Animal Structure and Adaptation

Theme: Adaptations
Grade Level: Third
Best Time to Plan Trip: Early fall or late spring

Unit Rationale

The Great Smoky Mountains are world-renowned for the diversity of plant and animal species found here. This great variety makes the national park an exemplary outdoor laboratory for the study of relatively undisturbed native flora, fauna, physical environs and processes of the southern Appalachians.
The Sugarlands area is a great place to study plant and animal adaptations for a variety of reasons. A number of animal exhibits exist in the visitor center. Students can look closely at animal coloration, teeth, and body shapes. Students can also read for information about the animals' habitat and food preferences, which leads to explanations about the animal's special adaptations. The close proximity of the Fighting Creek Nature Trail offers the observance of a wide variety of plants and common animals. Students can look more closely at plant adaptations such as the tendrils on poison ivy and Virginia creeper and look for behavioral adaptations in animals such as the "pecking" of a woodpecker. Students can also look and listen for several species of woodland birds.

State Education Standards (Tennessee)

Science

Embedded Inquiry
(0307.Inq.2) Select and use appropriate tools and simple equipment to conduct and investigation
(0307.Inq.6) Compare the results of an investigation with what scientists already accept about this question
Embedded Technology and Engineering
(0307.T/E.1) Describe how tools, technology, and investigations help to answer questions and solve problems
(0307.1.1) Use magnifiers to make observations of specific plant and body parts and describe functions
Interdependence
0307.2.1 Categorize things as living or non-living
0307.2.2 Explain how organisms with similar needs compete with one another for resources
Flow of Matter and Energy
0307.3.1 Describe how animals use food to obtain energy and materials for growth and repair
Heredity
0307.4.1 Identify the different life stages through which plants and animals pass
Biodiversity and Change
0307.5 Explore the relationship between an organism's characteristics and its ability to survive in an environment
//2009 Tennessee Standards//

Table of Contents

Planning a Successful Trip
Birds and Adaptations

Schedule for a day of activities in Great Smoky Mountains National Park

Morning
Travel to Sugarlands Visitor Center
Divide group in two sub-groups
(use three groups if you have a **minimum** of 3 hours)
•Structure and Adaptation activity
•Adaptation Hike on the Fighting Creek Nature Trail
•Visitor Center Search (optional if time allows of weather is poor)
Nature Trail
Switch Activities
Lunch
Return to School

Planning a Successful Trip

•Call Great Smoky Mountains National Park at 865-436-1713 to reserve the Sugarlands Training room (free of charge). Materials for this program may be borrowed from the National Park.

•There is no cost to use this site. Bus parking is available at the Sugarlands Visitor Center.

•Check the weather before you go. Temperatures in the mountains can be 10 - 15 degrees cooler than at your school.

•Bathrooms are located at the Sugarlands Visitor Center.

•Plenty of chaperones are recommended for the purposes of supervision the activities. We recommend that for the purposes of safety, a minimum of one adult should be available for every eight students When hiking, always travel with an adult at the lead and the back (sweep) of the group while you hike.

Birds and Adaptations Safety Considerations and Other Important Information

•Park Rules and Regulations

Great Smoky Mountains National Park is a federally protected public use area. Certain activities are prohibited by visitors. Be sure to read the rules and regulations of the National Park found in the appendix of this lesson. For further information or questions, you may contact the National Park at 865-436-1713. Please use common sense and appropriate planning whenever you participate in outdoor activities.

•Dressing for the Weather

Please remind your students to wear appropriate footwear and clothing for an extended outdoor program. Short pants, flip flops, or sandals aren't recommended. Temperatures in the mountains can be 10-15 degrees colder than at your school. You may wish to alter portions of the program should inclement weather appear.

•Restrooms and Water

Bathrooms and water fountains are located at Sugarlands Visitor Center.

•Packing Lunches

Lunches may be packed in a box with drink coolers and kept on the bus until lunch time. You may eat picnic style at the lawn of the visitor center, or travel to a nearby picnic area.

•Group Size

The locations for the on-site activities and parking lot at these area can accommodate a large group (several classes). For safety and enjoyment of the lessons, we recommend a group of no more than 50 students.

•Cell Phones and Emergency Contacts

Within the National Park, cell phones are not always reliable. Be sure to stick to your agenda. Cell phones will pick up in Gatlinburg. In case of emergency call 911. For non-emergencies within the National Park, contact park rangers at 865-436-1294. If you do not have phone reception in the National Park, contact the nearest park employee and they can assist using the park's radio communication system.

