Preparing Your Class

This section presents a series of pre-visit and extension activities as well as a worksheet to enhance learning during your visit to Fore! the Planet To get the most out of your Fore! the Planet experience, introduce activities as appropriate to your curriculum in the weeks leading up to your trip; bring the *Learning at the Exhibit Worksheet* along for use during your visit; and follow up with some of the extension activities in subsequent weeks.

The pre-visit and extension activities are grouped into six themes, each of which enhances ideas presented in several Fore! the Planet holes:

1. Backyard Naturalists

(Collection, observation and classification)

Hole 1: Butterfly Life Cycle

Hole 2: Seed Dispersal

Hole 6: Backyard Explorer

2. Animals in Motion

(Animal muscle mechanisms and behavior)

Hole 3: Bat Sonar

Hole 14: Bird Migration

3. Eat or Be Eaten

(Food webs, predator/prey relationships)

Hole 4: Food Chains

Hole 8: Predator and Prey

4. Evolutionary World

(Evolutionary timeline, evolutionary adaptations)

Hole 5: Evolution of a Golfer

Hole 7: Natural Selection

Hole 9: Dinosaur Extinction

5. Save the Animals

(Ecological change and effects on animals)

Hole 11: Spawning Salmon

Hole 13: Wild Corridors

Hole 16: Alien Species

Hole 17: Population Threats

Hole 18: Rainforest Threats

6. Save the Planet

(Environmental pollution)

Hole 10: Recycling

Hole 12: Landfills

Hole 15: Water Pollution

1. Backyard Naturalists

Purpose

To enhance student understanding of Fore! the Planet Holes 1, 2 and 6 by introducing them to the skills naturalists use to study nature.

Fore! the Planet Holes Explored

- Hole 1: Butterfly Life Cycle
- Hole 2: Seed Dispersal
- Hole 6: Backyard Explorer

Introduction

Children are naturally curious to explore and discover the world around them. The activities in this section encourage students to pursue their curiosity through methods used by scientists who study the environment: collection, observation and classification.

Activity 1: Seed Explorations

Seed Explorations Part I

For hundreds of years naturalists have been collecting artifacts from nature. Once compiled, these collections can be used for many different investigations in the laboratory. Have students start their own collection of seeds in the classroom.

Materials

- Collection area
- Sandwich bags
- Pencil
- Paper

Procedure

1. Discuss with students why scientists collect specimens. Discuss the importance of recording the location of their findings as well as the importance of collection ethics (e.g., not collecting individuals of an endangered species). Have students search for different types of seeds around their homes, schoolyards and nearby parks.

2. Once outside, have students look for seeds in different locations. When they find a seed have them put it into a sandwich bag and record the location of their find.

3. Return to the classroom. Ask students why they looked for seeds where they did. Discuss seed dispersal strategies of different plants.

4. When seeds are not available (depending on the season), other items may be substituted, such as leaves or twigs from different trees or even dried beans and nuts purchased in the supermarket.

Seed Explorations Part II

Naturalists use their senses to observe animals and plants in the wild. Sometimes they use tools such as magnifying lenses, microscopes and binoculars. While making observations, they record their results for further analysis and comparison. This activity introduces observation and record-keeping skills.

Materials

- Seeds collected from Part I
- A worksheet for noting observations
- Magnifying lens
- Pencil

Procedure

1. Provide each student with one type of seed to observe. Ask your students to describe the seeds using their sense of sight, smell and touch. Have them look at color, size, texture and special features. Encourage students to use a magnifying lens.

2. Have them record their results on the worksheet.

3. Then mix all nuts together in a pile and have the students pick out their original seed. Encourage the students to use their worksheet as a guide.

Seed Explorations Part III

Classification is an important part of scientific research. Scientists classify collected specimens according to their individual characteristics. The following activity allows students to identify characteristics that could be useful classification features.

Materials

- Collected seeds from Part I
- Worksheet from Part II

Procedure

1. Using the seeds collected as well as the worksheets used in Part II, have your students sort the seeds into different groups.

2. Ask them how they chose their categories. Was size, shape or color more important in their classification schemes? What other features could be used to classify the seeds?

3. In this exercise, there is no right or wrong: it is not important that your students come up with the correct classification scheme, rather that they think about the process of classification. Ask your students why they think it could be important to classify living organisms.

Extension Activities

Try this activity with plants, insects, birds and/or mammals. Or have your students devise a method for classifying all of their classmates (e.g., grouping by colors and patterns of clothes, hair length, eye color, etc.).

Further Reading

175 Amazing Nature Experiments
by Rosie Harlow and Gareth Morgan
(Random House, 1991).

Play and Find Out About Nature
by Janice VanCleave (Wiley, 1997).

2. Animals in Motion

Purpose

To enhance student understanding of Fore! the Planet Holes 3 and 14 by illustrating the mechanisms of animal movement and how it plays a part in animal behavior.

Fore! the Planet Holes Explored

Hole 3: Bat Sonar

Hole 4: Bird Migration

Introduction

Movement is a defining characteristic of animals. Animals move to gather food, find mates, escape from predators and migrate to different places. The type of animal movement varies with different animal species. Movement forms include walking, running, climbing, swimming and flying. The main activity in this section focuses on the physical mechanism of movements. Activities about bird migration and bat sonar are in the extension section.

Activity 2: Animals on the Go

Animals on the Go, Part I

Materials

- Posterboard
- Markers or crayons

Procedure

1. First get your students thinking about the different ways animals can move. Have your students observe different animals in motion. What types of movements do they make? Are the same muscles used to walk, swim, climb or fly?

2. Have your students draw on construction paper different types of animal motion. Or have them pantomime different animals.

Animals on the Go, Part II

(Adapted from *Beakman's World on Tour Teaching Guide,* © 1998, Cincinnati Museum Center)

This activity helps students to identify and model the bones, muscles and joints of the arm.

Materials

- 3 paper towel tubes or posterboard
- 2 long balloons
- Tape
- Scissors
- String
- Marker
- Pipe cleaner
- Paper hole punch (the smaller the hole, the better)

Procedure

1. Have the students label the three paper towel tubes humerus, radius and ulna. (If you are using cardboard, cut a piece of cardboard as long as the upper arm and two pieces of cardboard as long as the lower arm. Roll these into tubes and tape tightly. Then label them.)

