

FOREST AND STREAM BIODIVERSITY



*Ranger Led
Program*

THEME: Macroinvertebrates, Biodiversity, Ecosystems
GRADE LEVEL: Sixth, Seventh, or Eighth grade
BEST TIME TO PLAN TRIP: Spring or Fall

UNIT RATIONALE

Great Smoky Mountains National Park is made up of a variety of ecosystems. To help better understand the complexity of these ecosystems, an inventory is being taken of all the living organisms in the park. The All Taxa Biodiversity Inventory (ATBI) is a project of Discover Life in America (DLIA) that seeks to inventory the estimated 100,000 species of living organisms in Great Smoky Mountains National Park. Students will learn how researchers and park scientists use scientific methods to study stream and forest ecosystems. Your park visit will allow the students to become active participants in learning about park management.

STATE CURRICULUM STANDARDS - TENNESSEE

SIXTH GRADE

SCIENCE

Embedded Inquiry

- SPI 0607 Inq. 1
- SPI 0607 Inq. 2
- SPI 0607 Inq. 3
- SPI 0607 Inq. 4
- SPI 0607 Inq. 5

Independence

- SPI 0607 2.1
- SPI 0607 2.2

ENGLISH/LANGUAGE ARTS

Communication

- SPI 0601.2.4
- SPI 0601.2.5

SEVENTH GRADE

SCIENCE

Embedded Inquiry

- SPI 0707 Inq. 1
- SPI 0707 Inq. 2
- SPI 0707 Inq. 3
- SPI 0707 Inq. 4
- SPI 0707 Inq. 5

ENGLISH/LANGUAGE ARTS

Communication

- SPI 0701.2.7
- SPI 0701.2.8

EIGHTH GRADE

SCIENCE

Embedded Inquiry

- SPI 0807 Inq. 1
- SPI 0807 Inq. 2
- SPI 0807 Inq. 3
- SPI 0807 Inq. 4
- SPI 0807 Inq. 5

Biodiversity and Change

- SPI 0807.5.1
- SPI 0807.5.2
- SPI 0807.5.3
- SPI 0807.5.4

ENGLISH/LANGUAGE ARTS

Communication

- SPI 0801.2.7
- SPI 0801.2.8



SIXTH GRADE

SCIENCE

Embedded Inquiry

SPI 0607 Inq. 1 Design a simple experimental procedure with an identified control and appropriate variables.

SPI 0607 Inq. 2 Select tools and procedures needed to conduct a moderately complex experiment.

SPI 0607 Inq. 3 Interpret and translate data into a table, graph, or diagram.

SPI 0607 Inq. 4 Draw a conclusion that establishes a cause and effect relationship supported by evidence.

SPI 0607 Inq. 5 Identify a faulty interpretation of data that is due to bias or experimental error.

Interdependence

SPI 0607.2.1 Classify organisms as producers, consumers, scavengers, or decomposers according to their role in a food chain or web.

SPI 0607.2.2 Interpret how materials and energy are transferred through an ecosystem.

ENGLISH/LANGUAGE ARTS

Communication

SPI 0601.2.4 Select the most appropriate behaviors for participating productively in a team (e.g., contribute appropriate and useful information and ideas, understand the purpose for working as a team, understand the responsibilities of various roles within the team).

SPI 0601.2.5 Identify the functions and responsibilities of individual roles within an organized group (i.e., reporter, recorder, information gatherer, leader, timekeeper).

SEVENTH GRADE

SCIENCE

Embedded Inquiry

SPI 0707 Inq. 1 Design a simple experimental procedure with an identified control and appropriate variables.

SPI 0707 Inq. 2 Select tools and procedures needed to conduct a moderately complex experiment.

SPI 0707 Inq. 3 Interpret and translate data into a table, graph, or diagram.

SPI 0707 Inq. 4 Draw a conclusion that establishes a cause and effect relationship supported by evidence.

SPI 0707 Inq. 5 Identify a faulty interpretation of data that is due to bias or experimental error.

ENGLISH/LANGUAGE ARTS

Communication

SPI 0701.2.7 Select the most appropriate behaviors for participating productively in a team (e.g., ask primarily relevant questions that move the team toward its goal and contribute to the topic of discussion, articulate the goals that have been provided for the team work and ask clarifying questions, come to agreement by seeking consensus or following the majority).

SPI 0701.2.8 Identify the functions and responsibilities of individual roles within an organized group (i.e., reporter, recorder, information gatherer, leader, timekeeper).

EIGHTH GRADE

SCIENCE

Embedded Inquiry

SPI 0807 Inq. 1 Design a simple experimental procedure with an identified control and appropriate variables.

SPI 0807 Inq. 2 Select tools and procedures needed to conduct a moderately complex experiment.

SPI 0807 Inq. 3 Interpret and translate data into a table, graph, or diagram.

SPI 0807 Inq. 4 Draw a conclusion that establishes a cause and effect relationship supported by evidence.

SPI 0807 Inq. 5 Identify a faulty interpretation of data that is due to bias or experimental error.

Biodiversity and Change

SPI 0807.5.1 Use a simple classification key to identify an unknown organism.

SPI 0807.5.2 Analyze structural, behavioral, and physiological adaptations to predict which populations are likely to survive in a particular environment.

SPI 0807.5.3 Analyze data on levels of variation within a population to make predictions about survival under particular environmental conditions.

SPI 0807.5.4 Identify several reasons for the importance of maintaining the earth's biodiversity.

ENGLISH/LANGUAGE ARTS

Communication

SPI 0801.2.7 Select the most appropriate strategies for participating productively in a team (e.g., gain the floor in orderly ways, meet or set deadlines for completing each task, come to agreement by seeking consensus or following the majority).

