Soil Exploration

Theme: Soil and Terrestrial Invertebrate Monitoring
Grade: 6th-8th grade
Best Time to Plan Trip: Fall or Spring

Unit Rationale

Soils are the literal foundation of life in Great Smoky Mountains National Park. As a habitat, an influence on the climate of micro-niches, a sponge for rainfall, a surface for plant and tree growth, soils are a valuable resource. Students are often unaware of the biotic and abiotic factors of soils. During this study students will describe different ways of classifying soils, demonstrate two ways soils are studied, explain why soils are an important part of an ecosystem, and understand why park biologists need to study soils. Using scientific measuring tools, collecting techniques and examinations of forest life with a microscope, students have an opportunity to realize the relationship between macro-invertebrates and their environment

State Curriculum Standards - Tennessee

Sixth Grade

Science
Embedded Inquiry
- SPI 0607.INQ.2
- SPI 0607.INQ.3
- SPI 0607.INQ.4
- SPI 0607.INQ.5

Interdependence
- SPI 0607.2.1
- SPI 0607.2.2
- SPI 0607.2.3
- SPI 0607.2.4

English
Communications
- SPI 0601.2.4
- SPI 0601.2.5

Seventh Grade

Science
Embedded Inquiry
- SPI 0707.2
- SPI 0707.3
- SPI 0707.4
- SPI 0707.5

Earth and Space (The Earth)
- SPI 0707.7

English
Communications
- SPI 0701.2.7
- SPI 0701.2.8

Eighth Grade

Science
Embedded Inquiry
- SPI 0807.2
- SPI 0807.3
- SPI 0807.4
- SPI 0807.5

Biodiversity and Change
- SPI 0807.5.1
- SPI 0807.5.2
- SPI 0807.5.3
- SPI 0807.5.4

Physical Science (Matter)
- SPI 0807.9.12

English
Communications
- SPI 0801.2.7
- SPI 0801.2.8

Sixth Grade

Science

Embedded Inquiry

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

SPI 0607.Inq.3 Interpret and translate data in 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 food web.

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

SPI 0607.2.3 Identify the biotic and abiotic elements of the major biomes.

SPI 0607.2.4 Identify the environmental conditions and interdependencies among organisms found in the major biomes.

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

SPI 0707.Inq.3 Interpret and translate data in 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.

Earth and Space Science (The Earth)

SPI 0707.7.7 Analyze and evaluate the impact of man's use of earth's land, water, and atmospheric resources.

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.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.

Physical Science (Matter)

SPI 0807.9.12 Identify the basic properties of acids and bases.

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).

Correlation to the National Science Education Standards Content Standards Grades 5-8

Content Standard A

Science as Inquiry: All students will develop abilities necessary to do scientific inquiry and an understanding of scientific inquiry. This includes:

- answering questions through scientific investigation,
- conducting a scientific investigation,
- using appropriate tools and materials to gather, analyze and interpret data,
- thinking critically to make relationships between evidence and explanations,
- recognizing and analyzing alternative explanations and predictions
- communicating scientific procedures and explanations
- using mathematics in all aspects of scientific inquiry
- using technology to gather data and analyze

Content Standard C

Life Science: All students will develop an understanding of structure and function in living systems, regulation and behavior, populations and ecosystems and diversity and adaptations of organisms. Specifically students will understand:

- The structure and function of whole organisms and their ecosystems
- All organisms must be able to obtain and use resources, grow, reproduce and maintain stable internal conditions while living in a constantly changing external environment.
- An organism's behavior evolves through adaptation to its environment.

Content Standard D

Science and Technology: All students should develop abilities of technological design and an understanding about science and technology. This includes:

- designing a solution or product
- implementing a proposed design
- evaluating completed products
- communicating the process

Content Standard E

Science in Personal and Social Perspectives: All students should develop an understanding of personal health, populations, resources and environments, natural hazards, risks and benefits and science and technology in society.

Content Standard F

History and Nature of Science: All students should develop understanding of science as a human endeavor and the nature of history and science.

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Planning a Successful Trip

At Twin Creeks Science and Education Center

Schedule for a day of activities in Great Smoky Mountains National Park at Twin Creeks Science and Education Center

- Meet park ranger at Twin Creeks Science and Education Center
- Use restrooms
- Large group introduction
- Break into two groups
- Participate in activities
- Lunch
- Switch groups
- Large group conclusion

- Check the weather before you go. Lunch will be eaten outside.