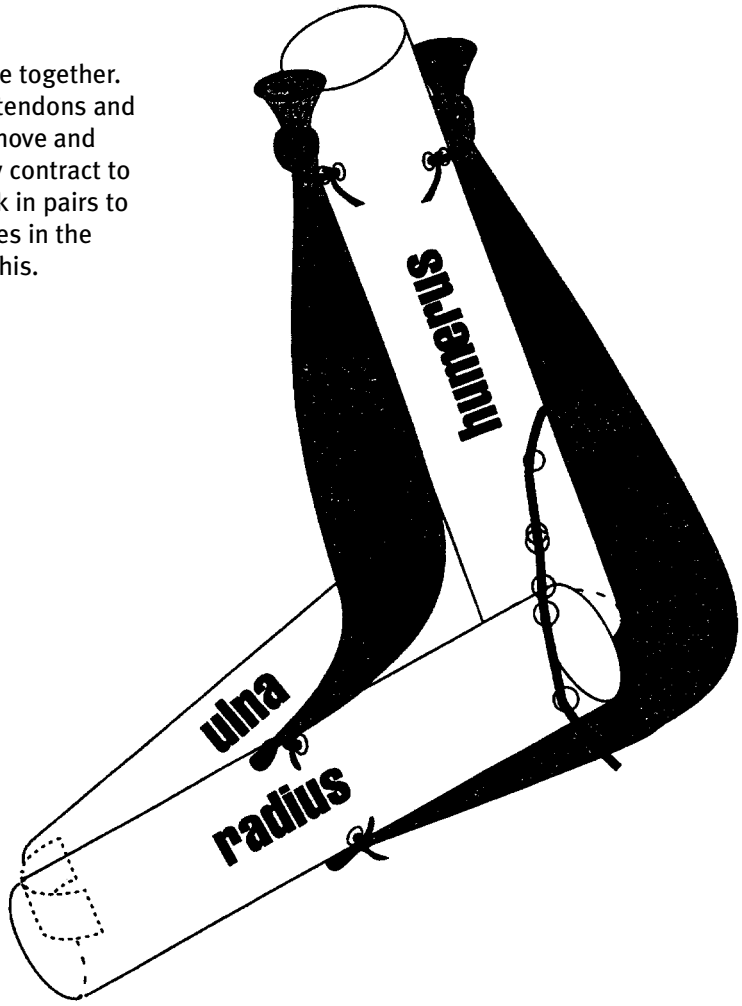
2. Have students punch two holes opposite each other at one end of each bone with the hole punch. Line up all three bones side by side with the holes matched up. The humerus should be between the radius and the ulna. Thread a pipe cleaner through each series of holes. Bend the pipe cleaner ends so they won't come out. Bind the radius and ulna together at the "wrist" with tape.

3. The balloons will represent the biceps and triceps muscles. (In our cardboard "joint", the arm will have only two muscles, but real arms have many.) Have students inflate both balloons only slightly and tie them closed. Attach the balloon muscles onto the bones with string in the following manner: Bend the model at the elbow to about 135 degrees, so it looks like an arm resting on a table. On the front of the "arm" attach the biceps muscle to the top of the humerus and then to the midpoint of the radius. On the back of the "arm" attach the triceps muscle to the top of the humerus and then to the midpoint of the ulna.

4. Have students test the joint by gently pulling on the balloons to stimulate contraction. Ask: What happens when the biceps contracts (gets shorter)? ***The radius and ulna move closer to the humerus.*** When this happens the triceps must relax (get longer). In order for the arm to be lowered, the triceps must contract while the biceps relaxes. The muscles can't both be relaxed or both be contracted at the same time if the joint is moving.

Discussion

Joints are places where bones come together. Muscles are attached to bones by tendons and make it possible for the bones to move and bend at the joint. Muscles can only contract to move bones, so muscles must work in pairs to move the bones. The biceps muscles in the upper arm are a good example of this.



Extension Activity

Strangers in the Night.

Movement can help animals find each other. This activity helps students understand how bats use echolocation to locate other bats in the dark. First pair up your students and have one student in each pair wear a blindfold. Have the sighted students move around the room. Ask the blindfolded students to locate their partners using sound only. The blindfolded students call their partners' names. The partners echo back with the same name. The blindfolded students should be able to determine the location of their partners based on where the "echo" is coming from.

Susan the Swainson's Hawk Flies South

Movement can also help animals look for better shelter and more food. Bird migration is a good example. Play the computer game **"Susan the Swainson's Hawk Flies South"** from the Academy's Fore! the Planet Web site. Check out **http://www.acnatsci.org/exhibits/foretheplanet/hawk1.html.**

Further Reading

DK Pockets: Animals of the World by David Alderton et al. (DK Publishing, 1999).

3. Eat or Be Eaten

Purpose

To enhance student understanding of Fore! the Planet Holes 4 and 8 by introducing the concepts of food webs and prey and predator relationships.

Fore! the Planet Holes Explored

Hole 4: Food Chains

Hole 8: Predator and Prey

Introduction

A food web shows the movement of energy through an ecosystem. Animals that eat other animals are carnivores. Examples include lions, hawks and sharks. Animals that eat plants are herbivores. Squirrels, snails and deer fall into this category. Carnivores eat prey to gain energy while herbivores gain energy from eating plants. Plants gain energy from the sun through the process of "photosynthesis." As organisms die, their bodies are absorbed by bacteria or fungi and become nutrition for plants. As a result, we can see that the energy is circulated originally from the sun.

Activity 3: Food Web Game

This game will illustrate to your students how energy moves through an ecosystem using raptors and their prey as an example. Before playing this game, discuss the feeding habits of raptors, and the feeding habits of the smaller animals that raptors eat. Discuss how plants obtain energy. Indicate relationships between various organisms (what each eats/energy flow) up through trophic levels. Bring in the idea of a web by choosing examples on a sample food web diagram (see materials) and showing how most organisms depend on more than one food source. Explain that in the game there will be three levels: raptors, plant-eating rodents, and plants. Describe how the game works and ask for predictions as to which level (raptors, rodents, plants) will accumulate the most energy.

Safety rules

- No tackling
- No grabbing hold of prey's name tag to make a capture (the string rips out)
- When two people are making an energy exchange, they are temporarily safe
- Set definite boundaries

Materials

- 2 lbs of peanuts (unshelled)
- Several quart containers
- Food web poster or diagram including sun, plants, herbivores, carnivores, and energy flow between each; this can be a commercial illustration or hand-drawn depiction
- Cardboard name-tags with string (to be worn necklace-style), listing the name of a raptor, a rodent, or a plant. Name-tags should be in ratios of 3 plants to 2 rodents to 1 raptor.