SPI 0801.2.8 Identify the functions and responsibilities of individuals within an organized group (i.e., reporter, recorder, information gatherer, leader, timekeeper).



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PLANNING A SUCCESSFUL TRIP

BIODIVERSITY - FOREST AND STREAM



SCHEDULE FOR A DAY OF ACTIVITIES IN GREAT SMOKY MOUNTAINS NATIONAL PARK

- Arrive at Sugarlands Visitor Center for restrooms and to meet rangers
- On-site activities with lunch in between activities
- Reload bus and return to school

SCHEDULE FOR A DAY OF ACTIVITIES IN GREAT SMOKY MOUNTAINS NATIONAL PARK

- Arrive at Cosby Picnic Area for restrooms and to meet rangers
- On-site activities with lunch in between activities
- Reload bus and return to school

Planning a Successful Trip

- The location for this trip is at the Sugarlands Visitor Center located near Gatlinburg. Park rangers will direct your bus driver where to park.
- All students, teachers, and chaperons will meet the park rangers at Sugarlands Visitor Center. The rangers will introduce themselves, state the theme of the program, and explain where and how the program will be conducted. The program includes several activity stations in and around the stream. Have the students bring a towel and extra shoes in case they get wet.
- There is no cost to use this site.
- Arrange to have a teacher or chaperone available for every 10 students.

Planning a Successful Trip

- The location for this trip is at the Cosby amphitheater, located near the picnic area parking lot. Park rangers will direct your bus driver where to park.
- All students, teachers, and chaperons will meet the park rangers at Sugarlands Visitor Center. The rangers will introduce themselves, state the theme of the program, and explain where and how the program will be conducted. The program includes several activity stations in and around the stream. Have the students bring a towel and extra shoes in case they get wet.
- There is no cost to use this site.
- Arrange to have a teacher or chaperone available for every 10 students.



SAFETY CONSIDERATIONS AND OTHER IMPORTANT INFORMATION



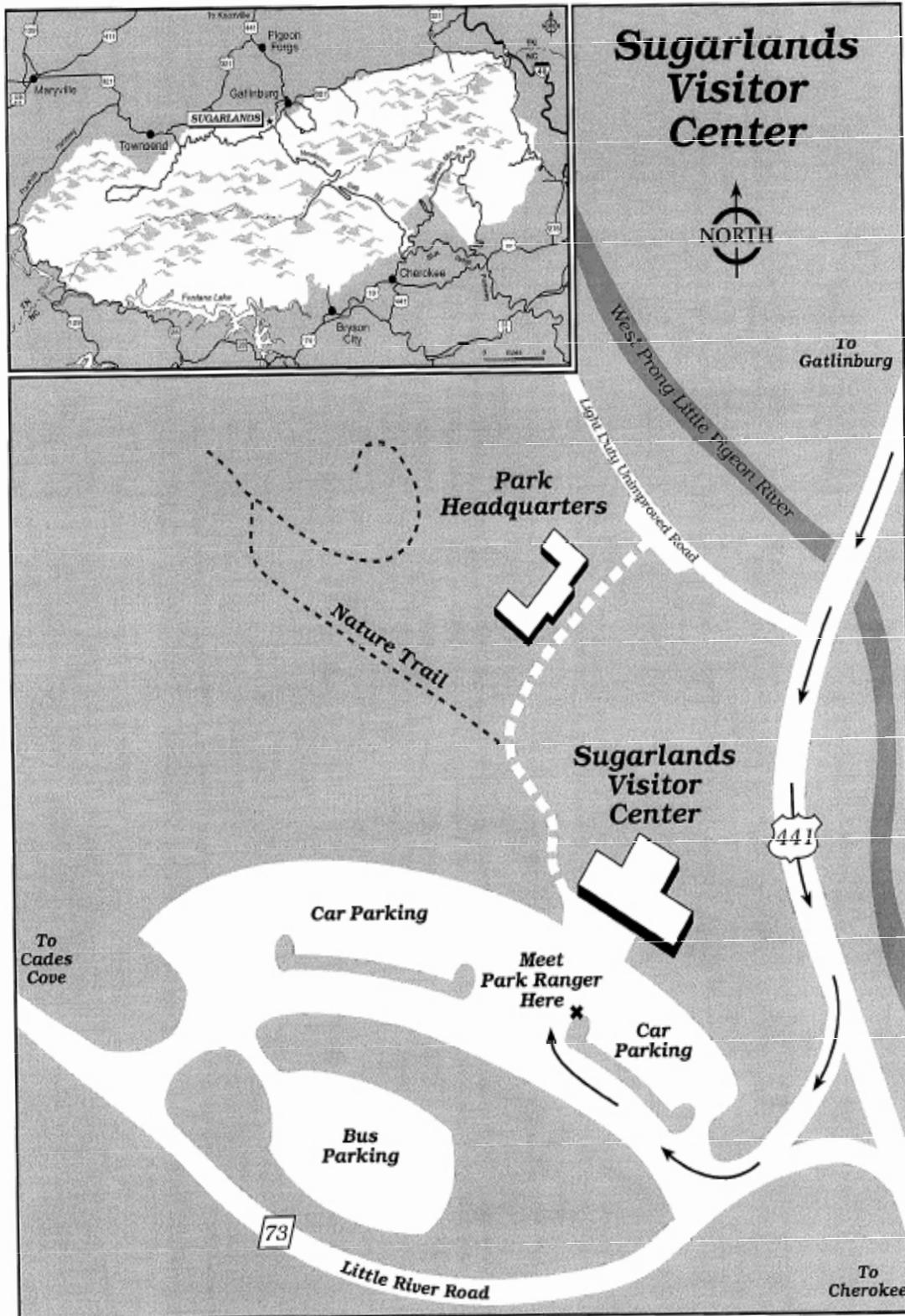
- Great Smoky Mountains National Park is a federally protected public use area. Please help the rangers keep all of the plants and animals protected in the park by not picking the plants or taking anything from the park.
- Please remind your students to wear appropriate footwear and clothing for this extended outdoor experience. Flip flops, slip-on shoes, or sandals are not appropriate for the program.
- Temperatures in some parts of the park can be 10-15 degrees colder than at your school. Long pants and layers are suggested for the program. Pants are the best precaution against cool temperatures, bee stings, ticks, and poison ivy.
- Within the park, cell phones are not always reliable. Rangers will follow the on-site agenda. If an unexpected problem occurs, rangers do carry park radios to make contact with the park dispatch office. For non-emergencies, call the Park Ranger dispatch at 865-436-1230 or contact a park employee.