•Name Tags

It is extremely helpful to rangers leading the program for students to wear clearly labeled name tags with first names only.

•Special Considerations

Ask for assistance from parents and volunteers who are comfortable in an outdoor environment. Students often gain their confidence in a new environment from the cues they receive from the adults around them.

•Poison Ivy

Please be aware of the presence of Poison Ivy throughout the park, particularly in the spring, summer and fall. Poison ivy is a three leaved plant which can grow on the ground as well as on "hairy" vines up trees. To avoid chances of an allergic reaction, stay on trails and avoid direct contact with vegetation. If contact occurs or is a concern, wash affected parts in cold soapy water immediately.

Pre-Site Test

Name_____

Pre Score:_____
Post Score:_____

Birds and Adaptations
Circle the correct answer:

1. A physical or behavior difference that helps animals survive is an _____.	Adaptation	Urban	Pesticide
2. Birds that swim are most likely to have _____ _____.	Short necks	Red heads	Webbed feet
3. Plants that produce berries are usually spread in the forest by _____ _____.	animals that digest the berries	wind that blows the berries	rain that washes the berries across the soil
4. Bird bones are _____.	thick and heavy to provide the structure birds need to fly	hollow and thin so that birds are light in weight	made only of cartilage so that birds are flexible during flight
5. An example of a physical adaptation is _____.	when an animal has coloration that makes it blend into its habitat	when butterflies migrate to warmer climates	when squirrels store acorns for winter feeding
6. An example of a behavioral adaptation is _____.	when a hummingbird has a long beak to reach into nectar bearing flowers	when a bear growing thicker fur to stay warm	when an owl hunts only at night to avoid competing with daytime hunters
7. Plants have sometimes have _____ _____ on their leaves to help them hold moisture.	small suction cups	a thick, waxy outer layer	a metallic layer

Pre-Site Test Continued

8. Animals adapt to harsh winter weather in 4 different ways. List these 4 adaptations (hint: MASH)	1. _____ 2. _____ 3. _____ 4. _____

9. Some insects have _____ shaped mouthparts that are adapted to help get nectar from tube-shaped flowers.	straw	sponge	tweezer
10. Insects often _____ flowers while they are feeding.	damage	pollinate	kill

Pre-Site Test

(Teachers: Administer this test once before teaching the pre-visit activities and once after the post site activities for comparable results of comprehension and retention)

Birds and Adaptations

1. A physical or behavior difference that helps animals survive is an _____.	**Adaptation**	Urban	Pesticide
2. Birds that swim are most likely to have _____ _____.	Short necks	Red heads	**Webbed feet**
3. Plants that produce berries are usually spread in the forest by _____ _____.	**animals that digest the berries**	wind that blows the berries	rain that washes the berries across the soil.
4. Bird bones are _____.	thick and heavy to provide the structure birds need to fly	**hollow and thin so that birds are light in weight**	made only of cartilage so that birds are flexible during flight
5. An example of a physical adaptation is _____.	**when an animal has coloration that makes it blend into its habitat**	when butterflies migrate to warmer climates	when squirrels store acorns for winter feeding
6. An example of a behavioral adaptation is _____.	when a hummingbird has a long beak to reach into nectar bearing flowers	when a bear growing thicker fur to stay warm	**when an owl hunts only at night to avoid competing with daytime hunters**
7. Plants have sometimes have _____ _____ on their leaves to help them hold moisture.	small suction cups	**thick, waxy outer layer**	a metallic layer

Pre-Site Test
Teacher Key Continued

8. Animals adapt to harsh winter weather in 4 different ways. List these 4 adaptations (hint: MASH)	1. **Migrate** 2. **Be Active (thicker fur, reliable food source)** 3. **Store Food** 4. **Hibernate**		
9. Some insects have _____ shaped mouthparts that are adapted to help get nectar from tube-shaped flowers.	**straw**	sponge	tweezer
10. Insects often _____ flowers while they are feeding.	damage	**pollinate**	kill

Pre-Site Activity
Visit with Animals.

Duration: 30 minutes
Class Size: as appropriate
Materials: as needed

Background Information for the Teacher:
During the on-site experience, students will be exploring manners in which animals and plants adapt to the changing conditions of their environment. Great Smoky Mountains prohibits willfully approaching certain species of wildlife. It is therefore recommended that a professional animal handler be brought into the school for a pre-site presentation, talk or other information.

Students can compare and contrast characteristics of animals, and see up close their physical attributes which promote their survival.