Procedure

This is basically a game of tag in which the object is for each person to accumulate peanuts which represent energy.

1. Each student role-plays either a raptor, rodent, or plant. Each student is allowed to capture or be captured only according to the relationships shown on the diagram and listed on the individuals name-tag. Pass out name-tags indiscriminately; avoid typing aggressive students as raptors or shy ones as plants.

2. A teacher or staff member plays the sun, responsible for distributing peanuts (energy) only to plants; no other life form can obtain needed food energy directly from the sun. Peanuts are accumulated but not eaten during the game; the total amount collected by each group will be counted at the end of the game.

3. Plants obtain energy from the sun: they begin with 4 peanuts apiece and maintain a total of 4 by returning to the sun when necessary. Since the student "plants" lack the defenses that many plants have against herbivores, they can run away.

4. Rodents get energy by capturing their specific food plants; they get 2 peanuts from each plant they capture. The rodents put one of these 2 into a special container for used-up energy lost to the food web (a corn plant puts energy into

growing leaves, stem, roots, cob, and kernels. Do we get all that energy when we eat corn?No, we only eat the kernels). Several of these used-up energy containers should be carried around the playing area by staff or teachers.

5. Raptors capture their rodent prey to obtain energy: 2 peanuts for each capture. Again, one of these must be put into a used-up energy container by the carnivore.

6. Organisms aren't out of the game if out of energy; they must simply seek out more from the appropriate source.

7. If enough staff are available, it's useful and fun to denote one staff person as "Death and Decay." When Death tags a player, that player must surrender all accumulated peanuts and start from scratch. Death can also capture raptors and serves as a means of siphoning peanuts from that group.

8. The game continues until the sun runs out of peanuts, or as long as desired up to that point.

Follow-up Discussion

Collect the peanuts from each group and count up the totals. Do they match the predictions? The game is set up as outlined above so that plants will usually have the highest total, rodents the next highest, and raptors the least. Is this the way things work in nature? How many peanuts did used-up energy accumulate (almost always higher than any of the other totals). Why did used-up energy get the most? How much energy does this leave for raptors? Depending on the age of the group, discuss pyramids of energy, biomass, and numbers. In a forest ecosystem, do you think there would be more raptors, rodents, or plants? Why? Distribute peanuts to be eaten equally among students.

Extension Activities

Take your students outside to a nearby park or wooded area. Ask them to find as many types of living organisms as they can. Have them try to guess if each organism is a predator, prey or both.

Further Reading

Food Chains by Alvin Silverstein, et. al. (Millbrook Press 1998).

4. Evolutionary World

Purpose

To enhance student understanding of Fore! the Planet Holes 5, 7 and 9 by exploring an evolutionary timeline and some adaptations produced by evolution.

Fore! the Planet Holes Explored

Hole 5: Evolution of a Golfer

Hole 7: Natural Selection

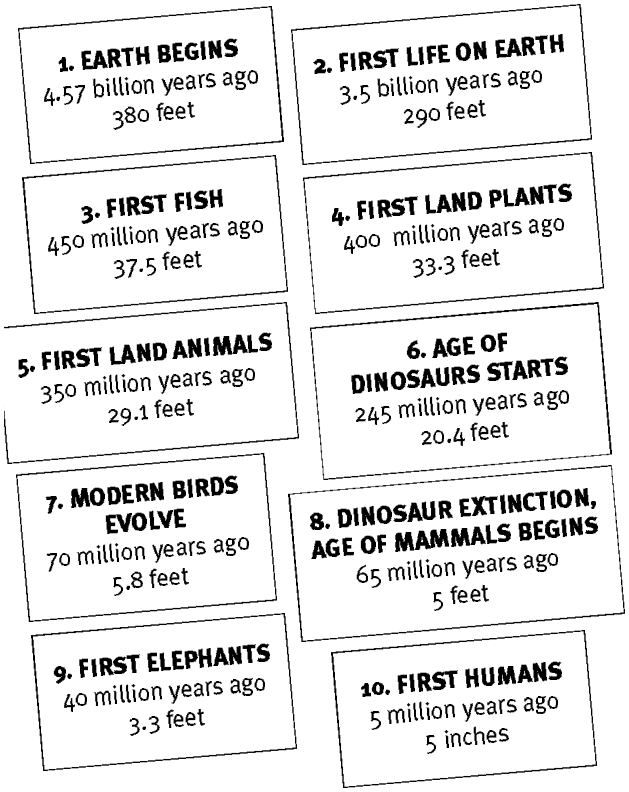
Hole 9: Dinosaur Extinction

Activity 4A: The Timeline of Life

Understanding the vastness of geological time is difficult even for adults. The following activity will allow your students to visualize a human timeline with one inch equaling one million years.

Materials

- Measuring stick (ruler or yardstick)
- Tape
- Markers
- 10 signs with string (to be worn necklace-style) as follows:



Procedure

1. Find a room or hallway that measures at least 380 feet in length, or do this activity outside. For younger students, mark the distances in a line on the floor with tape. For older students, let them measure the distances themselves.

2. Break students into 10 groups. Give each group a sign card and ask one student in the group to wear the sign necklace-style.

3. Have Group 1 walk to their point in geological time (if already marked) or have them measure 380 feet and then stand in that spot. Explain this is when the earth was formed. Have each successive group follow same procedure in chronological order, explaining each event.

4. When all groups are on their spots, have them look at the whole spread and explain the concept of geological time again. How far is the formation of the earth to the first life on earth compared to its distance from the evolution of humans? By comparing distances, students get a visual understanding of stretches of geological time.

Activity 4B: Design-a-Saur

This activity introduces students to classifying dinosaurs according to their lifestyle and physical characteristics and helps them understand dinosaur adaptations.

Every animal needs certain things to survive–food, water, shelter, and space. The place where an animal lives and is able to find these necessities is called its habitat. By looking at an animal's body, it is possible to make intelligent guesses about how and where that animal lives. Paleontologists, who study dinosaurs, base their ideas about how dinosaurs lived on both the way their bodies are built and the type of habitats in which they lived.