Animals and Plants of Concern in the park

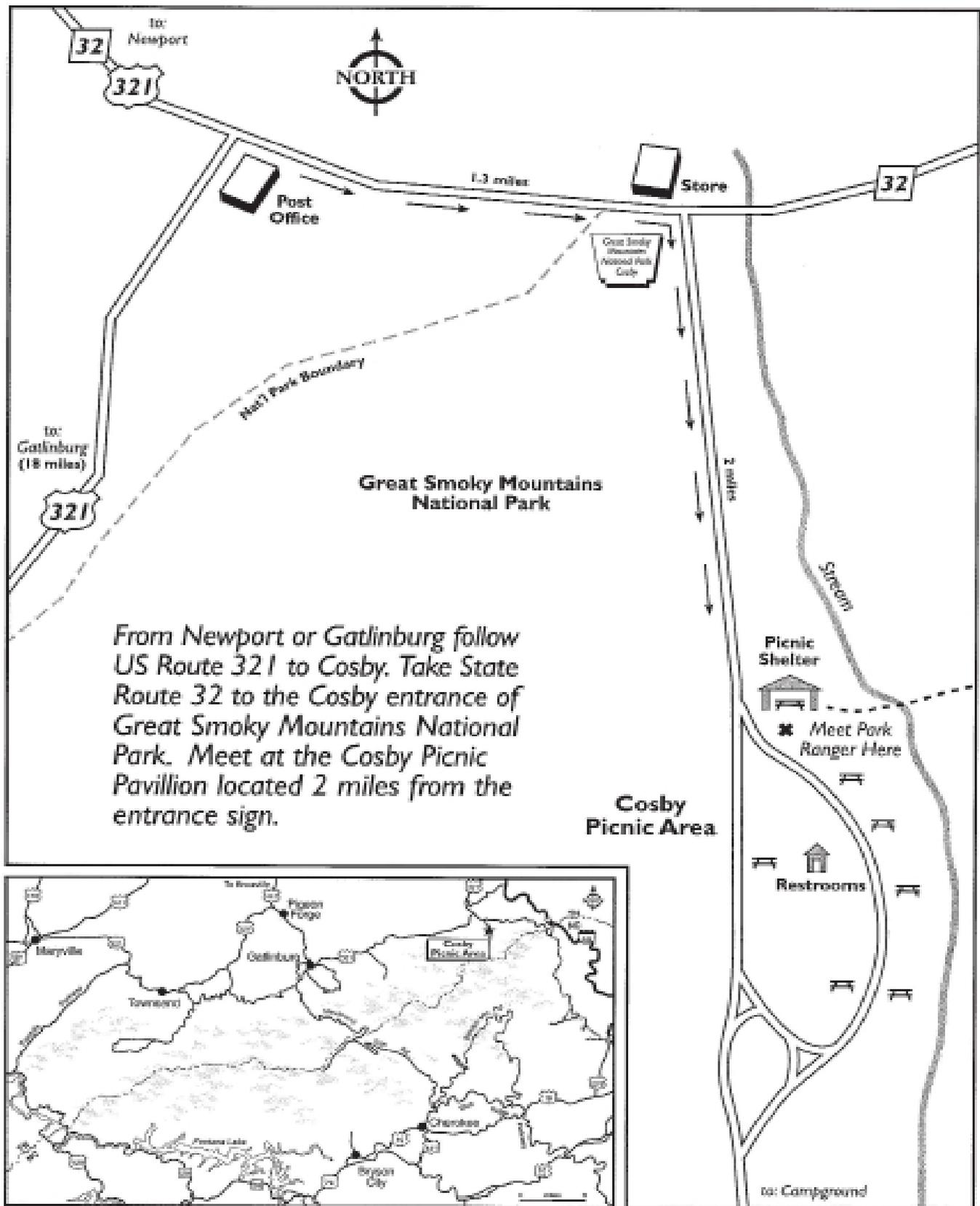
- All animals in the park are wild and their behaviors are unpredictable. Treat all animals with caution.
- Venomous snakes - Two species of venomous snakes live in the Smokies, the copperhead and timber rattlesnake. Students should be cautious where they place their hands and feet.
- Insects - Yellow jacket wasps are the insects of greatest concern. They build nests in the ground along trails and streams and are aggressive when disturbed. Stings cause local swelling and can lead to severe allergic reactions in sensitive individuals. Such persons should carry epinephrine kits.
- Poison Ivy - 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 wear long pants, stay on trails, and avoid direct contact with vegetation. If contact occurs or is a concern, wash affected parts in cold soapy water immediately.
- It is extremely helpful to rangers leading the program for students to wear clearly labeled name tags with first names only.
- Pets are not allowed on most park trails. Please do not bring them on the field trip.
- For more information about the park (Things to Know Before You Come) please visit the park’s website: <http://www.nps.gov/grsm/planyourvisit/things2know.htm>



MAP TO SUGARLANDS VISITOR CENTER



MAP TO COSBY PICNIC AREA



PRE-SITE ACTIVITY: BACKGROUND INFORMATION OF BIODIVERSITY IN THE SMOKIES



Grade Level: Middle School

Subject Area: Science

Activity time: 30 minutes

Setting: Indoors

Skills: Analyzing; Assessing; Connecting; Listening

Vocabulary: Biodiversity; Organism; Species

Objective: To understand the biodiversity of the Great Smoky Mountains National Park.