Potential Presenters:
American Eagle Foundation
Post Office Box 333
Pigeon Forge, TN 37868
Toll Free Phone: 1-800-2EAGLES

Rain Forest Adventures:
Telephone 865 428 4091
Mailing Address
109 NASCAR Drive, Sevierville, Tennessee 37862

Ripleys Aquarium
Ripley Entertainment, Inc
88 River Road
Gatlinburg, Tennessee 37738
Telephone 865-430-8808

On-Site Activity
Museum Search

Duration: 45 minutes
Class Size: 30 students
Materials: text for photos and student worksheets on following pages

Introduction (10 minutes)
Introduce the students to the unit by asking them how they adapted to the outdoor environment today? (jacket, long pants, shoes) How would you adapt to hot weather? (less clothes, sunscreen, sunglasses) Are these physical adaptations or behavioral adaptations? Explain that shivering can create some short-term heat energy, while sweating during can release heat from your body. These are physical adaptations.

Prepare students to learn some physical and behavioral adaptations of animals in the Great Smoky Mountains to help them adapt to winter. What are two factors that limit animals in the winter? (food, warmth).

Introduce the M.A. S. H. (Migrate, Active, Store, Hibernate) concept. Tell students that each of the letters represent a way for animals to survive the cold season. See if they can guess what M.A. S. H. stands for. Ask students how each of these adaptations would help animals survive the winter? If an animal stays active, what physical adaptations help them survive? (thicker fur, warm-blooded, available diet). Ask students if they can think of an example for each of the survival adaptations.

Show students a picture of one of the animals. Now ask them questions like these:

- What is the animal? (give clues as needed)
- Where might you find this animal in winter?
- Will this animal be able to survive the winter? Why or why not? (If needed, ask questions about what foods they eat and if theses foods could be found in winter. Ask them how the animal will protect itself from the colder environment).

Explain to students that not every animal fits perfectly into just one category. For instance, some of our smoky mountain animals may only hibernate if the weather gets cold enough (turtles, bears) or they may become active during the winter if there is a warm time period. Use the text on the following pages to place on the back of the photo cards if desired.

Museum Search (30 minutes)
Tell students that they are going to find animals that are specially adapted to living the Great Smoky Mountains in the Sugarlands Visitor Center Museum. These animals are all preparing now for surviving during the colder winter months. Explain to students that they are going to work in pairs to find animals in the museum that are listed on their paper handout. Each pair of students will be searching for different animals. After they find each animal, they will need to answer questions about the questions on their handout. The questions might ask them how the animal is adapted to survive the winter, or how the animal is adapted for finding its food, or how the animal is adapted to surviving in its particular habitat. They may have an animal on their worksheet that doesn't belong in the Great Smoky Mountains. They might have a question that asks how these non-native or exotic species impact their habitat or other native animals.

Conclusion (5 minutes)
Collect Sheets. Use a few animals to highlight the M.A.S.H. concept.

Resources and References

Great Smoky Mountains at Tremont. Connecting People and Nature a Teacher's Guide. 1993.

Teacher Background Text for Photos

Scarlet Tanager MIGRATOR
The Scarlet Tanager is an abundant breeding bird in the Park, inhabiting a range of habitats up to 5,000 feet in elevation. They feed primarily on flying insects caught from the treetops. They also feed on fruits like blueberries and blackberries in late summer. This species is a neotropical migrant who spends its winters in the tropical forests of Central America and northwestern South America.

Monarch MIGRATOR
Adult Monarch Butterflies feed on flower nectar, while the caterpillars feed primarily on milkweed leaves. Monarch butterflies are amazing insects because they migrate. When temperatures begin to drop in the US and Canada, these insects begin to head south to their overwintering areas in Mexico and California.

Bobcat ACTIVE
Bobcats are active in winter, but are rarely seen because they are nocturnal. They are carnivores and feed on squirrel, rabbits, rodents, and small birds. They are more likely to be successful in taking down small deer during winter when deer are weaker and more vulnerable. Bobcats have excellent senses of sight, smell, and hearing and are excellent climbers. They find shelter in hollow logs, inside hollow snags, or in thickets.

White-Tailed Deer ACTIVE
Deer spend the winter in sheltered woods, especially an evergreen forest. They browse on twigs and plants as they walk through the woods in winter. Deer grow a thicker coat for winter and the color changes from a reddish-born in summer to winter gray. The mountaineers called this the time when deer "put on the blue". This change allows them to be camouflaged all year.

