to the previous activity.

Conclusion

1. Why is it important to select a random sample?
2. How did the population estimates and the actual population differ?
3. Do you think this method is an accurate way to determine the population of a large area?
4. How does the class average compare to the actual population?
5. How was sampling real critters more or less difficult than for paper critters?
6. In a real sampling, would you be able to count every critter for an actual count? Explain.

Extension

Sprinkle sand on a sheet of graph paper and take several samples to find the approximate number of grains on the whole sheet.

Census Takers*

Census Takers Worksheet

Procedure:

- Carefully cut out the square *Critter Counter* at the bottom of this page. Be as exact as you can.
- Look at the page of critters. Estimate the total number of critters on the page. Record your estimate in the table below.
- Randomly drop your cut-out square on the page of critters, trace around it, and count the number you see within the square. Record the number in the table below. Do this five times. Add your five samples together to get a sample total.

	Population samples					
Estimate	A	B	C	D	E	Sample total

- Divide your sample total by five to get the average. Multiply the average by the number of square units on the page of critters to determine the population estimate.

Sample total	÷ 5 =	Average	x	Number of square units	=	Population sample estimate
	÷ 5 =		x		=	

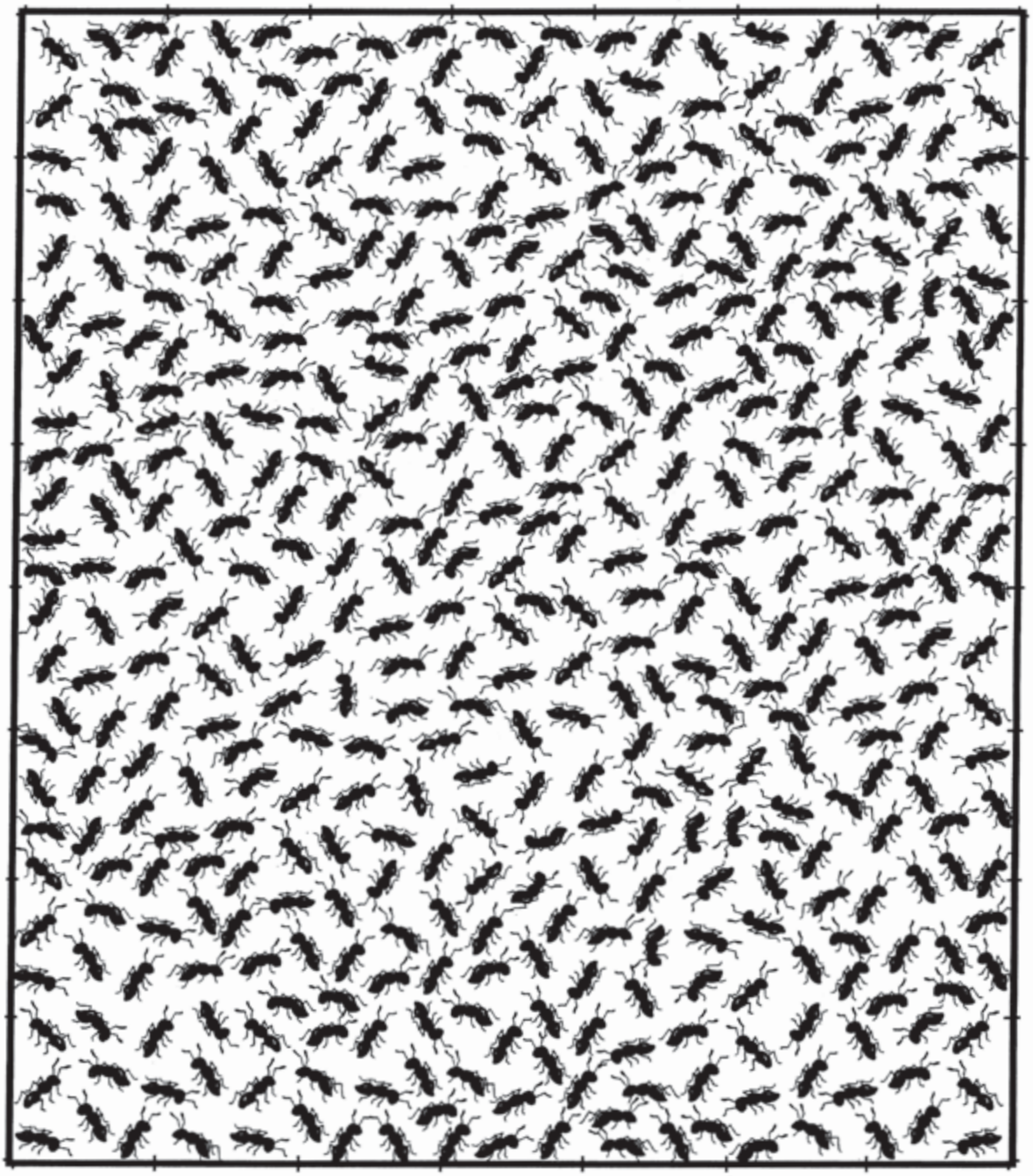
- Record the actual population and find the difference between your estimate and the actual. If your estimate is higher than the actual population, subtract the actual from the estimate.

Actual population	–	Population estimate	=	Difference
	–		=	

Critter Counter

Census Takers*

Critters Page



Hungry Cougars

Segment 3

Purpose

To define and analyze factors which affect carrying capacity

Materials

Per Student
a paper or plastic bag "stomach"

Per Class
stopwatch or timer

Teacher Prep

1. Before the activity, mark 200 poker chips to represent animals (prey) that follow these numbers:
   - 100 chips with "S" (squirrel) on one side and 1 kg on the other
   - 50 chips with "R" (rabbit) on one side and 2 kg on the other
   - 30 chips with "P" (porcupine) on one side and 7.5 kg on the other
   - 19 chips with "B" (beaver) on one side and 20 kg on the other
   - 1 chip with "D" (deer) on one side and 75 kg on the other

   (Use paper labels.)
2. Hide the chips around a large, open area. If possible, camouflage the chips.