Materials: Internet access

Background:

The Great Smoky Mountains National Park is a 2,200 square kilometer (800 square mile) reserve that straddles the mountainous divide between the states of Tennessee and North Carolina. With some of the highest peaks in eastern North America, the geology of the park is complex. Although known for its temperate forest richness and extensive old-growth forests, the park is challenged with a number of threats to its ecological integrity. These threats include invasive, exotic organisms in both terrestrial and aquatic systems; very high depositions of nitrogen and sulfur, high ozone levels; and increasing insularity as a result of human development and fragmentation of adjacent natural areas.

To help better understand the complexity of park ecosystems, an inventory is being taken of all the living organisms in the park. The All Taxa Biodiversity Inventory (ATBI) is a project of Discover Life in America (DLIA) that seeks to inventory the estimated 100,000 species of living organisms in Great Smoky Mountains National Park. The project has developed checklists, reports, maps, databases, and natural history profiles that describe the biology of this rich landscape to a wide audience. The species level of biological diversity is central to the ATBI. However, the project is developed within an ecological and conservation context. It also encourages understanding at other levels of organization, including genetic variation within species and ecosystem descriptions. As of January 2010, discoveries include 907 species new to science and 6,582 species new to the Park.

Procedure:

View the Biodiversity podcast video at <http://www.thegreatsmokymountains.org/ef/10modules.html>. Turn the microscope knob that appears on the computer screen to Section 1, Understanding Biodiversity. Click “Watch Video” and view video.

Discuss reasons for the vast biodiversity in Great Smoky Mountains National Park. Compare and contrast to other regions’ biodiversity.



PRE-SITE ACTIVITY: AQUATIC ADAPTATION



Grade Level: Middle School

Subject Area: Science

Activity Time: 60 minutes over two class periods

Setting: Indoors

Skills: Classifying; Comparing; Contrasting; Describing

Vocabulary: invertebrate;

Objectives: To introduce students to the defining characteristics of aquatic macroinvertebrates.

Materials: Insect identification Cards, “adoption” certificates (see following pages)

Procedure for Teacher:

Generate overhead transparencies of each macroinvertebrate in this packet (pages A-C). Cut the overheads into 18 individual overhead cards for the following activity.

Remind students that insects can be born from the land or the water. Divide students into groups of 2 or 3, share information about aquatic macroinvertebrates they will most likely find on their park trip. Allow each group to pick an insect (or teacher may assign them one).

Explain to each group that they will need to be able to identify “their” invertebrate while on the field trip. Give each student one evening to learn their creature by sight and study facts about their creature.

Procedure for Students:

The following day, students must be able to identify their creature. Students may participate in a challenge to identify their insect in front of the class. Teacher can randomly show the insect cards on the overhead. Students must quickly “claim” their creature if it was the one assigned to them. Each group earns points for each fact they can recall about their creature. Pass out an “adoption certificate” to each student upon successful identification of their macro-invertebrate. Participation and their total score earned during the quiz.

Extension:

Visit an area around your school where these macroinvertebrates may have hatched out of the water. See how many creatures in their adult stage can be found flying or crawling in the area. Students may have to research what their larvae changes into in its adult stage



PRE-SITE ACTIVITY: AQUATIC ADAPTATION (CONTINUED)



Overhead Quiz Cards for Aquatic Adoptions- Page A



A



B



C



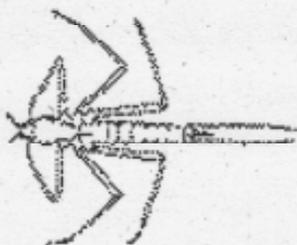
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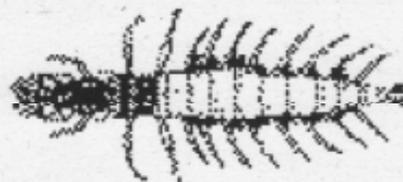
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F



G



H



PRE-SITE ACTIVITY: AQUATIC ADAPTATION (CONTINUED)

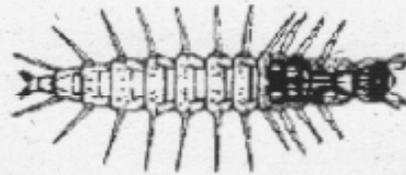


Overhead Quiz Cards for Aquatic Adoptions- Page B

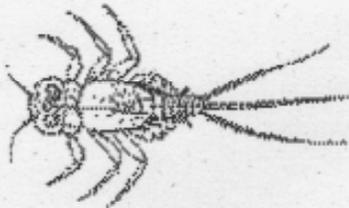
I



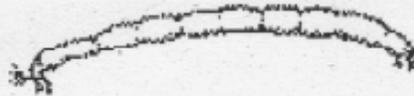
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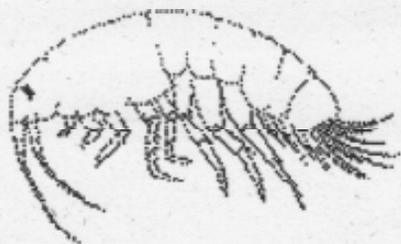
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O