Materials

- Design-a-Saur Worksheets
- Crayons
- Scissors

Procedure

1. Hand out sheets with dinosaur parts.

2. Explain to the class that they are going to design their own dinosaur, and that they can use the pieces in any way they want. Some students may want to assemble a recognized dinosaur; others may want to create a fantasy animal. To get them started, discuss one aspect of dinosaur anatomy , such as feet, or teeth, and the uses that this anatomical feature might have had for different dinosaurs.

3. Hand out crayons, glue, cardboard, and scissors, and allow the children to create their own dinosaurs. Hint: Color before cutting.

4. Tell students that they will be naming their dinosaurs. Explain that scientific names often come from the way people choose to describe the animal. (ex: *Tyrannosaurus* means "terrible lizard".) Other animals are named after the person who discovered them. (ex: *Hadrosaurus foulkii*) Other dinosaurs are named for the place that they were found. (ex: *Velociraptor mongoliensis*) Tell the students that they can name their animal based on a description of the animal, their own name, or any way that they would like.

5. Allow the students to show their dinosaurs to the rest of the class, and to explain their dinosaur's adaptations, habitat, and lifestyle.

Some Possible Dinosaur Adaptations

Teeth:

Flat teeth for plant eaters
(Hadrosaurus, Edmotosaurus)

Pointed teeth for meat eaters
(Tyrannosaurus rex, Albertosaurus)

Spikes:

Nose spikes as defense
(Triceratops, Centrosaurus)

Horns:

Thumb spikes for shredding vegetation
(Iguanodon)

Spines and plates:

Back plates for defense
(Stegosaurus, Ankylosaur)

Back spines or sails as heat catchers to warm up the dinosaur,
(Stegosaurus)

Feet:

Pillar-like feet for supporting large weight
(Apatosaurus, Brachiosaurus)

Three-toed feet for running
(Utahraptor, Allosaurus)

Clawed feet for attacking
(Velociraptor, Troodon)

Head crests:

Mating display
(Parasaurolophus, Oviraptor)

Producing sound, like a horn
(Corythosaurus, Parasaurolophus)

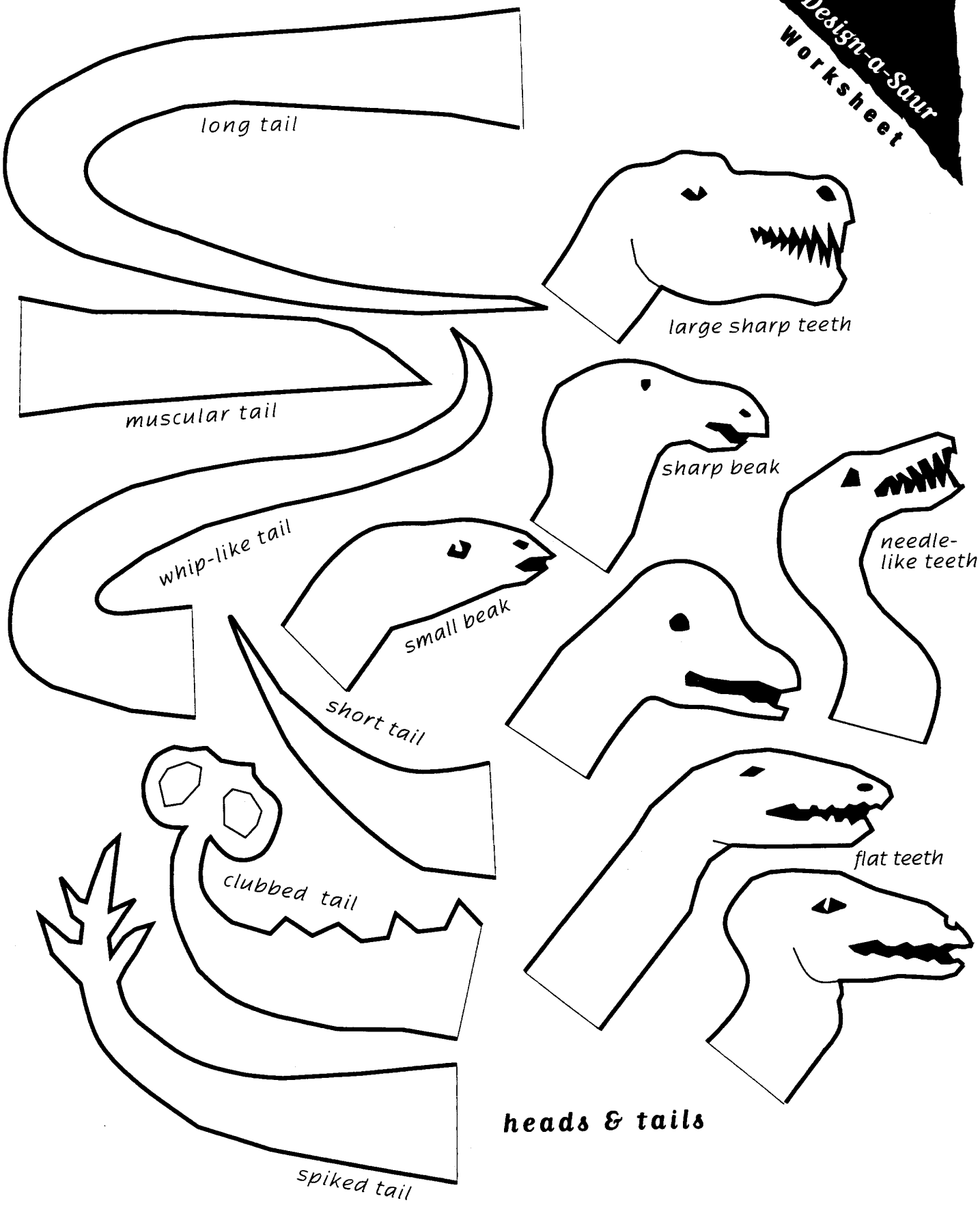
Claws:

Digging
(Segnosaurus)

Self defense
(Velociraptor, Deinonychus)