Background

Cougars are hunters. They are predators and need a large area of undisturbed forest to support the needs of their prey. In this simulation, each cougar must gather 50 kg of food, enough to live for one month.

Procedure

1. You are about to become a cougar. You are a solitary carnivore, eating deer, opossums, rabbits, mice, and other forest creatures. You usually hunt at night and have excellent eyesight and wonderful hearing. You run swiftly and can climb and jump 20 feet or more. If necessary, you can also swim. You usually use the element of surprise to help you stalk your prey.
2. You will be taken to your "habitat" and given time to hunt. To survive, you must gather at least 50 kg of food.
3. Your hunt will be timed. You'll have only 3–5 minutes to stalk and capture your food.
4. As you collect your food, put it into your "stomach" bag.

Hungry Cougars

Segment 3

Conclusion

1. How many of your classmates survived?
2. Two hundred chips were hidden. Were all the prey found?
3. What would happen if more cougars were added to the habitat?
4. Did anyone find the deer? The deer was worth 75 kg of meat, which is more than any cougar needs to survive. Would a real cougar have continued to hunt after getting that much food?

Extension

1. Play the game again, but add some "limiting factors." Ask students to pull one scenario from a bag. They MUST follow the scenario drawn. Some possible scenarios might be these:

   a. You were injured while hunting. You are lame and unable to move quickly. You must hop while you look for food.

   b. You were blinded by a porcupine while hunting. It is hard for you to find food. You must wear a pair of sunglasses with one lens blocked by construction paper while you look for food.

   c. Extra rain has fallen in your habitat and the stream is at its peak. The beavers have been affected by this change. If you find a beaver "chip" you cannot pick it up. If you pick it up, you will lose five chips when you tally at the end of the hunt.

   d. The walnut trees in the area are NOT producing walnuts. The squirrels are hungry and sick. If you find a squirrel "chip" you cannot pick it up. If you pick it up, you will lose two chips when we tally at the end of the hunt.

A Habitat Sit-In

Segment 3

Purpose:

To visualize the importance of food, shelter, water, and space in any habitat

Teacher Note: Please caution students to be careful when they're asked to "sit" in this activity and do not have them hold the "sitting" position too long.

Background

Habitats supply the food, water, shelter, and space needed to support living things. If any one of the four elements is missing, the habitat will be affected.

Procedure

1. In your class, count off one, two, three, and four. All the ones will be food, twos will be water, threes will be shelter, and fours will be space.
2. Stand in a circle following this pattern. People representing food will stand beside someone representing water, who will be beside someone representing shelter and then beside someone representing space. Stand shoulder to shoulder. Repeat the pattern until all students are included in the circle.
3. Turn so that you face the back of the person to your right. Everyone should be facing in the same direction—their fronts facing the backs of the people beside them.
4. Pull the circle closer together. There should be no more than a few cm between each person.
5. Very carefully squat into a seated position. You will sit on the lap of the person behind you for just a few seconds.
6. Working together, the person behind you is acting as your support.
7. All together, carefully stand up.
8. All "spaces" should step out of the circle.
9. Why would it be unsafe for the remaining people to now sit in a circle?

Conclusion

1. How does this activity demonstrate the importance of ALL four habitat needs—food, water, shelter, and space?
2. In the "real world," what might have happened to pull "space" out of the habitat?

Extension

1. Food, water, shelter, and space are all essential for a healthy habitat. From this activity, you can see how interconnected they are. Draw a picture or diagram to show this interconnection.

I Need My Space*

Segment 3

Materials

Per Student
1 full-sized (two-page) sheet of newspaper

Optional
traffic cones, chairs, yarn, or chalk to mark off area

Purpose:

To experience the need for space in a habitat

Teacher Prep

1. Before the activity, mark off boundaries based upon the size of your class. If your class size is
   - *20–24 students, you'll need a space 3.5 meters by 4.0 meters*
   - *25–29 students, you'll need a space 4.0 meters by 4.0 meters*
   - *30–34 students, you'll need a space 4.0 meters by 4.5 meters*
   - *35+ students, you'll need a space 4.0 meters by 5.0 meters*

Background

A habitat is a place where plants or animals live and can get everything they need. Every living thing must have food, water, shelter for protection, and enough space to grow, move, hunt, and play. In this activity, you'll see the need for space in every habitat.

Procedure

1. The sheet of newspaper represents the "minimum" amount of space you need to live, survive, and grow in a "special" habitat.
2. With your classmates, go to the habitat that's been created by your teacher. All your classmates will be living with you inside this habitat.
3. In a healthy habitat, none of the newspapers may overlap. If they overlap, you will be weakened and will not survive.
4. Two "animals" will begin by having both students place their newspapers inside the habitat. Once the newspapers are on the ground, they cannot be moved.
5. Look at the habitat and determine if it supplies lots of food, water, shelter, and space.
6. To double the population, add two more creatures. Be sure the newspapers don't overlap.
7. Evaluate the health of the habitat.
8. One at a time, the remaining animals will enter the habitat and place their newspapers on the ground.
9. Evaluate the "health" of the habitat after all animals have entered.

Conclusion

1. How many animals could live comfortably in this habitat?
2. What limited the number of creatures that could fit in this habitat?
3. How could you fit more creatures in the space?
4. What are some real-world limits to a habitat?

Extension

1. Look outside for an area densely populated with very young plants. If possible, protect that area from being weeded or mowed and watch what happens to the plants over a period of time.
2. Set up an experiment in which you plant radishes or other fast growing seeds in identical small flowerpots or paper cups. Plant one seed in the first cup, two in the second, four in the third, eight in the fourth, and so on, until you have seeds spaced 1 cm apart. Give each container the same amount of water and exposure to sunlight. Compare the plants as they sprout and mature.
3. Divide your classroom in half by running a string down the middle of the room. For an hour or two, carry out your normal schedule but keep everyone in only half the room. What happens?

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The Endangered Hoppit*

Segment 3

Purpose

To gain an understanding of animal extinction

Materials

a large number of similar, small objects such as popcorn, playing cards, or poker chips
timer or clock

Teacher Prep

Before the activity, mark off the hoppit's habitat. Spread small objects throughout this area to represent food.