P



PRE-SITE ACTIVITY: AQUATIC ADAPTATION (CONTINUED)



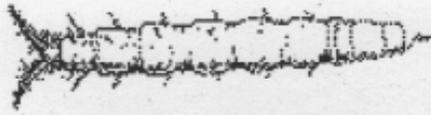
Overhead Quiz Cards for Aquatic Adoptions- Page C



Q



R



S



PRE-SITE ACTIVITY: AQUATIC ADAPTATION (CONTINUED)



Aquatic Adoption Cards

A. Alderfly Facts

- Carnivorous and may bite
- Develop over period of one to three years
- Mouth has large, chewing pinchers
- Smooth underside without gill tufts
- Abdomen has strand-like appendages extending from each side
- Three pairs of segmented legs on middle section of body with tiny pinchers at the end of each
- Straight, single feathery tail
- 3/4 to 4 inches long
- **Somewhat sensitive to water pollution**



B. Aquatic Worm Facts

- May be found in large numbers in organically polluted streams
- Moves by stretching and pulling its body along in a worm-like fashion
- May be red, tan, black or brown
- Can look like an earthworm or be much narrower and thread-like
- Segmented body
- Up to five inches long
- May have short bristles or hairs that help with movement, but are not usually visible
- **Tolerant of water pollution**



C. Riffle Beetle Larva Facts

- Up to 3/4 long
- Body is long, hard, still, segmented
- Six long segmented legs on upper middle section of body
- Back end has two tiny hooks and short hairs
- **Somewhat sensitive to water pollution**



D. Black Fly Larva Facts

- Move by drifting downstream on silken threads that extend from the tip of the abdomen
- Often stuck by their attachment disks to the surface of rocks, sticks or other debris in the streams
- Up to 1/3 inches long
- The head is usually black, but sometimes brown, tan or green
- One very tiny leg-like appendage directly under the head
- Attachment disks (small suckers) on the end of the abdomen
- Back end of the body widens and is bulbous
- No legs
- Tiny gills by head filter food from water
- **Tolerant of water pollution**



PRE-SITE ACTIVITY: AQUATIC ADAPTATION (CONTINUED)



E. Caddisfly Facts

- Some make houses or cases for themselves out of different materials such as rocks, sand, gravel, twigs or leaves using a glue-like substance secreted from their back end
- Some spin webs to trap food from the flowing water
- Up to 1 1/2 inches long
- Very small or no antennae
- Six segmented legs on upper middle section of body
- Filamentous gills may be on the end of the body or on the underside
- Two small, thick extensions at the end of the body and each has a single hook at the end
- **Although most species are very sensitive to pollution, some are pollution tolerant**



F. Crane-fly Facts

- Develop over a period of six weeks to five years
- Close to 300 species in North America
- Up to four inches long
- Head is usually retracted so the front end appears round
- Fleshy, plump, rounded segmented body
- Its digestive track (internal organs) can be seen moving back and forth as it crawls
- No legs
- Back end usually has several extensions or finger-like lobes
- Milky, light-brown, gray or greenish in color
- **Somewhat sensitive to water pollution**



G. Damselfly Facts

- Develop over one to four years
- Large eyes
- Large scoop-like lower lip
- No gills on the sides or underneath the abdomen
- Six long segmented legs on the upper middle section of the body
- 1/2 - 1 inch long
- Long spindly legs
- **Somewhat sensitive to water pollution**



H. Hellgramite Facts (also called Dobsonfly)

- Carnivorous and may bite
- One to four inches long
- Mouth has large, chewing pinchers
- Six segmented legs on middle section of body with tiny pinchers at the end of each
- Many fleshy, filamentous appendages on each side of the abdomen
- Back end is forked with two short tails and two hooks on each tail
- Gill tufts on the underside of the tail that look like "hairy armpits"
- Dark brown to black in color
- Often confused with fishfly but fishfly is smooth on underside with no gill tufts
- **Very sensitive to water pollution**



PRE-SITE ACTIVITY: AQUATIC ADAPTATION (CONTINUED)



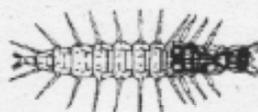
I. Dragonfly Larva Facts

- Develop over one to four year period
- Large eyes
- Large scoop-like lower lip
- Wide oval or round abdomen that may end in three wedge-shaped extensions
- No gills on the sides or underneath
- 3/4 - 2 inches long
- Six long segmented legs on upper middle section of body
- **Somewhat sensitive to water pollution**



J. Fish Fly Facts

- Carnivorous and may bite
- Develop during period of one to three years
- Mouth has large, chewing pinchers
- Up to 1 and 1/2 inches long
- Three pairs of legs on middle section of body with tiny pinchers at the end of each
- Back end is forked with two short tails and two hooks on each tail
- Often confused with hellgramite (dobson fly larva) but does not have fluffy gills on underside
- **Somewhat sensitive to water pollution**



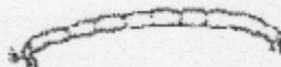
K. Mayfly Facts

- About 700 species in North America
- Develop in streams during a period of two weeks to two years
- Live on exposed rock surfaces in fast current or buried in soft stream beds
- Large numbers of flying adults may emerge from stream at the same time
- Plate-like or feathery gills along the sides of the abdomen
- Two or three long hair-like tails
- Six segmented legs on middle section of body
- Up to one inch long
- The body can be up to one inch long
- Body is usually flat
- **Very sensitive to water pollution**