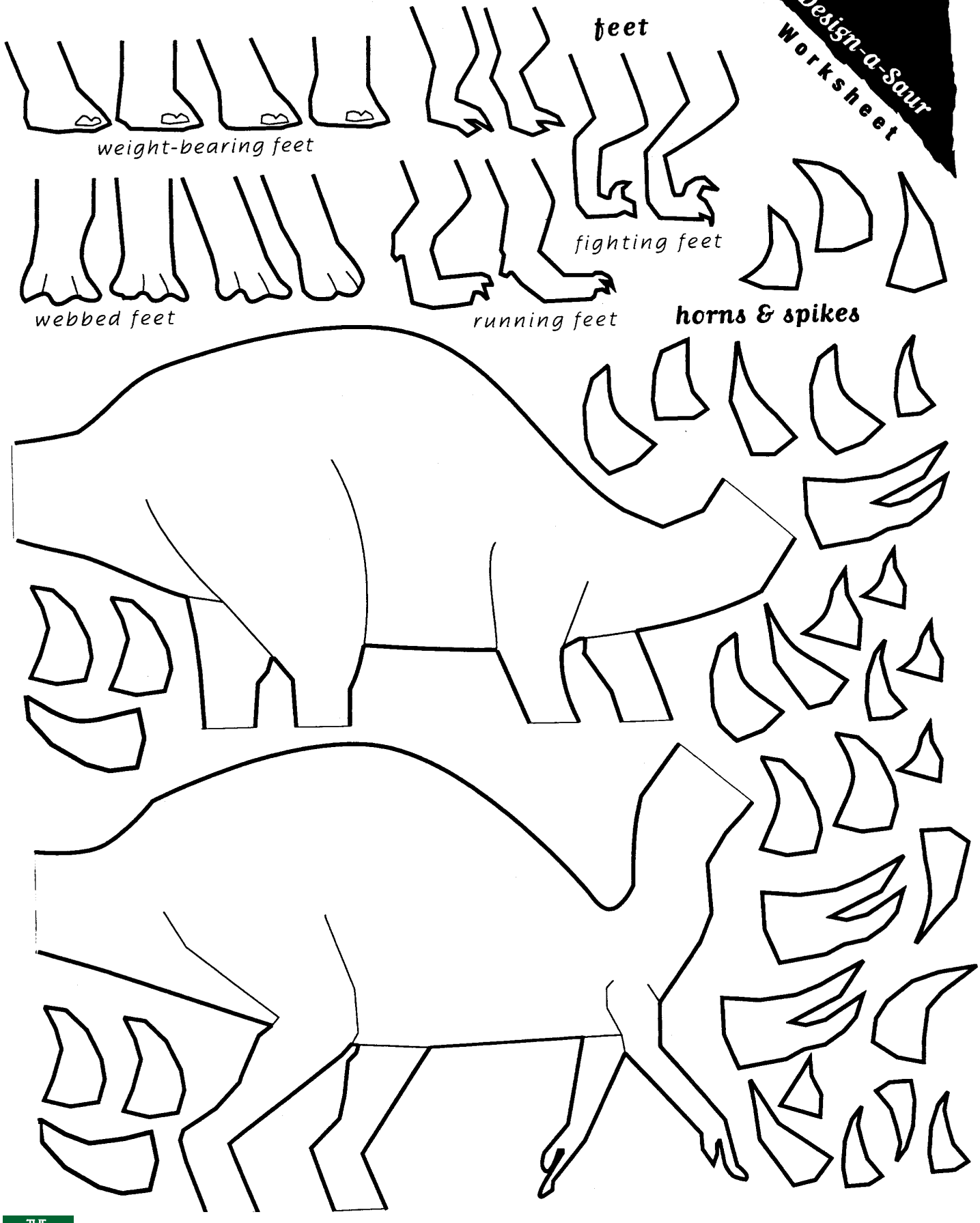
Attacking in order to kill for food
(Velociraptor, Deinonychus)