Rabbit ACTIVE
Rabbits seek shelter in the winter by hiding under brush, under a rock, in a den, or in an underground burrow. Winter food consists of dried weeds, buds, evergreen needles, and tree bark. Rabbits are active all winter except in extreme cold or stormy weather.
Chipmunk STORER
The home of the chipmunk is an underground tunnel with several rooms, the largest being the bedroom. Before winter arrives, the chipmunk puts a supply of seeds and nuts in its bedroom and makes a bed of leaves and grass on top of it. In warm winter weather, it feeds from its

food supply, but in the coldest weather it sleeps soundly in a ball with its tail wrapped around itself.

Beaver STORER
In the fall, beavers collect sticks and sapling by anchoring them in the mud at the bottom of the pond or river near their lodge. In the winter, beavers will swim out from their lodges, collect these sticks, and bring them back to the lodge to feed on.

Black Bear STORER
The black bear is not a true hibernator, but it does sleep most of the winter. In order to do this, bears eat extra food in the fall that is "stored" with them as a layer of fat. When cold weather arrives, they seek shelter under logs, in hollow trees, or beneath evergreen trees. As they sleep, their temperature and breathing rate drop only slightly. They may briefly wake up during the winter, but usually will not feed until spring.

Wood Frog HIBERNATOR
The wood frog feeds in moist woodlands on insects, spiders, mites, and snails. Because they are cold-blooded, their body functions slow down as the temperature drops. They will hibernate until the warmth and light cause of reactivation of body functions, when they will emerge and breed in woodland pools.

Woodchuck HIBERNATOR
Woodchucks live in open woods and fields. Their underground homes usually consist of several tunnels and dens. In the late summer, they gorge themselves on plants and some insects to put on extra weight. When cold weather begins, they go underground to their burrows and curl up. Their metabolism rate is dramatically reduced, and they remain in hibernation until spring.
Little Brown Bat HIBERNATOR
The senses of sight and hearing are well developed in bats. They use echolocation which is somewhat similar to radar. They emit ultrasonic calls far above the range of human hearing that are reflected from objects ahead of them. They hear the echos and are able to avoid obstacles and catch food in total darkness. Bats feed on flying insects. During the winter when insects are unavailable, most bats, such as the little brown bat, hibernate in caves or hollow trees. Some species migrate to warmer climates.

Hummingbird	1. How will this animal survive the winter? Hint: M.A.S.H. 2. How does the shape of its beak help it get food?
Timber Rattlesnake	1. This animal is a cold-blooded reptile. How will this animal survive the winter? Hint: M.A.S.H. 2. Why does the Timber Rattlesnake have rattles?
Eastern Chipmunk	1. How will this animal survive the winter? Hint: M.A.S.H. 2. What foods do chipmunks eat?
Appalachian Woodland Salamander	1. What is unique about this salamander's cheeks? 2. Why does the Imitator Salamander want to imitate it?
Assassin Bug	1. Why do you think this animal is called an assassin? 2. How does the bug kill its prey?

Rose-breasted Grosbeak	1. Describe this bird's beak? 2. How does the shape of its beak hel¬¬p it get food?
Copperhead	1. This is a cold-blooded reptile. How will this animal survive the winter? Hint: M.A.S.H. 2. How does the color pattern of the Copperhead help it?
Black Bear	1. How will this animal survive the winter? Hint: M.A.S.H. 2. What foods do black bears eat?
Screech Owl	1. How does the coloration of this animal help it? 2. What foods does a screech owl eat? r want to imitate it?
Broad-Wing Hawk	1. How will this animal survive the winter? Hint: M.A.S.H. 2. What foods does this hawk eat?

Monarch Butterfly	1. How will this animal survive the winter? Hint: M.A.S.H. 2. How does the shape of its beak help it get food?
Muskrat	1. This animal is a cold-blooded reptile. How will this animal survive the winter? Hint: M.A.S.H. 2. Why does the Timber Rattlesnake have rattles?
Black Rat Snake	1. How will this animal survive the winter? Hint: M.A.S.H. 2. What foods do chipmunks eat?
Turkey	1. What is unique about this salamander's cheeks? 2. Why does the Imitator Salamander want to imitate it?
Assassin Bug	1. Why do you think this animal is called an assassin? 2. How does the bug kill its prey?

Black-Throated Green Warbler	1. How will this animal survive the winter? Hint: M.A.S.H. 2. How does the shape of its beak help it get food?
Snapping Turtle	1. This is a cold-blooded reptile. How will this animal survive the winter? Hint: M.A.S.H. 2. Which animal likes to eat their eggs?
Red Fox	1. What time of day is the red fox active? 2. What foods does the red fox eat?
Mink	1. What habitat would you find a mink in? 2. What foods does a mink eat?
Dianna Fritillary Butterfly	1. Who does it mimic? 2. Why does it mimic this butterfly?