L. Midgefly Facts

- Almost 2000 species in North America
- Are found in all but the most polluted aquatic conditions
- Up to 1/2 inch long
- One pair of tiny, fleshy legs below the head and one pair on the back end
- The back end sometimes has a tiny pair of extensions that look like brushes
- A thin dark line (digestive tract) can be seen inside the body
- **Fairly tolerant of polluted water**



PRE-SITE ACTIVITY: AQUATIC ADAPTATION (CONTINUED)



M. Sowbug Larva Facts

- Also called the pillbug (adult stage)
- Up to $\frac{3}{4}$ inches long
- Seven pairs of legs
- Dark brown to grey in color
- Two pairs of antennae (one pair is much longer than the other)
- Much wider than they are high and rather flat
- **Somewhat sensitive to water pollution**



N. Whirligig Beetle Larva Description

- Pincher-like mouth parts
- Six segmented legs on middle section of the body
- The legs end in tiny claws
- Four hooks at the end of the body
- No tail
- **Somewhat sensitive to water pollution**



O. Scud Larva Facts

- They swim rapidly on their sides and are nicknamed "side swimmers"
- Usually found where there are plants in the water
- Seven pairs of tiny segmented legs
- Two pairs of antennae
- Color is white to clear
- $\frac{1}{4}$ to one inch long
- Resembles a freshwater shrimp
- Hard, plate-like shell except over the head and upper body
- **Somewhat sensitive to water pollution**



P. Stonefly Larva Facts

- Are found in cool, clean streams with high levels of dissolved oxygen
- Develop in the stream for period of three months to three years
- Are either predators or feed on fungi and bacteria from rotting leaves
- Two long antennae
- Two hair-like tails
- Six segmented legs on middle section of body
- $\frac{1}{4}$ - 2 inches long
- **Very sensitive to water pollution**



PRE-SITE ACTIVITY: AQUATIC ADAPTATION (CONTINUED)



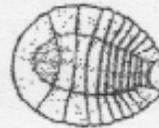
Q. Description of Riffle Beetle Adult

- Length is up to $\frac{3}{4}$ inch long
- Body is long, hard, stiff and segmented
- Six long segmented legs on upper middle section of body
- Back end has two tiny hooks and short hairs (may be hard to see)
- **Very sensitive to water pollution**



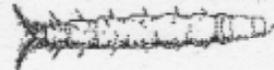
R. Water Penny Facts

- Segmented plate-like covering
- Six tiny segmented legs beneath the round body
- Color is brown, black or tan
- The water penny is the aquatic larva of a beetle; the adult of the species is not aquatic
- The body is often stuck flat to surfaces and looks like a tiny round leaf
- Measures $\frac{1}{4}$ " diameter
- **Very sensitive to water pollution**



S. Watersnipe fly Facts

- Body is tapered at the head end
- Up to two inches long
- Carnivorous/ they can bite
- Body has two feathery-like horns at the back end
- Many pairs of caterpillar-like legs on the underside
- Pale to green in color
- **Somewhat sensitive to water pollution**



PRE-SITE ACTIVITY: AQUATIC ADAPTATION (CONTINUED)



Certificate of Adoption

This document certifies that _____ has chosen to be
(student name)

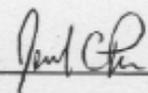
temporary caretaker of a _____ named _____
(type of macroinvertebrate) (name your creature)

while on a visit to Great Smoky Mountains National Park. The student promises to carefully collect macroinvertebrates while not causing any harm to the resources of the National Park. All creatures collected for observation will be safely returned to the waters from which they were born.

I agree to the care and responsibilities listed above

(student signature)

Park Official



Date _____

(photocopy and cut on dotted line).

Certificate of Adoption

This document certifies that _____ has chosen to be
(student name)

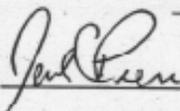
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I agree to the care and responsibilities listed above

(student signature)

Park Official



Date _____



ON-SITE ACTIVITY

PARK RANGER DIRECTED LESSONS



Grade Level: Middle School

Subject Area: Science

Activity Time: 3 hours

Class Size: Maximum 50 students

Setting: Outdoors

Skills: Classifying; Collecting Information; Comparing; Contrasting; Discussing; Evaluating; Experimenting; Hypothesizing; Listening; Observing; Proposing solutions; Recording data

Vocabulary: biodiversity; class; dichotomous key; dissolved oxygen; ecosystem; erosion; family; genus; groundwater; hydrology; hypothesis; invertebrate; insects; kick-net; kingdom; larvae; micro-organisms; nymph; nitrates; non-point source pollution; pH; phylum; point source pollution;

Objectives: Students will explore an aquatic ecosystem within Great Smoky Mountains National Park.

Materials: Study equipment provided by park rangers

Background:

The following is a brief description of available on-site activities. These activities will be led by park staff, but please be familiar with them, as the classroom teacher may be asked to assist on-site. Please let us know if there are certain activities you would like for your students.

Water Quality Testing (45 minutes)

Students will use different scientific methods and tools to test the water quality of a stream.

Pass the Ball (15 minutes)

This activity is designed to teach students about the water cycle, watersheds, and groundwater.

Who Polluted Our River (30 minutes)

Even though mountain springs are considerably clean, there are some unseen pollutants in the water. Students will learn about the various pollutants that can be found in the water and their source.

Aquatic Creatures (1.5 hours)

Students will generate and test a hypothesis about stream health based on what types of aquatic macroinvertebrates are found in the water.