Design-a-Saur Worksheet

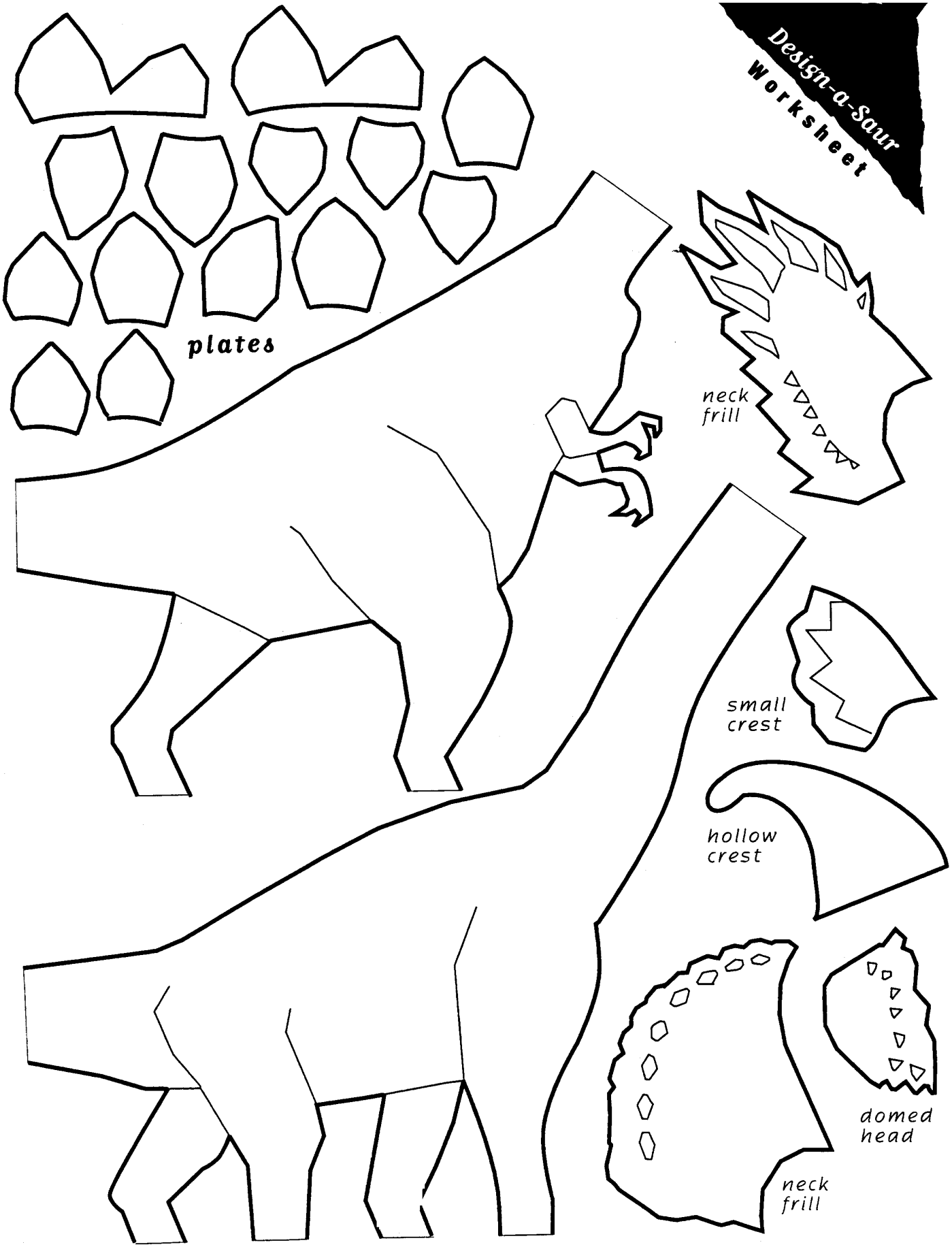


heads & tails

Design-a-Saur Worksheet



Design-a-Saur Worksheet



Follow-up Discussion

Discuss dinosaur adaptations and their uses, using a few actual dinosaurs as examples. Ask students what they think of these interpretations of the dinosaur adaptations. Are they similar or different to the way the students interpreted the adaptations? Remind students that these adaptations probably served numerous purposes for the dinosaurs. Ask students how they think that people came up with the ideas about the purposes of dinosaur adaptations. Tell students that the primary way that paleontologists come up with theories about dinosaur behavior is by looking at the fossils from that time period, such as dinosaur bones, dinosaur imprints, and fossils left by other animals and plants. Another method used by paleontologists is comparing dinosaurs to animals that are alive today. What are some animals alive today that have similarities to dinosaurs? What is similar about them? What are the differences? Did students use other animals alive today to decide what their dinosaur's body parts are used for?

Extension Activities

Grades 3-4:

6. Ask students to write a description of their dinosaur and the different adaptations that it has. Have students write a story about the dinosaur, or pair students and ask them to come up with a story that includes both of their dinosaurs.

Grades 5-up:

6. Ask students to write a detailed description of their dinosaur, its habitat, and the way it lives. Have them write a fictional narrative from the perspective of the scientist who first found the bones of this dinosaur.

Further Reading

Ranger Rick's Digging into Dinosaurs by National Wildlife Federation (McGraw-Hill, 1989)

The Evolution Book by Sara Stein (Workman Publishing Company, 1986)

5. Save the Animals

Purpose

To enhance student understanding of Fore! the Planet Holes 11, 13, 16, 17 and 18 by introducing concepts of ecological changes and how they affect animals.

Fore! the Planet Holes Explored

Hole 11: Spawning Salmon

Hole 13: Wild Corridors

Hole 16: Alien Species

Hole 17: Population Threats

Hole 18: Rainforest Threats

Activity 5A: The Interdependence of Life

(Adapted from *Project Learning Tree*)

In this activity, students will take a close look at one particular ecosystem (a forest) and will discover the ways that plants and animals are connected to each other. By substituting the appropriate information, you can also use the activity to study other ecosystems, such as oceans, deserts, marshes, or prairies.

A forest is a living community dominated by trees. Each plant in the forest, from tiny mosses to giant trees, has its own specific needs for things like sunlight and moisture. Because environments vary tremendously, a specific location will be better for certain plant species than for others, and those species will grow more abundantly as a result. The most dominant tree species in a forest usually determines the forest's appearance and suitability as a habitat for plants and animals. For example, in some forests, large, dominant trees may reduce sunlight and monopolize soil moisture and nutrients, thus limiting the types of plants that can grow beneath them.

While trees and plants are usually its most conspicuous elements, the forest ecosystem also depends on animals. Animals are vital to most plants because they help pollinate flowers and disperse seeds. At the same time, animals such as deer, rabbits, and insects may eat certain plants, greatly reducing their presence. Some insects can substantially damage a forest ecosystem if their numbers get too high. Insect-eating birds play an important role in keeping insect populations in check.

Materials

- Half a ball of yarn
- Resource materials about forest plants and animals

Procedure

1. Ask students to work in pairs or teams to brainstorm all the components they think they would need to make a healthy forest. Have each group choose a forest plant or animal and collect as much information as possible about that organism.

2. After they research the organisms, have the teams each make a name tag for their forest plant or animal, including a picture. Ask one person from each group to sit on the floor in a circle.

3. Starting with one "plant," ask that student to hold the end of a ball of string. Ask the team that studied the first plant to name another organism in the circle with which that plant interacts (for example, is eaten by or depends on). Pass the ball to this second student, who will wrap the string around one hand and pass the ball to the student representing an organism that the second team chooses to connect with. This process will continue until each "organism" is linked to the ecosystem and the ball is returned to the first student.

4. Now have students slide back until the string is taut. Tell student to keep still. But if they feel a tug, they should tug in response. When everyone is still, tell the student holding the original end of the string to gently begin tugging. Keep reminding everyone that if they feel a tug, they should tug in response. Through this mechanism, vibration will spread through the web of life until everyone is tugging and the whole web is shaking.

5. Ask students how the tugging demonstration might illustrate what happens when one of the links in an ecosystem is damaged through natural or human-made stress. ***The rest of the ecosystem feels the effects.***

6. Ask students to pick one organism in the system that they feel is the least important and have it drop out. Ask if any other organisms should drop out because they depended on that organism. After one or more have dropped out, ask students again to identify an organism that seems less important and repeat the procedure. Continue playing for a few more rounds, then ask the following questions:

- What happens when we remove a link in the forest ecosystem? ***Organisms that depend on it are affected.***
- Were the changes more dramatic when the system was composed of many parts or when it had fewer parts? ***fewer***
- What can we say about the relationship between how many parts the system has (its complexity or diversity) and how stable it is? ***In general, complexity makes it more stable.***

Some Forest Plants and Animals

azalea
clover
columbine
cottonwood
honeysuckle
lichen
maple tree
Douglas fir
paintbrush
pine tree
poison ivy
shelf fungus
violet

bark beetle
bat
beaver
bear
box turtle
butterfly
chipmunk
deer
earthworm
field mouse
red fox
tree frog
grasshopper
king snake
lizard
mosquito
hawk moth
opossum
barred owl
rabbit
raccoon
skunk
snail
red squirrel
tick
woodpecker

Activity 5B:
Habitat Loss Musical Chairs

(Adapted from *Beakman's World on Tour Teaching Guide,* © 1998, Cincinnati Museum Center)

Objective: To identify a number of animals that are part of the incredible biodiversity of the rain forest and infer the problems caused by their dwindling habitat.