Background

When a living thing can no longer be found on Earth, it is "extinct." Some living things are "nearly extinct" or "endangered." "Threatened" living things are likely to become endangered if they are not protected. An "extirpated" living thing can no longer live in the wild but is protected in another environment, like a zoo.

It is sad that more than 20 kinds of living things become extinct every week. Human activity that changes animal habitats is responsible for these losses.

Procedure

1. You and your classmates are hoppits. A hoppit is an imaginary creature which hops continuously when it's awake. A healthy hoppit hops on two legs. Hoppits spend their lives hopping and looking for food, storing their food in a small pile in their nest. They may also stop to rest and sleep in their nest. The only time you may stop hopping is when you are at your nest.
2. Begin your life as a hoppit. You will hop on two legs, gather food, and take it to your nest. You may only pick up one piece of food at a time, returning to your nest to store each piece of food.
3. Five minutes later—Bad weather is making it harder to get food. You can only hop on ONE leg now. If you hop on two legs, you will "die" and be out of the game of life.
4. Five minutes later—Human beings are building homes and stores around your habitat. You can still leave your food piles in your nest, but you cannot rest by your nest any longer. To stay alive, you must continuously hop on one leg while you gather food.
5. Five minutes later—Stop hunting for food and survey which hoppits are alive and which are dead. You MUST HAVE at least two hoppits for the species to continue.

Conclusion

1. How many hoppits lived? Were there enough for the species to continue?
2. What factors affected the hoppit population?
3. Compare these factors to limiting factors found in the real world.

Extension

1. Research endangered animals and plants found in your area. What caused them to be endangered?
2. How might the hoppits have adapted to their habitats as the habitats changed? How would these adaptations increase the hoppit population? Design a "newly improved" hoppit that has adapted to changes in its environment.

*** This activity is modified and used with the permission of the AIMS Education Foundation, http://AIMSedu.org**

Answer Key

Segment 3

The Bumper Crop

1. Answers will vary.
2. Answers will vary.
3. The quality of the seeds affected seed germination. Other variables were kept constant during this experiment.
4. In the real world, corn doesn't reach its biotic potential for many reasons. Corn seeds are eaten, the soil may be infertile, there may not be rain, other plants compete for space, and so on.
5. Answers will vary.
6. Answers will vary.

Census Takers

1. A random sample is necessary so that the results are not skewed. If a person selected the location for each sample taken, he/she might be biased and then the sample may have more or less than "average."
2. Answers will vary.
3. Answers will vary.
4. Answers will vary.
5. Answers will vary.
6. In most instances you would not be able to count every critter. It would only be possible in a very small area.

Hungry Cougars

1. Answers will vary.
2. Answers will vary.
3. More cougars in the habitat will have to share the same amount of prey. It's likely that all prey will be eaten and some cougars will starve.
4. No, animals in the wild only hunt and eat when they are hungry. They only take as much as they need and do not "store" food.

A Habitat Sit-In

1. To be able to sit in this circle, all parts must be present. Every person is needed, just as every element (food, water, shelter, and space) is needed in a habitat.
2. If a habitat were crowded, animals and plants would have to compete for food, water, and shelter. They may become aggressive. Food and water may become scarce.

I Need My Space

1. Answers will vary.
2. Space limited the number of animals in this habitat.
3. Carefully arranging the newspapers would help more animals fit in the space. Careful planning would help.
4. In the real world, habitats are limited by the amount of food and water, people clearing the land, weather, disease, and so on.

The Endangered Hoppit

1. Answers will vary.
2. The hoppit population was affected by competition from other hoppits, weather, and people taking their space.
3. In addition to these factors, animals also have to deal with disease, pollution, a loss of food and water, and so on.

On the Web

Family Sense

1. Answers will vary.
2. Answers will vary but might include that, after time, the sense of smell seems to dull to scents. It may be difficult to tell the difference between two scents.
3. With 500 pups crammed into a very small space, it would be hard to tell where each scent is located. Some scents are very similar. It would also be very noisy. Adult bats use position as a third way to locate their pups.

The NASA SCI Files™

The Case of the Zany Animal Antics

Segment 4

The tree house detectives dial up Mr. Doug Scheidt, the aquatics program lead at NASA Kennedy Space Center to learn more about endangered animals. Mr. Scheidt explains the levels of endangerment and various factors that can cause a species to become threatened or even extinct. The detectives are curious about when and how animals are rescued. Mr. Scheidt recommends that they visit Dr. Beth Chittick, a veterinarian at SeaWorld® in Orlando, Florida, to learn more about the rescue efforts for injured and sick animals. RJ heads to SeaWorld® and while there he also visits Ms. Virginia (Ginny) Busch, who explains the efforts of the SeaWorld® and Busch Gardens® Conservation Fund and the role it and other partners play in protecting and preserving wildlife. Finally, the detectives visit Mr. Cutchin's backyard, which has been certified as an official backyard habitat. Dr. D meets the detectives at Mr. Cutchin's and they review all they have learned. They believe they are ready to turn Jacob's backyard into the perfect habitat, and they might even be able to help Kali with her final requirement for her Girl Scout wildlife badge.

Objectives

Students will

- learn about government protections for living things.
- identify causes of endangerment which might lead to extinction.
- compare levels of endangerment.
- learn about what animals are being rescued and how they are rescued.
- examine ways to conserve backyard habitats.