- School buses can park at the program site.

- The pre-visit activities included in this packet are specific to the theme of your program and should be presented prior to your scheduled visit. The post-visit activities are designed to reinforce and build upon the park experience.

- A map to the Twin Creeks Science and Education Center can be found on page 8

- All students, teachers, and chaperones will meet the park rangers at theTwin Creeks Science and Education Center.

- The maximum number of students for this trip is 60. We require an adult or teacher for every ten students to create a positive and rewarding experience. The on-site instruction is conducted by a park ranger. However, your assistance is needed with discussion and discipline. Please feel free to contact the Park at (865)436-1258 if you have any further questions.

- Restrooms and water fountains will be available at the program site.

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

Background Information

Park Description:

The National Park Service is charged with the management and preservation of the nation's most precious natural and cultural resources. These resources are woven into our natural heritage, and they provide opportunities for recreation, appreciation of beauty, historical reflection, cultural enrichment, and education.

Great Smoky Mountains National Park is one of the largest protected land areas east of the Rocky Mountains. With over 500,000 acres (800 square miles) of forest, the Smokies contain an enormous variety of plants and animals. In terms of biological diversity, a walk from a mountain's foot to its peak is comparable to the 2,000 mile hike on the Appalachian Trail from Georgia to Maine.

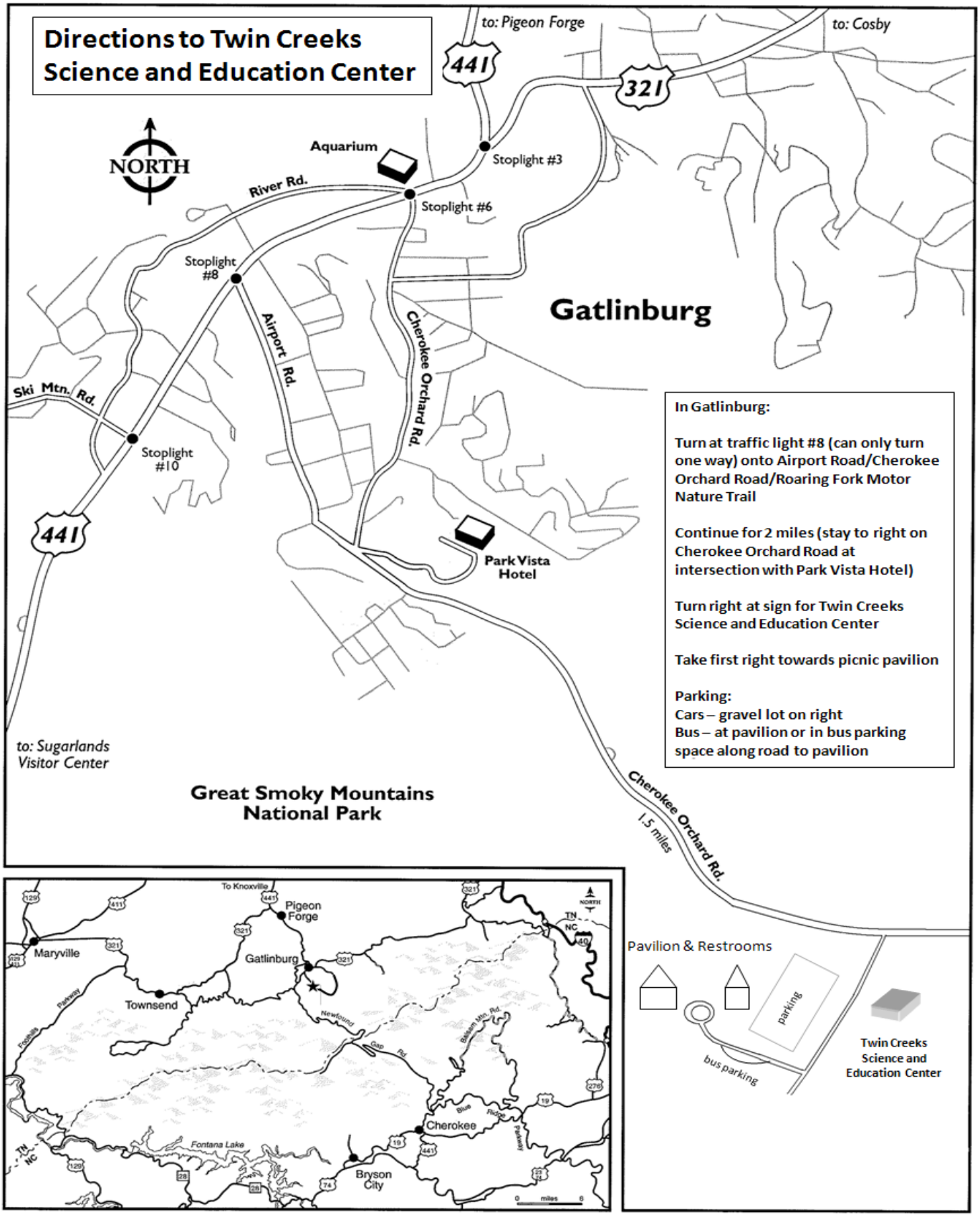
Because the National Park Service is charged with protecting resources and natural systems, the park engages in comprehensive research programs, such as air quality monitoring, to foster an understanding of park resources and to show how they are affected by local, regional, and global influences. Since the Smokies are so biologically diverse, the park is designated as an International Biosphere Reserve by the United Nations. The international system contains over 320 reserves in over 80 countries with the primary objectives of conserving genetic diversity and coordinating environmental education, research, and monitoring.