Gray Fox	1. How will this animal survive the winter? Hint: M.A.S.H. 2. Does the gray fox only eat other animals? What else might it eat?
Belted Kingfisher	1. What kind of foods does this bird eat? 2. How does the shape of its beak help it get food?
Eastern Box Turtle	1. This is a cold-blooded reptile. How will this animal survive the winter? Hint: M.A.S.H. 2. How is this animal adapted to protect itself from predators? Can all turtles do this?
Mud Dauber	1. Where does this wasp lay its eggs? 2. What do the wasp larva feed on?
Great Horned Owl	1. What is the primary animal that this owl hunts? 2. How will this animal survive the winter? (Hint: M.A.S.H – is the animal it feeds on available in the winter?)

Bobcat	1. How will this animal survive the winter? Hint: M.A.S.H. 2. What do you think this animal might eat?
Pygmy Salamander	1. This is a cold-blooded amphibian. How will this animal survive the winter? Hint: M.A.S.H. 2. What habitat would you find this animal in?
Wood Roach	1. How does the Wood Roach eat? 2. How does the Wood Roach digest its food?
Fence Lizard	1. What unusual coloration does this lizard have? 2. Why does the lizard show this color?
Screech Owl	1. What hunting adaptation helps the Screech Owl catch it's prey? 2. How does the Screech Owl's coloration help it?

Green Anole	1. How are the anoles toes adapted to help it? 2. When and why does its throat change colors?
Cardinal	1. What foods does this bird eat? 2. How does the shape of its beak help it get food?
Wild Hog	1. Does this animal belong in Great Smoky Mountains National Park? 2. Should we let the Wild Hog live in the Park? Why?
Stag Beetles	1. What is unusual about this animal's mouthparts? 2. What does the Stag Beetle use its jaws for?
Corn Snake	1. How will this animal survive the winter? Hint: M.A.S.H. 2. Is this animal warm blooded or cold blooded?

Sugarlands Visitor Center Museum Search Group 8

Barred Owl	1. How will this animal survive the winter? (Hint: M.A.S.H. – is its prey available in the winter?) 2. How does its coloration help it?
Ruffed Grouse	1. What unusual sound does this bird make? 2. How might this bird's coloration help it?
Hellbender	1. What foods does the hellbender eat? 2. Is this animal a reptile, fish, or amphibian? Why?
Cowbird	1. Do cowbirds belong in Great Smoky Mountains? 2. How are cowbirds adapted to laying so many eggs? How do they take care of all of the baby birds?
Sharpshin Hawk	1. What foods does this bird eat? 2. How does the shape of its beak help it get food?

On-Site Activity
Structure and Adaptations

Duration: 45 minutes
Class Size: 30 students
Materials: provided by National Park staff

Introduction (10 minutes)
Begin a discussion with the students about the challenges of an animal who lives in the forest. Ask students to list some natural "hazards" (such as extreme cold, finding food, escaping danger etc.) Next see if the students can come up with ways that animals meet those challenges (i.e growing a coat of thick fur, having keen eyesight, having long legs to escape something etc.)

Next the students will break into 3 small groups to examine work stations which focus on adaptations of specific animals.

Station One Birds:
Materials: photos of bird beaks (owl, hawk, grosbeak, woodpecker, duck, songbird) box of raisins (to represent nuts or berries), pipe cleaners (to represent worms), dry rice (to represent insects or seeds), cups of water (to represent nectar), straws (hummingbird beak), pliers (owl beak), spoons, (duck), scissors (woodpecker), tweezers (warbler
An adult at this station will describe what each food item represents. Using various tools, the students will try to pick up each food item as if they were a bird. Once they determine what "beak" works well with what food, see if they can then guess which bird from the photos would most likely eat.

Station Two Creepy Critters::
Materials: photos of butterfly, fly, mosquito and close ups of body parts, salamander puppet, snake skin, snake skeleton, turtle shell, magnifying boxes, kaleidoscopes, blow out party favor, sponge, plastic syringe.

For this activity, an adult will show picture of the various animals and ask students what special adaptation they night have. The adult will use the props to illustrate the adaptation. Next, ask the students to view photos of the butterfly, fly and mosquito. Ask them to guess which item represents each insects mouth part (sponge = fly, syringe= butterfly, party favor= butterfly). Continue the discovery by showing students the close ups of each mouth part.