Vocabulary

Bald Eagle Protection Act—federal protection for bald eagles; through conservation efforts there are now over 7,000 breeding pairs in the U.S.

endangered—in danger of extinction in all or part of its range

exploitation—when a species' population is reduced to a point that it cannot reproduce fast enough to sustain a viable population

manatee—a mammal with no known predators other than human beings; in the 18th and 19th centuries they were hunted for their meat, fat, and hides

special concern—a species might need protection and conservation; perhaps in the form of periodic monitoring of the populations and the threats to the species and its habitat

threatened—a species is likely to become endangered within the foreseeable future

veterinarian—a doctor for animals

Video Component

Implementation Strategy

The NASA SCI Files™ is designed to enhance and enrich 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 Zany Animal Antics*, discuss the previous segment to review the problem and what the tree house detectives have learned thus far. Download a copy of the **Problem Board** from the NASA SCI Files™ web site, select **Educators**, and click on the **Tools** section. The **Problem Board** can also be found in the **Problem-Solving Tools** section of the latest online investigation. Have students use it to sort the information learned so far.
2. Review the list of questions and issues that the students created prior to viewing Segment 3 and determine which, if any, were answered in the video or in the students' own research.
3. Revise and correct any misconceptions that may have been dispelled during Segment 3. Use tools located on the Web, as was previously mentioned in Segment 1.
4. Review the list of ideas and additional questions that were created after viewing Segment 3.
5. Read the overview for Segment 4 and have students add any questions to their lists that will help them better understand the problem.
6. **Focus Questions**—Print the questions from the web site ahead of time for students to copy into their science journals. Encourage students to take notes during the program to answer the questions. An icon will appear when the answer is near.

View Segment 4 of the Video

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

After Viewing

1. At the end of Segment 4, lead students in a discussion of the Focus Questions for Segment 4.
2. Have students discuss and reflect upon the process that the tree house detectives used to learn more about the future of space exploration. The following instructional tools located in the **Educators** area of the web site may aid in the discussion: **Experimental Inquiry Process Flowchart** and/or **Scientific Method Flowchart**.
3. Choose activities from the **Educator Guide** and web site to reinforce concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced and use activities to aid student understanding in those areas.

4. For related activities from previous programs, download the **Educator Guide**. On the NASA SCI Files™ home page, select **Educators**. Click on **Episodes** in the menu bar at the top. Scroll down to the 2003–2004 Season and click on *The Case of the Prize Winning Plants*. In the green box, click on **Download the Educator Guide**.

a. In the Educator Guide you will find

   a. **Segment 1** – *Danger! Deforestation*

   b. **Segment 2** – *Adapting for the Future*

   c. **Segment 4** – *Too Much of a Good Thing*

   Close the PDF window and return to the Educator Guide page. Click on **Episodes** in the menu bar at the top. Scroll down to the 2003–2004 Season and click on *The Case of the Inhabitable Habitat*. In the green box, click on **Download the Educator Guide**.

b. In the Educator Guide you will find

   a. **Segment 4** – *Bloomin' Algae*

5. Wrap up the featured online PBL investigation. Evaluate the students' or teams' final product, generated to represent the online PBL investigation. Sample evaluation tools can be found in the **Educators** area of the web site under the main menu topic **Tools** by clicking on **Instructional Tools.**

6. Have students write in their journals what they have learned about animals, classification, populations, habitats, food chains and webs, endangered animals, and animal rescue and conservation so that they can share their entry with a partner or the class.

Careers

research biologist
field biologist
veterinarian
technician
laboratory manager
medical technologist

Resources *(additional resources located on web site)*

Books

Anderson, Laurie Halse: *Manatee Blues, Vol. 4*. Pleasant Company Publications, 2000, ISBN: 1584850493.

Berger, Melvin and Gilda Berger: *Where Have All the Panda Gone?* Scholastic, Inc., 2002, ISBN: 0439266696.

Charman, Andrew: *I Wonder Why the Dodo is Dead and Other Questions about Extinction*. Houghton Mifflin, 1996, ISBN: 0753450143.

George, Jean Craighead: *The Case of the Missing Cutthroats: An Ecological Mystery.* HarperCollins Publishers, 1999, ISBN: 0064406474.

Jackson, Donna: *The Wildlife Detectives: How Forensic Scientists Fight Crimes Against Nature*. Houghton Mifflin, 2002, ISBN: 0618196838.

Jacobs, Francine: *Lonesome George, the Giant Tortoise.* Walker and Company, 2003, ISBN: 0802788645.

London, Jonathan: *Condor's Egg.* Chronicle Books, 1999, ISBN: 0811823121.

Miller, Louise: *Careers for Animal Lovers and Other Zoological Types*. McGraw-Hill, 2000, ISBN: 0658004638.

Swinburne, Stephen: *Once a Wolf: How Wildlife Biologists Fought To Bring Back the Gray Wolf*. Houghton Mifflin, 2001, ISBN: 0618111204.

Williams, Judith: *Saving Endangered Animals with a Scientist.* Enslow Publishers, 2004, ISBN: 0766022765.

Wright, Alexandra: *Will We Miss Them?* Charlesbridge Publishing, 1993, ISBN: 0881064882.

Video

Schlessinger Media: *Animal Life in Action: Endangered and Extinct Animals*
Grades 5–8

Schlessinger Media: *People Who Love Working with Animals*
Grades K–6

Web Sites

SeaWorld® and Busch Gardens® Conservation Fund
Visit this site to learn more about the fund and its projects around the world.
http://www.swbg-conservationfund.org/

SeaWorld®
This web site contains information for kids, parents, and teachers about animals. Learn how SeaWorld® and Busch Gardens® are working to protect endangered animals. Visit the Fun Zone for coloring books, songs, Shamu TV, and much more. There are also great resources available for teachers.
http://www.seaworld.org/

Discovery School Animal Cams
On the Discovery School web site you can view live images with animal cams.
http://school.discovery.com/schooladventures/*animalcams/index.html*

Kids' Planet
Kids' Planet is an interactive web site for kids to learn about animals. The web site has games, printable coloring pages, stories, cool facts, and much more.
http://www.kidsplanet.org

BBC – Science and Nature – Children's Zone
Learn about animals, view video clips, take fun quizzes, listen to animal sounds, and play online games on the BBC's Children's Zone web site.
http://www.bbc.co.uk/nature/reallywild/

Operation Wildlife
This informative web site gives valuable information on what to do if you find an injured wild animal.
http://www.owl-online.org/content/library/field.htm

ASPCA's Animal Land
Visit the ASPCA's web site to learn about animals, play games, view cartoons, and learn how to take care of pets.
http://www.animaland.org/