The Smokies also have a rich cultural history. Native Americans have lived in this area for thousands of years, and permanent white settlement began around 1800. The coming of commercial logging around 1900 stripped trees from two-thirds of what is now park land. Established in 1934, the park was created from more than 6,000 tracts of private and commercial land that was bought mostly with money raised and privately donated. Centrally located within a two-day's drive for half of the nation's population, Great Smoky Mountains National Park has the highest visitation of all the national parks in the country.

Twin Creeks Science and Education Center Description:

Dedicated in November of 2007, Twin Creeks Science and Education Center is a 15,000 square foot facility located just outside of Gatlinburg, TN. The facility provides office space for several of the park scientist. The building also provides a space for researchers to perform biological inventory and monitoring while offering education programs for students and teachers on these same subjects.

Map To Twin Creeks Science and Education Center



Pre-Site Activity
Soil Study Activities

Grade Level: 6th-8th
Subject Area: Science
Activity time: 45 minutes
Setting: Classroom
Skills: Communicating, Analyzing, Listening, Listing, Organizing

Vocabulary:

•**Aspirator**: a piece of scientific equipment that uses suction to collect specimens that are too small to pick up with hands or tweezers.

•**Biological Monitoring**: a technique scientists use to check the condition of a particular species or ecosystem over time.

•**Friable**: a type of soil consistence in which the soil unit "pops" when squeezed gently between the thumb and forefinger.

•**Horizon:** an individual layer within the soil which has its own unique characteristics (such as color, structure, texture or other properties) that make it different from the other layers in the profile.

•**Humus**: the layer of the soil profile composed of decomposed organic matter from dead and decaying plants and animals.

•**Lithosphere:** the outer layer of soil and rock on the planet, named after the Greek word "lithos," which means stone.

•**Litter:** the loose covering of leaves, needles, twigs, branches, stems and fruits from the surrounding trees on top of soil.

•**Macroinvertebrate:** an animal that lacks a backbone and is large enough to be seen without a microscope.

•**pH scale:** measures how acidic or basic a substance is. The scale measures values from 0 to 14. Distilled water is 7, Acids are found between 0 and 7, and Bases are from 7 to 14.

•**Soil Consistence**: describes the firmness of each individual soil unit and how easily a unit can be broken apart. Can be either loose, friable, firm or extremely firm.

•**Soil Profile**: the "face" of a soil, or how it looks if a section is cut out of the ground. It will show individual horizons and soil properties.

•**Soil Structure**: the shape of individual units of soil. Can be blocky, granular, prismatic, columnar or platy. Most of the soil in this area is granular, or soil that cannot be molded when moist and crumbles easily when dry.

•**Subsoil:** in a soil profile, the layer below the topsoil. Usually this is severely weathered parent material. It appears lighter in color than the topsoil. Also called the "B Horizon."