Station Three Mammals:
Materials: rubber tracks, animal fur, skulls and photos for River Otter, Bear, Raccoon and Deer. Adult will facilitate a show and tell activity to describe each track, fur and skull in size, color and shape only. Compare the eye sockets on the skulls. Once element has been discussed, ask the students to match up all the right pieces to complete the mammal.

On-Site Activity
Plant Adaptations Guided Hike

Duration: 45 minutes
Class Size: 30 students
Materials: teacher guide for plant survival hike (included)

The following pages will assist the teacher in conducting a nature hike about plant adaptations.

Several stops can be made along the way on the Fighting Creek Nature Trail behind Sugarlands Visitor Center.

Teacher Guide for Adaptations Hike
along Fighting Creek Nature Trail

Flora or Fauna	Location on Fighting Creek Nature Trail	Adaptation
Evergreen Trees Pines Eastern Hemlock	Throughout	• Their leaves are called needles. They are coated with wax to keep the water in all year. With long, narrow, needle-like leaf designs, they can conserve water, but they can't gather as much sunlight in each needle, or leaf. They gather sunlight longer (during winter), but produce less food when it is very cold.
Pine Trees	A section of the trail before the Owenby Cabin has more than any other place	• Grows fast because they don't like shade and must outgrow competing trees. • Have thick bark that makes them somewhat fire resistant.
Deciduous Trees Variety	Throughout	• Broad-leaved plants lose their leaves and stop making food in the winter. This process is chemically complicated, but basically, when the days get darker, plants have complex biochemistry that sets a series of events in motion. Changes occur in the ratio of specialized plant hormones that stop the trees from making chlorophyll. As the chlorophyll breaks down in the leaves, other colors show through. Leaves become spectacular because photosynthesis requires not only green chlorophyll, but also chemical interactions with a few other specialized pigments including: xanthophyll (yellow), carotene (orange or red), and terpenes (chemicals that generally make up a plant's essential oils which give plants their smell). Different species of trees have different amounts of these chemicals which results in a variety of colors! • Trees pull in all the nutrients they can from the leaves and then cut the leaves off from their main stems. The point where leaves are cut off is called the "zone of abscission" and is marked by a scar. You can tell a deciduous tree's species just by examining its leaf scars.
Fallen Leaves	Throughout	• On the ground, leaves are broken down by bacteria, fungi, earthworms, and other organisms. The decomposed leaves restock the soil with nutrients, and become part of the spongy humus layer on the forest floor that absorbs and holds rainfall.

Rhododendron	Throughout	• When the temperature drops below 35F, rhododendron leaves begin to cup and curl at the edges. At 25F, the leaves have curled so tight that half the leaf surface has disappeared and the leaves droop. When temperatures hit the teens, leaves shrivel even tighter, turn brownish-green and dangle like stiff string beans. This response to temperature changes is a rhododendron's method of preventing loss of moisture through the leaves. • The upper side of a rhododendron leaf is leathery. The bottom side is dappled with tiny air valves that control the flow of air in and out of a leaf. Cold air contains less moisture than warm air. So when low temperatures and high winds arrive, the leaf valves close. By looking out a window on a winter day, one can determine roughly how cold it is by the degree the rhododendron leaves have curled and drooped. When temperatures rise, the leaves open again. • The rhododendron makes the same response in summer when temperatures become excessive; only the leaves curl upward to prevent undue moisture loss.
American Holly	Several places along the trail have small holly bushes.	• The spines on the leaves protect it from being eaten by cattle and deer. • The red berries are attractive to birds that eat and disperse them.
Doghobble Shrub (Black Bear Adaptation)	Low bushy shrub on the left after you cross the first "big" bridge and after you go by the Ownby Cabin.	•Bears have learned that dogs that chase them can't easily get through it, so the bear will just bound over the thicket while the dogs get tangled up.
Sycamore Trees	Along the stream sides-there's a very large one right by the first "big" bridge	• Produces a seed pod (fruit) that floats-this is how it is spread along the river and stream banks. • The seed pod is mature in the fall but hangs on all winter until the spring floods arrive.
Poison Ivy (and other vines)	Throughout	• Red berries that birds love to eat & and then spreads them around. • Tendrils for "climbing". • Poisonous for protection from humans and possibly other animals.
Christmas Fern	Throughout the trail on the ground. It's the only fern visible in the fall.	• Stays green thru the winter allowing it to continue to manufacture food when other ferns can't.

Post-Site Activity
Service Learning Extension
Birds and Adaptations

Duration: unliminted
Class Size: any
Materials: pen, paper, binoculars

Introduction (10 minutes)
Awareness and understanding of animal adaptations can unlock a new appreciation to the natural world. Our homes and nearby communities are full of natural wonders. This activity encourages students to participate in a scientific survey of their own backyard.