Wildlife Conservation Society Kids Go Wild
This web site contains information about animals and conservation, education, and management efforts towards animals.
http://wcs.org/7490/kidsgowild

Kids Go Wild—Wildlife Conservation Society
Find out about wild animal news across the globe, learn fun wild animal facts, and play wild animal games in the arcade.*http://www.kidsgowild.com/*

World Wildlife Fund
WWF directs its conservation efforts toward three global goals: saving endangered species, protecting endangered habitats, and addressing global threats such as toxic pollution, over-fishing, and climate change. From working to save the giant panda and bringing back the Asian rhino to establishing and helping manage parks and reserves worldwide, WWF has been a conservation leader for more than 40 years.
http://www.worldwildlife.org/index.cfm

Wildlife Conservation Network
Wildlife Conservation Network is dedicated to the support of conservation entrepreneurs who are working actively with local communities to protect endangered flagship species and preserve their natural habitats.
http://www.wildnet.org/index.htm

International Wolf Center
The International Wolf Center advances the survival of the wolf populations by teaching about wolves, their relationship to wild lands, and the human role in their future. Wolves, once on the nearly extinct list, have recovered to levels that might lead to their removal from the endangered list.
http://www.wolf.org/wolves/index.asp

Bat Conservation International
BCI's mission is to teach people the value of bats, to protect and save critical bat habitats, and to advance scientific knowledge through research.
http://www.batcon.org/

Endangered Species
Visit EndangeredSpecies.com and click on your area on the United States map to find out the endangered and threatened animals in your area.
http://www.endangeredspecie.com/map.htm

U.S. Fish & Wildlife Service – Endangered Species Program
Visit this U.S. Fish & Wildlife Service's web site to find a list of threatened and endangered wildlife, species information, conservation practices currently in place, and the laws and policies in place to protect wildlife.
http://endangered.fws.gov/

American Museum of Natural History
Located in New York, the American Museum of Natural History contains a large volume of information on endangered species and habitats, the causes of endangerment, and possible solutions to the problem.
http://www.amnh.org/nationalcenter/Endangered/

Endangered Species of the Next Millennium
Learn about endangered species on this web site. The site explains what animals are endangered, why they are endangered, and how they became endangered.
http://library.thinkquest.org/25014/english.index.shtml

EndangeredSpecie.com
Visit this web site to learn more about endangered species, including causes of endangerment, ways you can help, laws that protect, and many other valuable resources related to endangered species.
http://www.endangeredspecie.com/

Activities and Worksheets

In the Guide

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Interpret and make inferences about bald eagle populations. 78

Postcards That Protect
Identify and complete research about living things that are threatened, endangered, or categorized as of special concern. 79

Cape of Good Hope
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Points of View
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A word search about animals. 86

Happy Habitat
Make your own crossword puzzle to create a happy "habitat" for a few words. 87

Answer Key
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On the Web

Going Wild in the Backyard
Learn more about Backyard Wildlife Habitats™

Saving Bald Eagle

Segment 4

Purpose

To interpret and make inferences about bald eagle populations

Materials

graph paper
calculator

Background

The Bald Eagle Protection Act was passed in 1940. This law prohibited collecting or harming bald eagles, their nests, and their eggs. Since then, this act has been amended several times, reflecting an increased public awareness of the plight of the bald eagle. In fact, in 1995, the U.S. Fish and Wildlife Service reclassified the bald eagle from endangered to threatened in all of the lower 48 states.

Procedure

1. Carefully read and analyze the data in the table, Bald Eagle Pairs.
2. Graph this information as a line graph to show change over time.
3. Be sure you label each axis of your graph and give your graph a title. "Time" should go on your "x-axis" and "Number of bald eagle pairs" should be represented by your "y-axis."

Conclusion

1. What pattern or trends do you see in the number of bald eagle pairs?
2. Using the data in the table, determine the data range. Remember, the range is the difference between the largest number and the smallest number in a set of data.

Extension

1. DDT, an insecticide that was used along coastal and other wetland areas, was banned on December 31, 1972 in the U.S. DDT built up in the fatty tissue of adult female bald eagles. These female birds produced eggs with very thin shells. The shells broke when the female birds sat on the nests. What relationship do you see between the data and the banning of DDT?

Table – Bald Eagle Pairs*

Year	Number of Bald Eagles
1963	417
1974	791
1981	1,188
1984	1,757
1986	1,875
1988	2,475
1989	2,680
1990	3,020
1991	3,391
1992	3,747
1993	4,016
1995	4,452

Postcards That Protect

Segment 4

Purpose

To identify and research living things that are threatened, endangered, or categorized as of special concern

Materials

(per student)

10-cm x 15-cm cardboard or poster board rectangular cutouts

art materials—crayons, colored pencils, magic markers

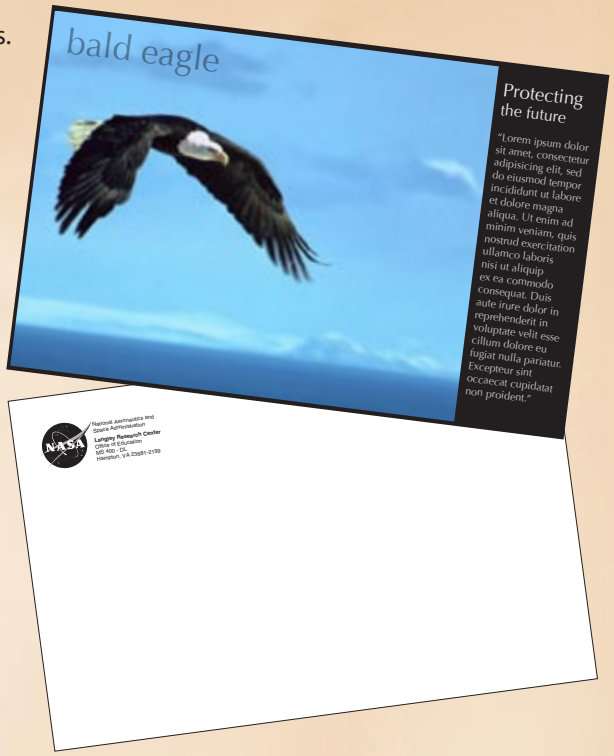
research materials

Background

Some plants and animals need protection or they may become extinct. When a living thing can no longer be found on Earth, it is "extinct." Some living things are nearly extinct, or endangered. Threatened living things are likely to become endangered if they are not protected. Living things that might need some form of protection may be identified as a special concern. Officials keep an eye on living things of special concern, alert to changes in their populations and habitats.