•**Topsoil**: the layer in a soil profile under the organic matter, also called the "A Horizon." Usually darker than the layer below.

Materials:

•Vocabulary and Definitions (listed above and on left)
•Ranger-led Soil Survey Worksheets (pages 10-13)
•Computer with internet connection

Objectives:

1) become familiar with the vocabulary associated with the soil lesson
2) become familiar with the instructions and wording of the ranger-led Soil Survey worksheets
3) learn about biodiversity and soil geology through short video podcasts

Procedure:

If you think that your students will need extra support and time in reading and comprehension of the instructions on the field trip, review the instructions of the ranger-led Soil Survey worksheets (pages 10-13) together as a class.

Have the students read over the vocabulary associated with the soil lesson. Answer any questions that may come up. If you are uncomfortable answering any of the questions, write down the question and these questions may be asked to the ranger during the field trip.

To view the Biodiversity podcast video go to **http://www.thegreatsmokymountains.org/eft/10modules.html** Turn the microscope knob that appears on the computer screen to Section 1, Understanding Biodiversity. Click "Watch Video" and view video.

To view the Linking Geology and Life podcast video go to **http://www.thegreatsmokymountains.org/eft/10modules.html** Turn the microscope knob that appears on the computer screen to Section 3, Why so diverse here? Click "Watch Video" and view video.

Soil Survey (Test 1 and 2)

SOIL & TERRESTRIAL INVERTEBRATE MONITORING

STEP 1

Location: School: Date and Time:

Observe the study area and check off the correct description:

Describe the covering of the soil surface (check only one of the three categories):

__Soil is completely exposed and bare
__Soil is covered by leaf litter
__Vegetation (plant life) is growing on the soil surface

Canopy Cover: __No Canopy (open) __Some tree cover* __Many trees above*

* if there is tree cover, are there leaves present? ___yes ___no

* if there is tree cover, are there needles present? ___yes ___no

STEP 2

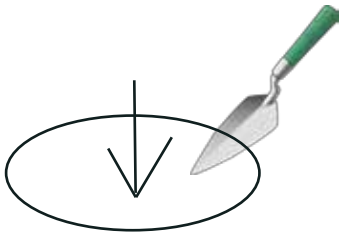
Test 1. Shake Jar

In this activity you will begin the process of separating the different sediments of your soil. Many soils are made of soil, silt, and clay.

1. Ask the ranger to fill the **glass quart jar** labeled "Shake Jar" 2/3rd full of **water**.

2.Select an area of ground near your selected flag and gently clear away all sticks. Be careful not to uproot any living plants or trees.

3. Using the **trowel**, scoop out a pocket of soil within the cleared area by digging **straight down** into the soil. Remember the hole should get deeper, **not** wider. Use the trowel to add enough soil to the jar until the water and soil mixture rises to the top of the jar.



4. Screw the lid back on the jar and invert (turn upside down, then right side up) jar 20 times.

5. Put the jar down on a level surface to settle while you complete Test 2.

Turn Page Over

STEP 3

Test 2. Soil pH Test

In this activity you will make a mixture of soil and water to determine if your soil is acidic or basic (alkaline). Sometimes a soil pH reading helps scientists understand what plants or trees can survive and grow in it.

8. Take out the s**mall measuring plastic cup** with a 30 ml line written on it. Fill to the 30 ml line with the **squirt bottle.**

9. Pour the 30 ml of water into the **small pH jar**.

10. Take ONE **pH strip** out of the bag and reclose the bag.

11. Dip the colored end of the **pH strip** into the water and remove quickly. Shake excess water from the strip and immediately compare the color of the strip to the color pH chart in the bag. Place the used pH strip into the large container, NOT back into the bag. The pH of the water: _____

12. Measure 30 ml of loose soil from your dig site.

13. Place the 30 ml of loose soil into the pH jar that contains water to create a soil and water mixture and stir with a **spoon** while you count to 20.