Smokies Ground Plot (1.5 hours)

To help scientists understand what biotic and abiotic elements are present in an ecosystem, small areas will be explored. Students will construct plots, inventory the biotic elements, and record environmental conditions. Scientific tools will be provided for students to collect and identify macroinvertebrates.



POST-SITE ACTIVITY

GRAPHING ELEVATION TRENDS AND STEWARDSHIP



Grade Level: 6th-8th

Subject Area: Science

Activity time: 60 minutes

Setting: Classroom

Skills: Analyzing, Applying, Assessing, Calculating, Charting, Communicating, Connecting, Contrasting, Discussing, Evaluating, Generalizing, Graphing, Inferring, Predicting, Summarizing

Vocabulary:

•Stewardship: Our responsibility to care for our natural resources - land, air, wildlife and water - sustainably, so future generations can enjoy them.

Objectives:

- 1) demonstrate the ability to graph provided data
- 2) describe the trends seen from the graph
- 3) communicate the park-wide trends of water quality within the park
- 4) understand the term “Stewardship”
- 5) learn how each student can become a steward to their own school and community

Materials:

- “Great Smoky Mountains Watershed Elevation Trends” worksheet (pages 23-24)
- Teacher Answer Key (page 25)
- Computer with internet connection

Background:

Great Smoky Mountain watersheds show distinct differences in geology and morphology (land shape) with elevation (example: steeper slopes at higher elevations). Differing elevations show differing levels of the various parameters. Ask students to hypothesize some reasons why elevation would affect the pH, nitrates, and sulfates.

Procedure:

Have the students individually study the table of provided information of elevation versus several parameters. The students will then construct a graph of elevation versus pH, elevation versus nitrate, and elevation versus sulfate. Remind the students to label their axes. After graphing, the students should be able to use the graph to summarize in words what trends are seen within the graph. Regroup the students upon completion of the graphs and summary. Compare answers as a group.

To view the Stewardship podcast video go to <http://www.thegreatsmokymountains.org/eft/10modules.html> and turn the microscope knob that appears on the computer screen to Section 7, Backyard Stewardship. Click “Watch Video” and view video. Ask students how they can become stewards within their own school and community.



GREAT SMOKY MOUNTAINS WATERSHED ELEVATION TRENDS



Great Smoky Mountain watersheds show distinct differences in geology and morphology with elevation (example: steeper slopes at higher elevations). Different fish species are more common in different elevation ranges.

Comparison of Different Parameters in regards to Elevation

Current Conditions

<u>Elevation (feet)</u>	<u>pH</u>	<u>Nitrate (kg/ha)</u>	<u>Sulfate ($\mu\text{eq/l/yr}$)</u>
1,000-1,500	6.66	10.5	44.2
1,500-2,000	6.57	11.5	35.6
2,000-2,500	6.34	12.8	32.8
2,500-3,000	6.30	18.8	36.8
3,000-3,500	6.12	23.9	42.9
3,500-4,000	6.18	35.2	71.2
4,000-4,500	5.85	34.7	74.8
4,500-5,000	5.74	34.6	72.8
5,000-5,500	5.66	49.9	37.7
>5,500	5.11	64.3	38.0

Construct a graph of elevation versus pH, nitrate, and sulfate. Remember to label your axes.

A. Elevation versus current pH

B. Elevation versus nitrate

C. Elevation versus sulfate



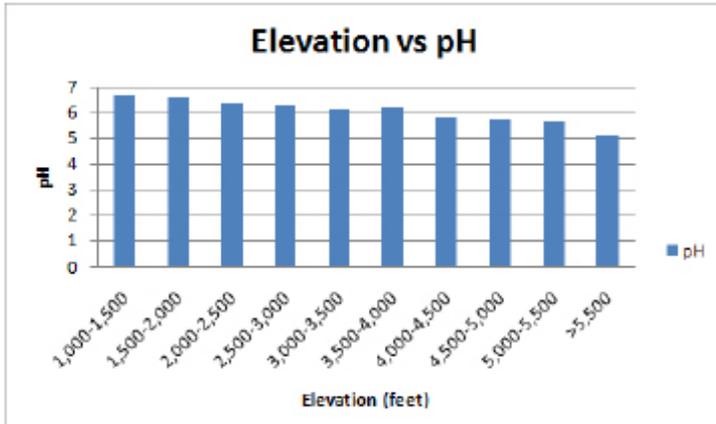
Summary of Graphs

- A. By viewing your graph, what is the overall trend of elevation versus pH?
- B. By viewing your graph, what is the overall trend of elevation versus nitrate?
- C. By viewing your graph, what is the overall trend of elevation versus sulfate?

GREAT SMOKY MOUNTAINS WATERSHED ELEVATION TRENDS TEACHER ANSWER KEY



A.



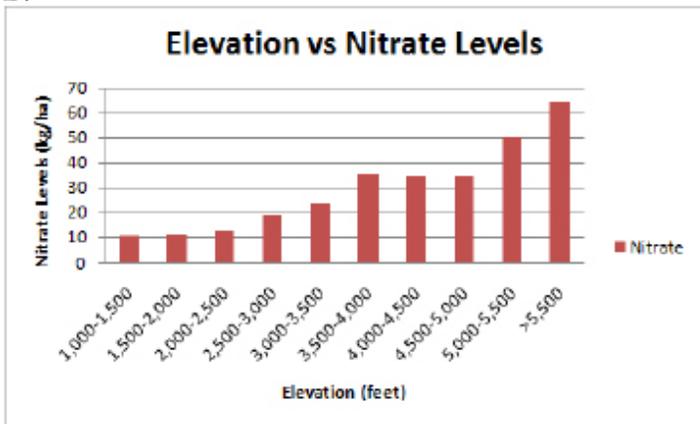
Summary of Graphs

A. By viewing your graph, what is the overall trend of elevation versus pH?

pH decreases as elevation increases.