Procedure

1. Find out more about endangered and threatened species. One place to begin your research is at the U.S. Fish and Wildlife Services Web site: *http://endangered.fws.gov/wildlife.html#Species*
2. Choose one species and do more research.
3. Decorate the front of the rectangular card with drawings of your species.
4. Send the card to a friend or family member. On the message side, tell the person why this living creature should be protected.



Conclusion

1. What endangered or threatened living things can be found in your area?
2. What can you do to help protect these living things?

Extension

1. As a fund-raiser, make copies of some of the postcards. Give all proceeds to a wildlife conservation program.
2. Create an endangered species calendar.

Cape of Good Hope*

Segment 4

Purpose:

To visualize how many endangered cats would be needed to create a fur cape

Materials

large, plastic garbage bag
newspaper
pelt pattern
scissors
transparent tape
ocelot pelt pattern (p. 82)

Teacher Prep

1. Prior to the activity, enlarge the ocelot pelt pattern to a scale of 1:5. If you create the pattern by using an overhead transparency, project the pelt so that it is 117.5 cm from the tip of the ocelot's nose to the tip of its tail.
2. Divide the class into groups of three to five students.

Background

In the past, unregulated hunting has caused near extinction for many fur-bearing animals. Some smaller cats, such as the ocelot or margay, have been used for "elegant" coats and luxury items. These cats have thick, tawny brown coats that are often spotted black and striped for camouflage in rain forest regions.

Procedure

1. In your group, create a fashion design team. You are going to design and create a cape or coat from the large, plastic garbage bag.
2. Create the cape or coat by using the garbage bag as fabric.
3. Few people really want to wear garbage bag coats. But some DO want to wear fur coats. You're going to see how many pelts it would take to cover your garbage bag coat and turn it into a fur coat.
4. Look at the ocelot pelt pattern. The Fish and Game Department drew this pattern from an actual, confiscated ocelot pelt.

   a. The area to the right of the dashed line indicates the underbelly fur, which is a lighter color and has a different nap from the upper fur. Because of this difference, the under part of the fur is not used in the fashioning of the capes; instead, it is wasted.

   b. The animal's limbs and head are also not used.

   c. Look at the darkened areas in the head. Those closest to the nose are the eyeholes and those farther in are the ear holes.

   d. The outlined places in the shoulder indicate areas where the fur is flawed. These flawed areas, head, limbs, and tail are not used for creating the coats.
5. Cut off all the unuseable parts.
6. Use the new ocelot pattern to cut as many "usable" pelt pieces out of newspaper as needed to cover your plastic bag coat.
7. Tape the pieces on to cover the entire coat.
8. Have a fashion show.

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Cape of Good Hope*

Segment 4

Conclusion

1. How many pelts did it take to make your cape?
2. Why is such a small part of the cat's pelt used to make the coat? Why isn't more used?
3. On a striped coat, would it be important for all the stripes to line up? How about a spotted one? How would the lining up of stripes affect the number of pelts it would take to complete one coat?