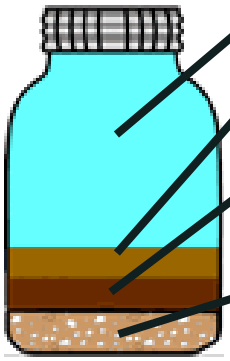
14. Return to your soil/water pH jar. Test the pH with ONE **pH strip** of the upper water layer above the soil. The pH of the water/ soil mixture: _____

15. The soil is (circle one): Acidic (pH=0-6) Neutral (pH=7) Basic/Alkaline (pH=8-14)

16. Return to the Test 1 Shake Jar and notice different layers of sediments or particles in the sample. Layers may be very thin, but the color of the sediments should make the layers visible.

17. How many layers can you count in your sample (floating material is considered a layer)? ____layers.

18. Circle "Yes" or "No" for each question below:



* Is there anything floating around on the top surface? ***Yes*** ***No***
(This is the organic layer.)
* Can you find clay in the next layer? ***Yes*** ***No***
(This will be floating in the water on top of the silt layer.)
* Can you see a silty layer? ***Yes*** ***No***
(The second biggest particle is called silt. This can take several hours to completely settle, but it will be visible on top of the sand.)
* Can you find a sandy layer? ***Yes*** ***No***
(Sand is the heaviest sediment. It will settle to the bottom of your jar.)

19. Which layer is the thickest? _____ sand _____ silt _____ clay _____ organic layer

20. Make sure all of your materials are back in your container before leaving your site.
Materials checklist: ____ shake Jar (cleaned), ___ pH water squirt bottle, ____pH strip bag, ____ pH jar (cleaned), ____ trowel, ____ spoon, and ____measuring plastic cup with 30 ml line.

Soil Survey (Test 3 and 4)

SOIL & TERRESTRIAL INVERTEBRATE MONITORING

STEP 1

Location: School: Date and Time:

Observe the study area and check off the correct description:

Describe the covering of the soil surface (check only one of the three categories):

__Soil is completely exposed and bare
__Soil is covered by leaf litter
__Vegetation (plant life) is growing on the soil surface

Canopy Cover: __No Canopy (open) __Some tree cover* __Many trees above*

* if there is tree cover, are there leaves present? ___yes ___no
* if there is tree cover, are there needles present? ___yes ___no

STEP 2

Test 3. Soil Consistency, Structure, and Moisture Tests

1. Have one member of the team put on the **gloves** and push the **metal hand auger** into the ground using a twisting motion. Stop when the black line is at ground level. With a twisting motion, slowly pull the auger out of the ground.

2. Imagine that the soil sample you extracted is a snake with its head closest to the top of the auger (the surface layer), followed by the body (the middle layers) and ending with the tail (the deepest layer). Carefully push the soil sample up from the bottom of the auger using your gloved thumb. Carefully roll the sample onto your **paper plate** making sure the 'snake' stays lined up. Ask a ranger if you need help.

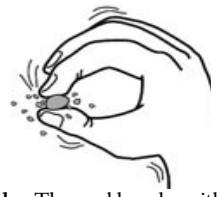
Soil Consistency Test

3. Divide your "snake" with the **metal knife** into 3 equal sections and examine them for rocks and roots. For each soil snake section, circle the best description below:

	Surface Layer ("head of snake")	*Middle Layer ("middle of snake")*	*Deepest Layer ("tail of snake")*
Rocks	None Few Many (more than 3)	None Few Many (more than 3)	None Few Many (more than 3)
Roots	None Few Many (more than 3)	None Few Many (more than 3)	None Few Many (more than 3)

4. Measure the soil consistency by taking a ped (small clump of soil) from each layer. Hold the ped between your thumb and forefinger and squeeze until it pops or falls apart. For each soil snake section, circle the best description below:

Loose: You have trouble finding a single ped and the soil falls apart.



Friable: The ped breaks with a small amount of pressure.

Firm: The ped breaks when you apply a large amount of pressure before it breaks.

Extremely Firm: The ped can't be broken with your fingers.

Surface Layer ("head of snake")	*Middle Layer ("middle of snake")*	*Deepest Layer ("tail of snake")*
Loose Friable Firm Extremely Firm	Loose Friable Firm Extremely Firm	Loose Friable Firm Extremely Firm

Turn Page Over

Soil Moisture Test

5. Measuring the amount of soil moisture is important to help scientists understand how much water is available for plant roots. For each section of your sample, determine the percent of soil moisture. To do this, squeeze each section of soil into a clump in your hand. For each layer, mark an "X" next to the best description below. Each layer can have only one "X."