Teacher Information: pH is declining at 0.2 units/yr at elevations 1,000-3,500 feet but no change above 3,500 feet. If current trends continue, median pH of Little River at Elkmont (elev. 2,146feet) will be 6.0 in 34 years, many others <25 years (Robinson et al. 2007)

B.

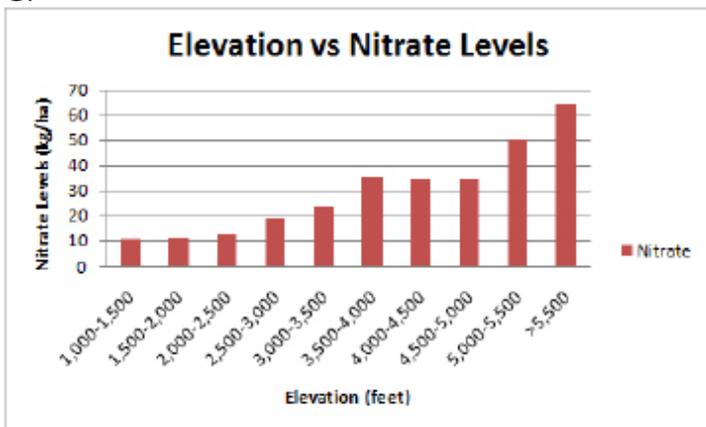


B. By viewing your graph, what is the overall trend of elevation versus nitrate?

Nitrate concentrations increase as elevation increases.

Teacher Information: Nitrate concentrations and total N deposition (kg/ha) show no change, although ammonia and nitrate in precipitation has been declining (Robinson et al. 2007). There was elevated nitrogen and cations leaching in soils following hemlock decline and mortality (Yorks et al. 1999)

C.



C. By viewing your graph, what is the overall trend of elevation versus sulfate?

Sulfate concentrations decrease from 1,000-2,000 feet and increase from 2,000 feet until 5,000 feet and then decrease.

Teacher Information: Sulfate concentrations have been declining at a rate of -0.83 to -1.3 eq/l/yr at elevations less than 3,500ft consistent with decreasing atmospheric sulfate deposition; similar to rates seen at Hubbard Brook (Gbondotugbawa and Driscoll 2002) from low to high elevation (-1.2 to -2.5 eq/l/yr) (Robinson et al. 2007)



POST-SITE ACTIVITY

STEWARDSHIP



Grade Level: Middle School

Subject Area: Science

Activity Time: 30 minutes

Setting: Classroom

Skills: Applying;
Communicating; Connecting

Vocabulary: conservation;
protection; stewardship

Objectives: To understand what the term “Stewardship” means and how students can become a steward in their school and their community.

Materials: Internet access

Procedure:

To view the Stewardship podcast video go to

<http://www.thegreatsmokymountains.org/eft/10modules.html> Turn the microscope knob that appears on the computer screen to Section 7, Backyard Stewardship. Click “Watch Video” and view video. Ask students how they can become stewards within their own school and community.



POST-SITE ACTIVITY

EXPLORE YOUR NATIONAL PARKS



Grade Level: Middle School

Subject Area: Science

Activity Time: 30 minutes

Setting: Indoors

Skills: Varying skills depending on activities selected

Vocabulary: Varying vocabulary depending on activities selected

Objective: To teach students about the various aspects of the National Park Service.

Materials: Internet access

Background:

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 learn how to become a web ranger for the National Park Service, go to: www.nps.gov/webrangers

To learn how 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://www.ParkTraining.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 1,500 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, National Endowment for the Humanities (NEH), National Gallery of Art, National Park Service, Smithsonian, National Science Foundation (NSF), and National Aeronautics and Space Administration (NASA). Go to: <http://www.free.ed.gov/>





PARENT/CHAPERONE LETTER

Greetings Parents/Chaperones:

Park rangers are pleased to be presenting an educational program to the students in Great Smoky Mountains National Park. In order to achieve the goals for a successful program, the park rangers will need your assistance in the following ways:

(These points will help to ensure that park rangers and teachers will be able effectively conduct the lessons and activities throughout the trip.)

- The program will be conducted outside and there will be some hiking throughout the trip. Prepare your student with appropriate footwear, long pants, layers, and rain gear.
- If your child is bringing a lunch from home, we recommend that students bring water to drink and a lunch with minimal packaging. Soft drinks are usually left unfinished by students, and remaining sugary drinks cannot be poured out on the ground. (Minimally packaged lunches lead to less trash being left behind or scattered by the wind. Additionally, this reduces the accumulated trash to be disposed).

If you are a chaperone attending the field trip:

- Please be an active part of the lessons. Keep up with the group and listen to the information being given in the case that you may be called upon to assist (handing out materials, sub-dividing groups etc.).
- Please do not hold conversations with other chaperones or use a cellular phone while the rangers are teaching the students.
- Refrain from smoking during the trip. If you must smoke, please alert a ranger or teacher and remove yourself from the group.
- Please be aware that the program will be conducted outside and that there will be some hiking throughout the trip. Prepare yourself with appropriate footwear, long pants, layers, and rain gear.
- We recommend that parents and students bring a small towel in their backpacks to sit on at lunch (there are no picnic tables at the program site).

Thank you for your needed assistance. We look forward to meeting you on the program!

Sincerely,

The Education Staff at Great Smoky Mountains National Park