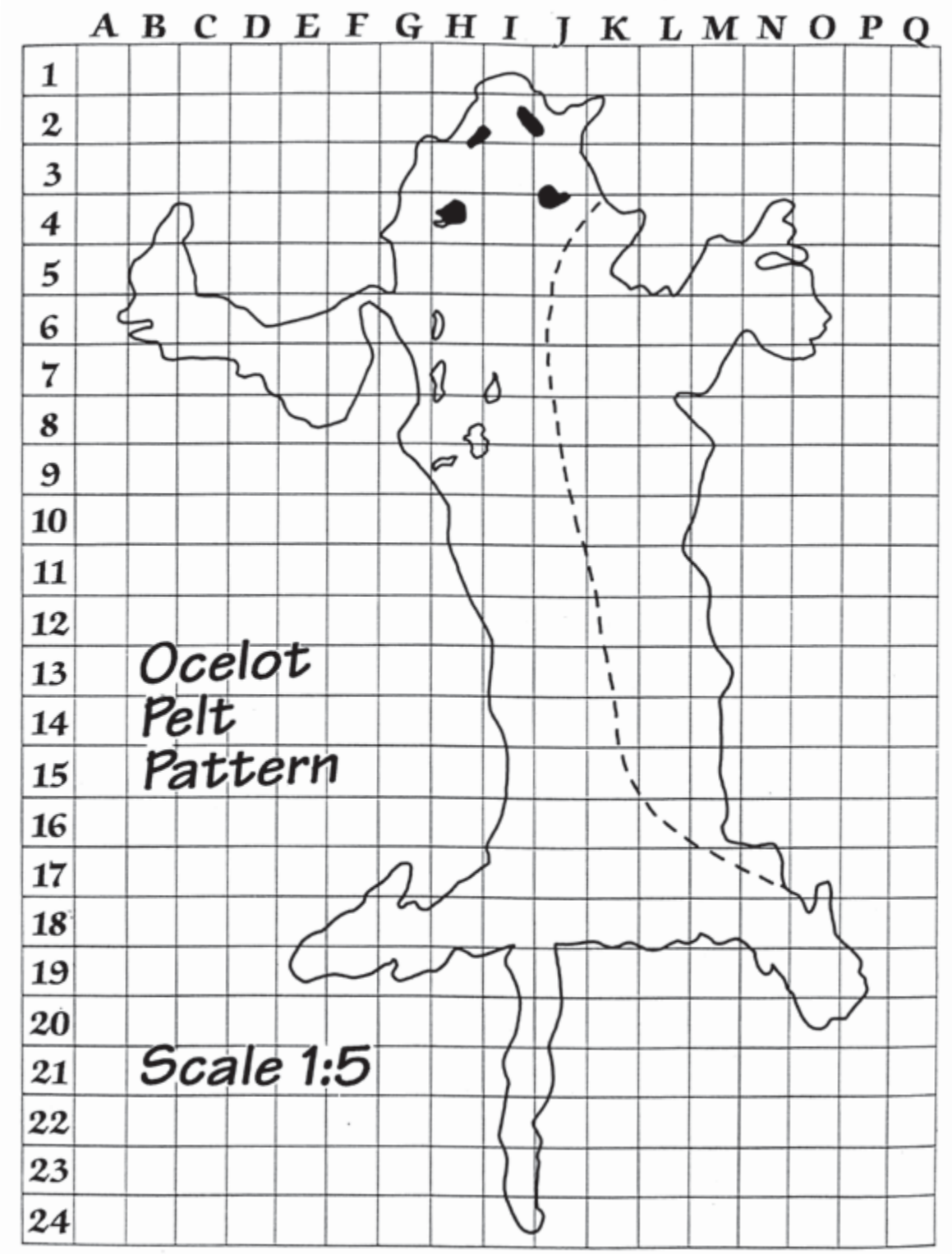
Extension

1. Draw stripes on your newspaper pelts and try to line them up on your coat. How would doing so affect the number of pelts needed for the coat?
2. Do more research on endangered cats and what is being done to protect them.
3. Visit a zoo to observe cats and other endangered animals.

Ocelot

Cape of Good Hope*

Ocelot Pattern



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Points of View

Segment 4

Purpose

To look at issues from more than one point of view

Teacher Note: *You may want to use these situations for role-play. Encourage your students to think about the issues from different perspectives. They may want to dress up to help act out the parts.*

Materials

What are you thinking?
(p. 84–85)

Background

People often have very different ideas and opinions. They base these opinions upon their background, family interactions, needs, and values.

When people have opposing opinions, it's often difficult to make decisions. It may become a judgmental time, when something is deemed right or wrong, good or bad. Using the following steps to help solve a problem can move people from judging an issue to evaluating an issue.

You might try to

- understand the situation and get as much information as possible.
- check your feelings.
- consider any information you may have on the needs or intentions of the other people involved.
- write down conflicts.
- brainstorm for alternatives.
- evaluate each alternative.
- decide which alternative is best for most.
- explain your choice to others.
- take action.

Procedure

1. Read through the situations listed on the "What are you thinking?" sheet.
2. Choose one point of view. You'll discuss this topic from that perspective.
3. Discuss the issue with your friends, carefully listening to their ideas and opinions.
4. Take a vote at the end of the discussion to see how many people agree with one side or the other.

Conclusion

1. What is the difference between a fact, an opinion, and an inference?
2. What were the main facts you used to support your opinions?
3. Did your discussion use more facts than opinions?
4. Which helped persuade the others—facts or opinions?
5. What can you do to change the problem?

Extension

1. Create your own scenarios by writing your own environmental issues, situations, and points of view.
2. Survey other groups in your school or at home to find out their opinions on the issues. Create posters or flyers to raise awareness about an important issue.

Points of View

What are you thinking?

What are you thinking? —Worksheet

Environmental Issue 1: Animal habitats are being destroyed, causing many animals to become endangered.

Situation: A young bat, taken in by a family when it was sick, has been raised to maturity and can no longer live in the family's small apartment.

Points of View

Son or daughter—has been very involved in taking care of the bat; loves it very much; wants it to have a good home

Father or Mother—bat was more expensive to care for than the family expected; believes the bat has become dependent upon the family and will not survive in the wild; thinks the bat should be given to the zoo

Fish and Wildlife Representative —concerned because the bat is an endangered animal; even though it's thoughtful that the family has taken care of the bat, they shouldn't have kept it and should have contacted official wildlife rescue teams to take care of it

Environmental Issue 2: Trees are being cut down and animal habitats are being destroyed

Situation: A farmer and his/her son or daughter are looking at clearing a piece of land for farming.

Points of View

Farmer—farming has been in the family for years; it's a hard life, but one they love; plans to plant crops to help support family

Son or Daughter—just studied about the greenhouse effect and is concerned about the environment; believes people should stand up for what they believe; wants an expensive CD player and new sneakers for next birthday

Naturalist—very outspoken about the need to protect the land; the land has some rare species of birds living there; very few natural habitats like this one around; represents the government to set this land aside as protected

Environmental Issue 3: The climate seems to be warming and the air is becoming more polluted.

Situation: City council is meeting to discuss closing the downtown streets to personal cars.

Points of View

City Council Member—downtown streets are congested; there would be less traffic if only mass transit were allowed downtown; wants to be re-elected

Citizen 1—needs to get downtown to work but lives outside the city; works late at night and doesn't feel safe walking the streets late at night

Citizen 2—doesn't think cars are the problem but points to factory pollution; angry about increases in bus costs; thinks personal cars can go downtown but only if they have three or more people in the car

Points of View

What are you thinking?

Environmental Issue 4: Land is scarce and must be protected.

Situation: City council meeting to discuss how a piece of land will be used.

Points of View

City Council Member—tired and overworked; wants to be fair, but wants to be re-elected; has small children waiting at home; worries about balancing the city's budget

Racing Car Owner—racing club made large donation to city last year; wants to use land to build a raceway

Naturalist—land is forested and has several plants and animals that can't be found anywhere else in the city; wants a park built

Hunter—wants to maintain the area as natural but wants to allow fishing and hunting; close to the center of town, but not too close for safety issues

Real Estate Developer—wants to build a housing development on the land and bring in more people to increase employment opportunities

Environmental Issue 5: Our air, water, and land are all being polluted.

Situation: Chemicals have been found in the local water source.