% of moisture in Soil	How does the soil feel when I clump it in my hand?	Surface Layer	Middle Layer	Deepest Layer
0-25%	It feels dry. It forms a weak ball, but grains break away easily.			
25-50%	It feels slightly moist. It forms weak ball and shows my fingerprints, but grains break away.			
50-75%	It feels moist. It shows my fingerprints and leaves my fingers slightly damp.			
75-100%	It feels wet and forms a ball in my hands. A small amount of water can be squeezed from it.			
100%	It feels wet and forms a ball in my hands. Water drips from it when I squeeze it.			

STEP 3

Test 4. Soil and Air Temperature Test

6. Use the **stopwatch** to clock 2 minutes while you complete both temperature readings. The **metal soil thermometer** is for reading the soil temperature. Stick the pointed end into the ground and stop at the black line. After 2 minutes record the measurement. Your temperature readings must be in degrees Celsius.

Soil temperature reading: _____ °C

7. The **blue air thermometer** is for reading the air temperature. Hold the thermometer by the string and record the measurement after 2 minutes. Your temperature readings must be in degrees Celsius.

Air temperature reading: _____ °C

8. Are the air and soil temperatures similar? Why or why not?

9. Make sure all of your materials are back in your container before leaving your site.
Materials checklist: _____ Soil auger, _____ Paper plate, _____Metal Knife, _____ Stopwatch, _____ Pair of gloves, _____ Blue Air thermometer, and _____Soil thermometer.

Pre-Site Activity
Invertebrate Study Vocabulary

Grade Level: 6th-8th

Subject Area: Science

Activity time: 45 minutes

Setting: Classroom

Skills: Communicating, Analyzing, Listening, Listing, Organizing

Vocabulary:

•**All Taxa Biodiversity Inventory:** also called the ATBI. A research project in the Great Smoky Mountains National Park to inventory every life form in the park. It is estimated that we currently know only 14,000 of an estimated 100,000 species.

•**Aspirator:** a piece of scientific equipment used that uses suction to collect specimens that are too small for hands or tweezers to pick up.

•**Baseline Information:** information about how things are now, at this point in time, so we will know if there is a change the next time we look at it.

•**Biodiversity:** the variety, distribution and abundance of life forms and ecological processes in an ecosystem; includes the ways in which different life forms interact.

•**Biological Inventory:** a technique scientists use to study the various life forms in a given area. In the Great Smoky Mountains National Park, inventories are done in study plots.

•**Biological Monitoring:** a technique scientists use to check the condition of a particular species or ecosystem over time.

•**Canopy**: the top layer of the forest; the treetops.

•**Community:** all populations of species existing in the same area.

•**Density:** the number of individuals of a given species within a certain area.

•**Diversity:** the number of species in an area and also their relative abundance.

•**Ecosystem:** a system formed by the interaction of groups of organisms with each other and their environment.

•**Humus:** the part of the soil profile that is composed of decomposed organic matter from dead and decaying plants and animals. Also called the duff layer.

•**Hypothesis:** a proposition based on assumptions that can be evaluated scientifically.

•**Invertebrate**: an animal that does not have a backbone such as an insect.

•**Litter:** the covering over soil in a forest made up of leaves, needles, twigs, branches, stems, and fruits from the surrounding trees.

•**Macroinvertebrate**: an animal lacking a backbone and that is large enough to be seen without a microscope.

•**Population**: all organisms of the same species living in the same area.

•**Sample:** a count of a random selection of individuals from the larger community.

•**Taxonomy**: the classification of plants and animals according to their natural relationships.

Materials:

•Vocabulary and Definitions worksheet (listed on left)
•Computer with internet connection.

Objectives:

1) become familiar with the vocabulary associated with the terrestrial invertebrate lesson
2) understand the biodiversity of the Great Smoky Mountains National Park
3) recognize that many plants and animals here are endemic species, meaning they are known to live only in the park
4) learn of the threats that are affecting the plants and animals of the park
5) learn about several terrestrial invertebrates that students may find during their field trip.

Procedure:

Have the students read over the vocabulary associated with the terrestrial invertebrate lesson. Most if not all of the definitions will be used within the terrestrial invertebrate monitoring session.