Directions for students:
1) Count and identify the birds at your bird feeder, backyard, or nearby park for 30 minutes. You may watch longer than 30 minutes but no less.
2) For each kind of bird you see, keep track of the highest number of individuals that you observe at any one time. Use your record sheet to help keep track of your counts.

For example:
When you start your count at 10:03 am you see 3 Robins in your yard. At 10:18 am a flock of 8 Robins land in your yard. At 10:31 the flock flies away and only 2 robins remain in your yard. You record 8 by American Robin on your data sheet.

Another Example: When you start watching your bird feeder at 2:37pm there are 5 Gold Finches eating thistle seeds from the feeder and sitting in nearby bushes. At 3:02 a cat walks by as scares all but one Gold Finch away. You record 5 American Gold Finch on your data sheet.

This information can be turned into a class survey project, or if done at the school, you can follow a different protocol and choose to submit to the National Schoolyard Birding Challenge at http://www.fledgingbirders.org

Post-Site Activity
Explore Your National Parks

Duration: 30 minutes
Class Size: any
Materials: internet access

The Great Smoky Mountains are world renowned for their diversity of plant and animal species. This great variety makes the park an exemplary outdoor laboratory for the study of relatively undisturbed native flora, fauna, physical environs and processes of the Southern Appalachians. The park is the largest federally preserved and protected upland area east of the Mississippi River offering park visitors a refuge from the stresses of everyday life.

You and your students can learn more about this special place as well as participate in on-line activities to further your knowledge of the National Park Service and other federally protected lands. Please check out the following web addresses:

Especially for Kids

To become a web ranger for the National Park Service, got to:
www.nps.gov/webrangers

To become a Junior Park Ranger at Great Smoky Mountains National Park or other parks, go to:
www.nps.gov/learn/juniorranger.htm

Especially for Teachers

For a comprehensive understanding of the background and development of the National Park Service that is perfect for teachers and others those who need the maximum amount of accurate information in the minimum amount of time, go to:
http://wwwParkTraining.org

The U.S. Department of Education is pleased to announce the newly remodeled and updated Federal Resources for Education Excellence (FREE) website. It now provides richer, more expansive resources to teachers and students alike. There are over 1500 resources to take advantage of at FREE, ranging from primary historical documents, lesson plans, science visualizations, math simulations and online challenges, paintings, photos, mapping tools, and more. This easily accessible information is provided by federal organizations and agencies such as the Library of Congress, National Archives, NEH, National Gallery of Art, National Park Service, Smithsonian, NSF, and NASA. Go to:
http://www.free.ed.gov/

Appendix A
Park Essentials to Know Before you Go

Traffic and Travel Tips

Restrictions on Large Vehicles

Trailers, RVs, and buses are prohibited on some secondary roads in the park, including Balsam Mountain Road, Greenbrier Road past the ranger station, Heintooga Ridge Road, Rich Mountain Road, Roaring Fork Motor Nature Trail, and the road exiting the park at Metcalf Bottoms Picnic Area. Caution is also advised when traveling on Little River Road between the Townsend entrance to the park and Elkmont Campground, and on the road leading into Cataloochee Valley.

Overheated Engines and Brakes

When traveling uphill on hot days, watch your engine temperature carefully to make sure it is not overheating. If overheating occurs, stop at a pullout to allow your vehicle to cool down before continuing.

When driving downhill on steep mountain roads, it is important that you shift to a lower gear to use the braking power of your engine to prevent your brakes from over heating and failing. If your vehicle has an automatic transmission, use "L" or "2." (Overheated brakes smoke and give off an acrid smell.) Keep an extra cushion of distance between you and the vehicle in front of you as protection against sudden stops.

Avoid Collisions with Animals

Watch for animals crossing roads, especially at night. Scores of bears and other animals are killed by motorists every year. Following posted speed limits will reduce your chances of hitting wildlife.

Use Pullouts if Driving Slowly

As a courtesy to other park visitors, slow moving vehicles should use pullouts to let other cars pass. Pullouts are located every mile or so on most park roads.

Gas Stations

There are no gas stations or other related services available in the park. Complete services are available in Cherokee, NC, Gatlinburg, TN, and Townsend, TN.

Emergency Number

In the event of an emergency, call 911. For non-emergency calls to park headquarters, dial (865) 436-1200.