Materials

- Chairs placed in a circle
- Music (soundtrack to The Jungle Book, The Lion King, etc.)

Procedure

1. Start out by having students sit in their chairs and explain that their chairs represent rainforest animal "homes" like trees, vines, underbrush, or pools of water. Then invite students to choose a rainforest animal they would like to represent. Here's a short list of animals from rain forests around the world to get you started:

alligator	electric eel
armadillo	millipede
anaconda	nightjar (bird)
capybara (rodent)	fer de lance (snake)
emerald tree boa	agouti (rodent)
mountain gorilla	giraffe stag beetle
hoatzin (bird)	hornbill (bird)
green iguana	chameleon
ring-tailed lemur	potto (primate)
kinkajou	praying mantis

2. Have students stand up. Take a chair away from the circle and start the music. Students walk around the circle while the music is playing. When the music stops, the student who does not find a "home" to live in (sit down in) becomes extinct (is out). Continue on until all the animals are extinct but one. **Ask:** Is this still a rain forest? Does only one species of animal, and one kind of home, have much of a chance of survival?

3. As the game progresses you may want to move multiple chairs to illustrate the interdependence of life. The extinction of one animal in a habitat can result in many animals becoming extinct because a critical portion of the food web is missing.

Discussion

This game demonstrates that all these species have very little chance for survival without the habitat they require. Habitat loss is the biggest threat facing animals in tropical rain forests around the world. Rain forests cover only 6% of the earth's surface, yet an area of rain forest equivalent to the size of the state of Washington is cut down for timber, firewood, farming, cattle ranching, and development every year. The rain forest supports an incredible number of plants and animals. Four times as many bird species live in the tropical Central American corridor than the entire forested eastern United States. In a rain forest of Malaysia or the Amazon, you will find ten times the number of tree species that you would in the same-sized area of a deciduous forest in eastern North America.

6. Save the Planet

Purpose

To enhance student understanding of Fore! the Planet Holes 10, 12 and 15 by making students aware of environmental pollution.

Fore! the Planet Holes Explored

Hole 10: Recycling

Hole 12: Landfills

Hole 15: Water Pollution

Activity 6: Talking Trash, Not!

(Adapted from *Project Learning Tree*)

By taking a look at their own trash, students can learn a lot about how and why they throw things away. They can find ways to cut down on the waste they produce and to improve the way waste is managed in their community.

More and more people are involved in reusing, recycling or recovering materials that people previously referred to as "trash." In fact this "trash" is composed of valuable raw materials. Consequently, your community may sponsor recycling or composting programs, or have a waste-to-energy facility to decrease the amount of material disposed as waste.

To the teacher

For this activity, you will need some kind of large container (or containers) to hold a week's worth of classroom trash. Large cardboard boxes, a large trash barrel, or several plastic trash bags will all work well. You will also need to make arrangements so that no one collects trash from your room during the week.

Materials

- Large box, boxes, pails or other containers for sorted waste
- Rubber gloves
- Map of North and South America
- Bathroom scale (optional)

Procedure

1. Discuss with students whether it is really possible to throw something away. Where is "away?" Do these things somehow disappear? Can trash continue to affect us even after we've thrown it away?

2. Tell students that for one week they will not throw anything away while in school. Explain that everything they want to throw away during the week should go into the large container you prepared earlier.

NOTE: Food wastes can be messy and unsanitary to keep. You might have students collect food waste in a separate container, weigh it and record the contents before they throw it away.

3. Have students predict how full the trash container will be by the end of the week. You might also have them predict the types of items that will make up the greatest proportion of the trash.

4. At the end of one week (or at the end of each day), have students look at their trash. Did more or less accumulate than they'd predicted? You can sort through the trash and hold up items for them to see, or you can have one or more students sort through the trash. Be sure that whoever sorts wears rubber gloves. Record on the chalkboard the quantity and type of each item.

5. Using the following questions, discuss what usually happens to trash:

What usually happens to classroom trash at the end of each day? ***Someone collects it and takes it to a dumpster.*** You might want to take the students to see the dumpster.

Where does the trash end up? How often is it picked up? Have students guess. ***In most cases, someone collects it from the dumpster and takes it to a local landfill where it is buried or to an incinerator where it is burned. Recyclable materials that are separated are often taken to a recycling facility.***

What are the pros and cons of burning trash? ***Greatly decreased the volume of waste. May put harmful pollutants in the air.***

What are the pros and cons of landfills? ***They provide easy disposal for large amounts of waste in a relatively sanitary fashion. Landfills are filling up and new landfills are difficult to site.***

Where do the materials come from that make the items in trash? ***Paper comes from trees, metal cans from minerals in the earth, plastics from fossil fuels, fruit from trees and other plants.***

When people use things only once and then throw them away, what are the effects on our supply of natural resources? ***We have to use more minerals and fossil fuels for energy to create new products.***

Extension Activity

Trash Action Plan

Have the students develop an action plan to reduce the amount of trash they generate, then carry out the plan. Here are some suggestions of things your group can do. The students may also have other ideas.

- Set up a scrap box. Have students put papers which they've only used one side of in the scrap box. When someone needs paper for scratch work or a short assignment, he or she can use a piece from the scrap box.
- Set up a "recycling center" in one corner of your room for the class (or for the whole school). You might collect aluminum, glass, plastics, and/or paper. Be sure to discuss what you're going to do with the collected material before you begin! ***Find out what your school, community or city is already doing. Consult the blue and yellow pages of the telephone book to locate recycling centers.***
- Create a compost pile outside your building. (Contact your state environmental agency for composting regulations.) Food scraps from your class, other classes and the cafeteria can all be collected and then dumped in the compost pile. Building maintenance crews can also dump grass clippings and other yard waste into the compost pile.

Operation Cleanup

Have students clean up one of the public environments in the neighborhood.

Environmental Times

Create a newspaper called "Environmental Times" and write articles on environmental issues.

Further Reading

Project for a Healthy Planet by Shar Levine and Allison Grafton (Wiley, 1992)

Learning at the Exhibit Worksheet *(Answers are in parentheses)*

1. Butterfly Life Cycle

What does metamorphosis mean?

(a change in form, like butterfly from caterpillar)

What are the four stages in a butterfly' s life cycle?

(egg, larva, pupa, butterfly)

2. Seed Dispersal

Why is the eclectus parrot not a good disperser of seeds?