Pre-Site Activity
Invertebrate Study Vocabulary

Students will probably be familiar with most of the definitions but reviewing the list before the trip is essential. Answer any questions that may arise and write down any questions that you may not feel comfortable answering. Ask these questions of the ranger during the field trip.

To view the Biodiversity podcast video go to **http://www.thegreatsmokymountains.org/eft/10modules.html**. Turn the microscope knob that appears on the computer screen to Section 1, Understanding Biodiversity. Click "Watch Video" and view video.

To view the Spruce Fir podcast video go to **http://www.thegreatsmokymountains.org/eft/10modules.html**. Turn the microscope knob that appears on the computer screen to Section 2, A Connected Web. Click "Watch Video" and view video.

To play the Bucket of Bugs game go to **http://www.thegreatsmokymountains.org/eft/10modules.html**. Turn the microscope knob that appears on the computer screen to Section 4 Studying Diversity. Click "Play Game" and follow instructions.

Pre-Site Activity
Soil Connections

Grade Level: 6th-8th

Subject Area: Science

Activity time: 30 minutes

Setting: Classroom

Skills: Applying, Communicating, Connecting, Discussing, Categorizing

Materials:
- Paper
- Pencils

Objectives:
1) connect personally to soil
2) create thinking map of different ways of classifying soil

Background:
Many students in Eastern Tennessee have firsthand experience with the environment - either through hobbies such as fishing, hunting, gardening, camping, or riding horses/ATV's. Additionally students may have experience in the outdoors through recreational activities such as swimming in streams/lakes or hiking.

Procedure:
Students can write personal, narrative accounts of their own experience in the outdoors and how is each outdoor activity tied to soil.

Additionally students can create a thinking map to create a visual representation for the different ways of classifying soils.

On-Site Activity
Soil Study

Grade Level: 6th-8th

Subject Area: Science

Activity time: 75 minutes

Setting: Outside in the park

Skills: Analyzing, Applying, Calculating, Classifying, Communicating, Comparing, Discussing, Experimenting, Gathering information, Hypothesizing, Measuring, Predicting, Summarizing

Materials: Rangers will provide all materials

- Clipboards
- Soil kits
- Soil data sheets
- Pencils

Objectives:

1) describe different ways of classifying soils
2) demonstrate two ways soils are studied
3) explain why soils are an important part of an ecosystem
4) explain why park biologists need to study soils

Background:

Before park biologists do any kind of a study, whether they are looking at mammals, plants or insects, they must look at the soil in the area. This is important because along with temperature, sunlight and moisture, soil will determine what can grow in the area.

Procedure:

Students will be asked about the components that make up soil (weathered bedrock, decomposing plant and animal material). Students will understand that the properties of soil in an area changes over time. Some properties (temperature, moisture and compaction) change quickly, in minutes, hours or days and some (pH, color, structure, fertility, organic matter, density, micro-organisms) take years or even (horizon formation, kinds of minerals, particle size) hundreds of years.

The students will collect data in groups on some characteristics of soil that are important to understand when examining an ecosystem. These will include moisture, structure, color, consistence, texture, organic components, pH and temperature.

Students will regroup and review the data collected. They will determine what is considered healthy soil and what current trends are showing.

On-Site Activity
Terrestrial Invertebrate Study

Grade Level: 6th-8th

Subject Area: Science

Activity time: 75 minutes

Setting: Outdoors in the park

Skills: Analyzing, Applying, Calculating, Classifying, Communicating, Comparing, Discussing, Gathering information, Hypothesizing, Measuring, Predicting, Summarizing

Materials: provided by the rangers

- Data sheets
- Clip boards
- Pencil
- Insect collecting supplies (insect aspirators, jars or bug boxes, field sifter, magnifying glass)

Objectives:

1) recognize the diversity of soil invertebrates in the park
2) understand why soil invertebrates are important,
3) identify soil invertebrates using an insect key to the taxonomic level of Order/Class.