Pets

Dogs are allowed in campgrounds, picnic areas, and along roads, but must be kept on a leash at all times. The leash must not exceed 6 feet in length. Dogs are only allowed on two short walking paths—the Gatlinburg Trail and the Oconaluftee River Trail. Pets are not allowed on any other park trails. Pet excrement must be immediately collected by the pet handler and disposed of in a trash receptacle. Pets should not be left unattended in vehicles or RVs. Large national parks that have extensive backcountry areas as a rule do not allow dogs on trails. These include parks such as Yellowstone, Yosemite, Grand Canyon, Glacier, Rocky Mountains, and several others. Great Smoky Mountains National Park has prohibited dogs in the backcountry since the park was first established in the 1930s.

Hiking Safety

Your are responsible for your own safety! Travel in Great Smoky Mountains backcountry areas has inherent risks and hikers assume complete responsibility for their own safety. Rescue is not a certainty! Carry a current park trail map and know how to read it.

•Carry 2 small flashlights or headlamps—even on a day hike. If you have trouble on the trail, darkness may fall before you can finish your hike.

Take adequate water—minimum 2 quarts per person

Appendix A Continued
Park Essentials to Know Before you Go

per day. All water obtained from the backcountry should be treated either by filtering or boiling.
•Carry a small first aid kit.
•Check the current weather forecast and be prepared for quickly changing conditions.
•Wear shoes or boots that provide good ankle support.
•Avoid hypothermia (the dangerous lowering of body temperature) by keeping dry. Avoid cotton clothing. Dress in layers that can be easily removed or added as you heat up or cool down. Always carry a wind-resistant jacket and rain gear—even on sunny days!
•Don't attempt to cross rain-swollen streams; they will recede rapidly after precipitation stops and the wait may save your life! When crossing any stream more than ankle-deep: unbuckle the waist strap of your pack, wear shoes, and use a staff to steady yourself.

Ice and Wet Leaves

In winter, most trails at high elevation will be covered with ice. Use crampons or other traction devices for your boots. In autumn, loose, slick leaves on the trail cause many hikers to fracture their ankles. Be certain to wear ankle supporting boots.

Safety Around Wildlife

•Encounters With Bears
Bears in the park are wild and their behavior is unpredictable. Although extremely rare, attacks on humans have occurred, inflicting serious injuries and death. Treat bear encounters with extreme caution.
•Venomous Snakes
Two species of poisonous snakes live in the Smokies, the northern copperhead and timber rattlesnake. Although very few snake bites occur here, visitors should be cautious where they place their hands and feet, especially around old buildings and stone fences. No fatalities from snakebites have ever been recorded in the park.
•Insects
Yellow jacket wasps are the insects of greatest concern. They build nests in the ground along trails and streams and are aggressive when disturbed. Avoid perfume, powder, and scented deodorants which may attract yellow jackets. Stings cause local swelling and can lead to severe allergic reactions in a few sensitive individuals. Such persons should carry epinephrine kits.
•Poison Ivy
Please be aware of the presence of Poison Ivy throughout the park, particularly in the spring, summer and fall. Poison ivy is a three leaved plant which can grow on the ground as well as on "hairy" vines up trees. To avoid chances of an allergic reaction, stay on trails and avoid direct contact with vegetation. If contact occurs or is a concern, wash affected parts in cold soapy water immediately.

Appendix B
What to Carry/ How to Pack For Your Trip

The following information is recommended to assist students in packing for their trip.
From experience is has been found that students will often bring too many items on a class trip, or not enough of the right items.

For the **Animal Structure and Adaptations** trip,

Students should wear:
• Sturdy walking shoes. Hiking boots are not necessary, but flip flops or slip on shoes are not appropriate for the waking portion of this trip.
•Long pants are suggested any time you visit the National Park. This is the best precaution against cool temperatures, bee stings and ticks.

Students should bring:
A lunch which includes water to drink, and healthy meal to provide them with energy for extended periods of walking and learning.
Lunches should be packed in large boxes or coolers and kept on the bus until lunchtime.

Other reminders:
Students will not need anything except the materials that the teacher provides. iPods or other electronic devices (if permitted on the bus) should not be brought off the bus during any part of the program.
•Cameras are recommended to preserve memories of the trip and to share with family members.

Appendix C
Resources and References

Boring, Mel. Birds, Nests and Eggs (Take-Along Guides). NorthWord Books for Young Readers, 1998.

Goodman, Susan. Claws, Coats and Camoulflage. Millbrook Press, 2001.

Halfmann, Janet and Laurie Allen Klein. Little Skinks Tail. Sylvan Dell Publishing, 2007.