Points of View

Proud Owner—lived in neighborhood for year; has a beautiful lawn and flower bed; has back problems so cannot weed yard; uses weed killer because it's easy and cheap

Neighbor—proud of the neighborhood but concerned about the children inhaling chemical fumes; weeds own lawn

President of local company—local company pumps fumes into the environment, just below the legal levels; adding equipment to reduce pollution would be expensive; employs many people who live in the neighborhood

Employee of the company—has three children and a dog to support; can't afford to lose the job; one of the children has asthma

Government Representative —warns that stronger regulations may be applied to the company

Zany Animal Words

Segment 4

Find the words in the word bank.

omnivore	carnivore	herbivore	producers
consumers	food chain	migration	reproduction
habitat	territorial	population	endangered
bald eagles	exploitation	vertebrate	invertebrate
ectotherm	endotherm	classification	species

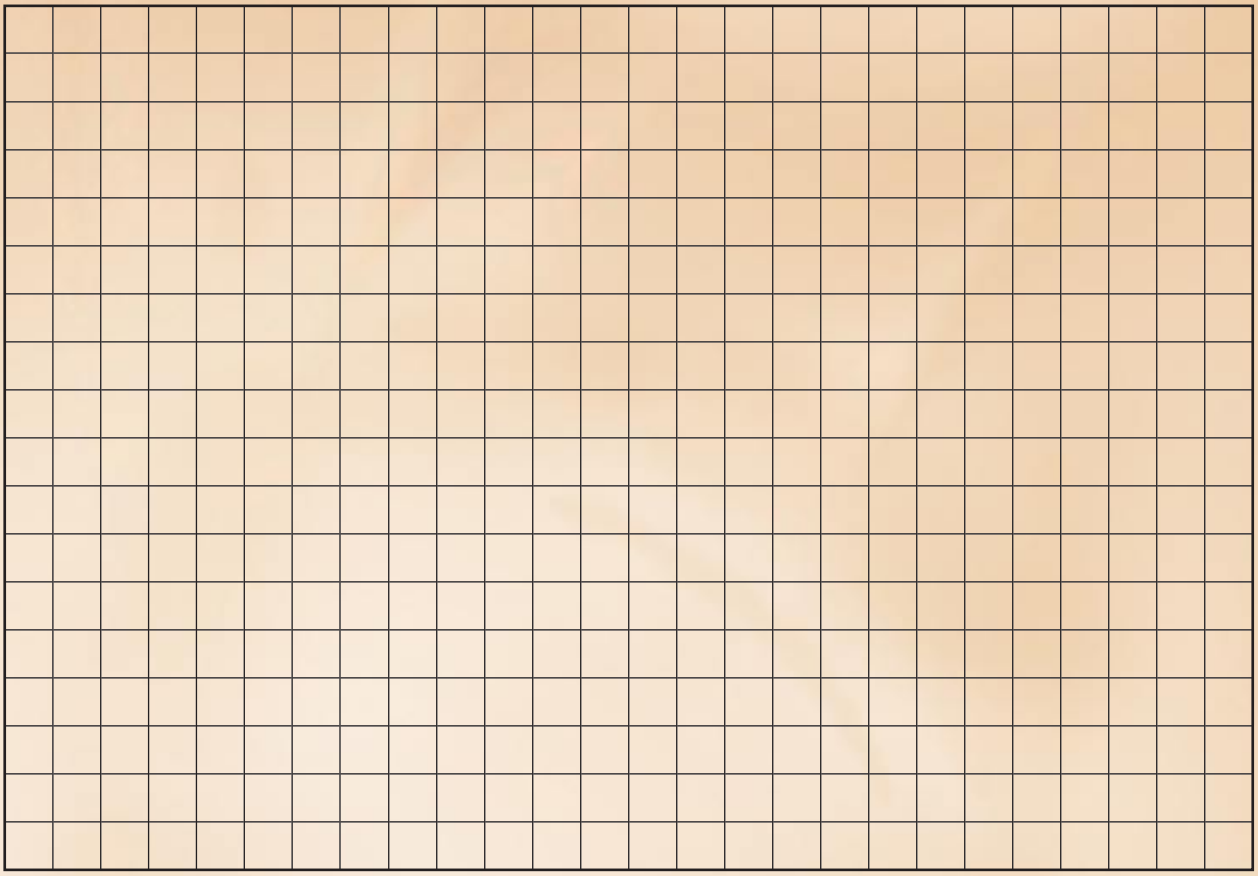
B	C	O	N	S	U	M	E	R	S	Y	N	E	A	P	S	A	M	O	O	N	F
A	N	M	O	M	G	T	A	T	I	B	A	H	E	E	H	G	U	Y	I	I	I
L	A	C	A	M	O	R	P	M	E	T	S	Y	I	H	S	R	A	E	L	D	G
D	O	R	D	F	P	E	R	I	A	K	M	C	I	C	R	I	P	A	O	E	N
E	N	M	A	O	I	O	M	B	N	G	E	N	S	T	E	N	T	H	T	N	E
A	H	E	E	O	T	I	U	A	I	P	A	O	X	R	C	S	E	S	H	D	O
G	K	A	I	D	O	R	K	N	S	I	N	I	Y	S	U	I	R	I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

Happy Habitat

Segment 4

Create a crossword puzzle with the following terms and the grid below.

omnivore	carnivore	herbivore
producers	consumers	food chain
migration	habitat	endangered
ectotherm	endotherm	vertebrate
invertebrates	population	



Across

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

Down

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

Answer Key

Segment 4

Saving Bald Eagle

1. Answers will vary, but students should note a steady increase in the number of breeding pairs.
2. The range is 4035.

Postcards That Protect

1. Answers will vary.
2. Answers will vary.

Cape of Good Hope

1. Answers will vary.
2. Only the central portion of the cat's back, without leg fur and without light colored belly fur, is used.
3. Each cat's strip or spot pattern and coat color is slightly different; therefore, completing a coat may involve considerable waste. It would take a lot of pelts to complete such a coat.

Points of View

1. A fact is something that can be proven and has actual existence. An opinion is someone's view or judgment. An inference is a statement based upon information or other statements believed to be true.
2. Answers will vary.
3. Answers will vary.
4. Answers will vary.
5. Answers will vary.

Backyard Wildlife Habitats™

1. Encourage your family to use little or no chemicals on their yard, to plant only native plants, and to learn more about the living things in your backyard.
2. If we harm the environment today, we will be eliminating habitats for others.

Zany Animal Words

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