Background:

The students will be assisting in monitoring the population of terrestrial invertebrates in a special area set up for that purpose. They will study the species richness or diversity (what species are here) and the species evenness or density (how common are those species). All plants and animals are important to the ecosystem, and learning about the smallest of animals is as important as learning about the big animals like bears and deer. Why do you think this is the case? It is also important to look at the main tree species that surround the plot. Why do you think this is important? (Different species of insects and spiders need different amounts of shelter, different amounts/types of leaf litter). What are some of the possible threats to the soil and, therefore, the soil invertebrates? The first step in inventorying invertebrates is collecting. Students will be shown the techniques they will use to collect insects. Also, the plant life growing in an area can tell you something about the type of soil in an area e.g. the Rhododendron shrub (pH 4.5-6.0) grows in more acidic soil than a maple tree (pH 6.0-7.5).

Procedure:

The students will be divided into groups to collect invertebrates that live in soil. After 12 minutes of collecting, students will be brought back to classroom area to view invertebrates under the video microscope. Students will work together to identify invertebrates to the Order/Class level. Discussion will be on special adaptations, food chain importance and other unique features. Data will be posted to a website for future comparisons. The data collected today is part of a larger monitoring project. Today's data is just a snapshot of what is currently happening. The information becomes most meaningful when compared over time. This is what park rangers do to monitor the health and condition of park resources.

Post-Site Activity
Make the Connection!

Grade Level: Middle School

Subject Area: Science

Activity Time: as time allows

Setting: In classroom

Skills: **Analyzing; Comparing; Contrasting; Describing; Discussing; Presenting; Researching**

Vocabulary: Varying vocabulary depending on

Objectives: To further expand students understanding of the relationship between biotic and abiotic factors in the environment.

Materials: internet or library access

Procedure:
While visiting Great Smoky Mountains National Park, students explored the relationships between biotic and abiotic factors of the environment. To expand upon their experience, place students into small teams to conduct further research. Ask students to pick three organisms from the following list that live in the national park.

Using the internet, allow each team to research their choices and identify the following:
A.) What does each organism eat?
B.) What eats or preys upon each organism?
C). What happens to each organism when seasons change in a deciduous forest?
D.) Connect the three organisms in a relationship (this could be their placement in a food web, their habits within the ecosystem, a comparison of shelter etc).

Once information has been gathered, ask students to illustrate the connections between their organisms with the rest of the class. Students may do this through drawings, skits, or other creative measures.

American Beaver

American Bull Frog

Bald Eagle

Black Bellied Salamander

Black Rat Snake

Brook Trout

Bumblebee

Centipede

Common Snapping Turtle

Corn Snake

Coyote

Deer Mouse

Dobsonfly

Eastern Box Turtle

Eastern Cottontail

Eastern Garter Snake

Eastern Gray Squirrel

Elk

Firefly

Five-lined Skink

Land Snails

Meadow Vole

Millipede

Mink

Monarch Butterfly

Northern Cardinal

Northern Copperhead

Raccoon

Red-shouldered Hawk

Red-spotted Newt

Red Squirrel

Screech Owl

Stonefly

Striped Skunk

Timber Rattlesnake

Walking sticks

White-tailed Deer

Wild Turkey

Wood Frog

Wood Roach

Post-Site Activity
Habitats and Stewardship

Grade Level: 6th-8th

Subject Area: Science

Activity time: 20 minutes

Setting: Classroom or Computer room

Skills: Applying, Communicating, Connecting, Decision making, Discussing, Identifying cause and effect, Manipulating, Proposing solutions, Summarizing

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

Materials:
• Computers with internet connections

Learner Objectives:
1) learn about the different habitats of various plants and animals
2) be able to build a computer generated habitat for a selected animal and protect it from a series of threats
3) understand the term "Stewardship"
4) learn how each student can become a steward to their own school and community

Background:
During the students' study within the park they were able to understand that certain plants and animals can only live in specific places (habitats) due to the soil's pH, temperature, etc. These computer games allow the students to strengthen the connection between different aspects of the habitat and the plants and animals that live in these habitats. Additionally, the "Home, Sweet Habitat" game allows the students to see how different threats can endanger the lives of both plants and animals.

Procedure:
To play the Where Do Things Live? game go to **http://www.thegreatsmokymountains.org/eft/10modules.html** and turn the microscope knob that appears on the computer screen to Section 3 Why so diverse here? Click "Play Game" and follow instructions.

To play the Home, Sweet Habitat game go to **http://www.thegreatsmokymountains.org/eft/10modules.html** and turn the microscope knob that appears on the computer screen to Section 5, Biodiversity Threats. Click "Play Game" and follow instructions.

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.

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