(its sharp beak may crack the seed pit, preventing the seed's growth)

Why is the cassowary a good disperser of seeds?

(it eats fruit, but can't digest the seeds, which are dispersed in the birds'droppings)

3. Bat Sonar

Are bats blind?

(no, they can see, but they use sonar to navigate in the darkness)

How do bats avoid obstacles in the dark?

(they send out sonar waves which hit obstacles and return to the bats so they know what's in front of them)

4. Food Chains

Which organism in this whole is a primary producer?

(primary producers are organisms that turn light energy into food energy, i.e. plants, in this case the Douglas fir)

Which is a secondary consumer?

(secondary consumers eat primary consumers, which eat plants, in this case, the great-gray owl eats the red tree vole)

5. Evolution of a Golfer

What is a vertebrate animal?

(an animal with a backbone)

What key feature allows human beings to play golf, among many other things?

(the brain)

6. Backyard Explorer

What are some tools you can use for studying nature in your back yard? (look for clues in the hole itself)

(magnifying glass, journal, your sense of observation)

7. Natural Selection

Are long beaks and strong wings an advantage or disadvantage to the birds on the new island with lots of seeds and no predators?

(disadvantage)

Are short beaks and weak wings an advantage or disadvantage on the new island with lots of seeds and no predators?

(advantage)

8. Predator and Prey

What is the fly trying to do in this hole? Why is its job important to the ecosystem?

(get to the picnic to lay eggs; flies help the decomposition process, breaking down nutrients essential to other plants and animals)

What predators eat the fly?

(frog, spider)

9. Dinosaur Extinction

How did dinosaurs die in the sudden death scenario?

(disruption of habitats and food chains)

How did dinosaurs die in the gradual change scenario?

(inability to evolve and adapt)

10. Recycling

What are some alternatives to throwing plastic in the trash?

(reuse, recycle)

How can you help the environment when you go to buy a product in the store?

(buy things with less packaging, buy recycled products, ask the store to stock these items)

11. Spawning Salmon

Salmon are born in rivers but then swim to the ocean to reach maturity–why do they later return to the rivers?

(to breed and lay eggs)

What are some of the obstacles in the path of the returning salmon?

(predators, dams, fishing, pollution)

12. Landfills

What are some of the problems with continuing to dump trash in landfills?

(lack of space, leaking chemicals into groundwater)

If on average, every American produces 4 lbs of trash per day, what can you do to help?

(reduce, reuse, recycle, compost)

13. Wild Corridors

What is a wild corridor?

(green spaces that are connected, allowing animals to move freely)

What are some of the solutions people have come up with to help animals in fragmented habitats?

(tunnels under roads for panthers and salamanders, ramps and traffic control around pipelines for caribou, saving chunks of forest and parks next to each other)

14. Bird Migration

Why do birds migrate?

(to breed and to feed)

Where do Swainson's hawks migrate from and to in the fall?

(from western North America to Argentina in South America)

15. Water Pollution

How do pollutants from our lawns, yards, farms and factories get into water ways?

(water runs downhill, picking up and carrying trash, chemicals, and other wastes with it)

What are two things you can do to prevent water pollution?

(recycle used motor oil, reduce pesticide use, clean up pet waste, participate in litter cleanups)

16. Alien Species

What is meant by the term alien species?

(when a species of animal or plant is introduced to a habitat from a foreign place)

What is one example of destructive results from an alien species?

(the brown tree snake in Guam wiped out many native bird species; the cane toad in Australia multiplied out of control; the vine kudzu in America crowded out other native plants)

17. Population Threats

What are some of the human threats to a small, isolated population of bears?

(hunting, pesticides, destruction of habitat)

What are some of the natural threats to a small, isolated population of bears?

(too few cubs born, too many deaths of adult bears, shortage of food, too many predators, disease)

18. Rainforest Threats

Why is the rain forest important to you and me?

(the trees and plants are important to the atmosphere and climate, contributing oxygen and preventing global warming)

What are some of the threats to the rain forest and what is needed to save it?

(clear cutting for farming and economic development; sustainable development ideas like butterfly farming that support local people and preserve the rain forest)

Acknowledgements

The mission of
The Academy of Natural Sciences
is to expand knowledge of nature
through discovery,
and to inspire stewardship
of the environment.

Founded in 1812, The Academy of Natural Sciences of Philadelphia is the oldest science research institution in the Western Hemisphere and a world leader in the fields of natural science research, education and exhibition.

Popular features in the Academy's Museum include the new exhibit, **Dinosaur Hall,** home to fearsome *Tyrannosaurus rex* and the newest carnivore on the block, *Giganotosaurus,* the biggest meat-eating dinosaur ever discovered. There's the hands-on experience, **The Dig,** where visitors dig for real fossils; **Butterflies,** the exhibit with live tropical butterflies that fly all around you, taking you into the heart of the rain forest; the **Live Animal Center** that cares for over 100 wild animals unable to survive on their own in the wild; and the children's nature museum, **Outside-In.** Changing exhibits highlight the ongoing research of Academy scientists.

The Academy has three research groups: the **Biodiversity Group, The Patrick Center for Environmental Research, and The Estuarine Research Laboratory.**

Biodiversity Group studies the identity, relationships and ecology of organisms. Through the Academy's vast biological collections and individual research efforts, Academy scientists explore the diversity of life forms, and their evolution, adaptations, survival and extinction.

The Patrick Center for Environmental Research at The Academy of Natural Sciences examines water quality issues and their relationship to living resources. It is considered a pioneer and a leader in developing new means to assess water quality.

The Estuarine Research Laboratory on the Patuxent River in Maryland focuses on the natural processes occurring in estuaries and coastal oceans. The Estuarine Research Laboratory offers diverse educational programs for teachers, students and concerned citizens.

The Educator's Guide to Fore! the Planet

Fore! the Planet was conceived by Willard Whitson, Director of Exhibits. Concepts for the holes were culled from hundreds of ideas created by Academy staff.

Fore! the Planet Exhibit

Exhibit design:	Willard Whitson Leslie Cohen
Graphics:	Jane Spencer Gene Nopper
Text:	Sean Duran Rich Clark Barry Lewis Linda Wolf
Website:	Judy Kim

Fore! the Planet Educator's Guide

Editor:	Linda Wolf
Activities:	Rita Hoffstadt Stacy Carr
Design:	Gene Nopper