

TERRESTRIAL INVERTEBRATES



THEME: Effects of Air pollution on Terrestrial Invertebrates

GRADE: Sixth

BEST TIME TO PLAN TRIP: Fall or Spring

UNIT RATIONALE

All plants and animals are important to the ecosystem. Although often overlooked, terrestrial invertebrates are as important to the ecosystem as the large vertebrates are. The functional responses of terrestrial invertebrates to soil pH, soil temperature, and air temperature provide a complete assessment of the ecosystem model. During the study students will be assisting in monitoring the population of terrestrial invertebrates in a predetermined area.

SCIENCE 6TH GRADE NORTH CAROLINA STANDARDS

NATURE OF SCIENCE

Students are involved with science as a human endeavor that relies on reasoning, insight, skill and creativity as they participate in on-going research projects at the Great Smoky Mountains National Park. Students are exposed to science's universal laws through a systematic study of the rules, patterns and cycles in nature.

SCIENCE AS INQUIRY

Students are involved in scientific investigation that involves the collecting of relevant evidence, the use of logical reasoning and the application of imagination to devise hypotheses and explanations to make sense of collected evidence. Students use tools of investigation to collect data and mathematics to gather, organize and present data.

PERSONAL AND SOCIAL PERSPECTIVES

Students make personal and societal connections to the issues facing the Great Smoky Mountains National Park. Specifically, they will be exposed to the form and function of interacting systems.

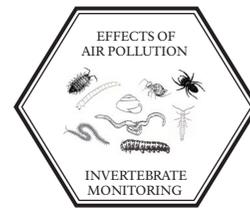
Competency Goal 1: The learner will design and conduct investigations to demonstrate an understanding of scientific inquiry.

- 1.01 Identify and create questions and hypotheses that can be answered through scientific investigations.
- 1.03 Apply safety procedures in the laboratory and in field studies.
- 1.04 Analyze variables in scientific investigations.
- 1.05 Analyze evidence.
- 1.06 Use mathematics to gather, organize, and present quantitative data resulting from scientific investigations.
- 1.08 Use oral and written language to Communicate findings.
- 1.10 Analyze and evaluate information from a scientifically literate viewpoint by reading, hearing, and/or viewing.

Competency Goal 4: The learner will investigate the cycling of matter.

- 4.01 Describe the flow of energy and matter in natural systems.
- 4.02 Evaluate the significant role of decomposers.
- 4.04 Evaluate the significance of photosynthesis to other organisms.
- 4.05 Evaluate designed systems for ability to enable growth of certain plants and animals.





Competency Goal 6: The learner will conduct investigations and examine models and devices to build an understanding of the characteristics of energy transfer and/or transformation.

6.01 Determine how convection and radiation transfer energy.

6.02 Analyze heat flow through materials or across space from warm objects to cooler objects until both objects are at equilibrium.

Competency Goal 7: The learner will conduct investigations and use technologies and information systems to build an understanding of population dynamics.

7.01 Describe ways in which organisms interact with each other and with non-living parts of the environment.

7.02 Investigate factors that determine the growth and survival of organisms including:

7.03 Explain how changes in habitat may affect organisms.

7.04 Evaluate data related to human population growth, along with problems and solutions

7.05 Examine evidence that overpopulation by any species impacts the environment.

7.06 Investigate processes which, operating over long periods of time, have resulted in the diversity of plant and animal life present today.

LANGUAGE ARTS 6TH GRADE NORTH CAROLINA STANDARDS

Competency Goal 1 The learner will use language to express individual perspectives drawn from personal or related experience.

1.02 Explore expressive materials that are read, heard, and/or viewed.

1.03 Interact appropriately in group settings.

1.04 Reflect on learning experiences.

Competency Goal 2 The learner will explore and analyze information from a variety of sources.

2.01 Explore informational materials that are read, heard, and/or viewed.

MATH 6TH GRADE NORTH CAROLINA STANDARDS

Competency Goal 1: The learner will understand and compute with rational numbers.

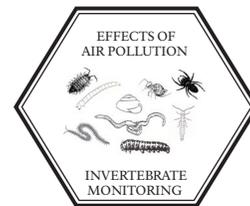
1.02 Develop meaning for percents.

1.03 Compare and order rational numbers.

1.05 Develop fluency in the use of factors, multiples, exponential notation, and prime factorization.

1.07 Develop flexibility in solving problems by selecting strategies and using mental computation, estimation, calculators or computers, and paper and pencil.





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.

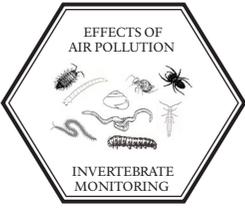
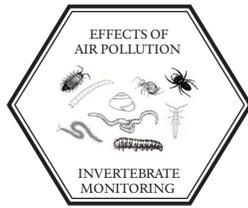


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PLANNING A SUCCESSFUL TRIP

AT PURCHASE KNOB

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

- Meet park ranger at Purchase Knob
- 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 Appalachian Highlands Science Learning Center Purchase Knob can be found on page 8

• All students, teachers, and chaperones will meet the park rangers at the Appalachian Highlands Science Learning Center at Purchase Knob.

• 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 (828) 926-6251 if you have any further questions.

• Restrooms and Water

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

AT OCONALUFTEE VISITOR CENTER

SCHEDULE FOR A DAY OF ACTIVITIES IN GREAT SMOKY MOUNTAINS NATIONAL PARK AT OCONALUFTEE VISITOR CENTER

- Meet park ranger at Oconaluftee Visitor 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 Oconaluftee Visitor Center can be found on page 8

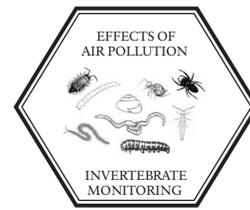
• The maximum number of students for this trip is 50. We require an adult or teacher for every ten students to create a positive and rewarding experience. The on-site instruction is conducted by a park ranger. However, your assistance is needed with discussion and discipline.

• Restrooms and Water

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



SAFETY CONSIDERATIONS AND OTHER IMPORTANT INFORMATION



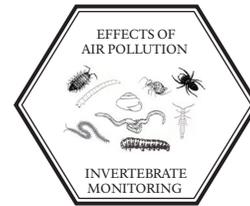
- Great Smoky Mountains National Park is a federally protected public use area. Please help the rangers keep all of the plants and animals protected in the park by not picking the plants or taking anything from the park.
- Please remind your students to wear appropriate footwear and clothing for this 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.

Purchase Knob Description:

The Purchase Knob property, over 530 acres in size, was donated to Great Smoky Mountains National Park by Katherine McNeil and Voit Gilmore in January 2001. Situated at an elevation of over 5,000 feet, the area contains old-growth forests, mountain meadows and high elevation wetlands. It also rests on geological formations that aren't found anywhere else in the park, lending to a unique and diverse habitat for the study of plants and animals. The house is the location of the Appalachian Highlands Science Learning Center, whose mission is to provide a space for researchers to perform biological inventory and monitoring while offering education programs for students and teachers on these same subjects.

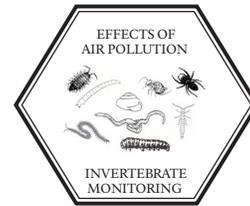
Oconaluftee Visitor Center Description:

The Oconaluftee Visitor Center is located 2 miles north of Cherokee, NC, on US-441. Situated at an elevation of 2,040 feet, the area contains cove hardwood forests. The adjacent Mountain Farm Museum is a collection of nine historic log structures that were moved from sites throughout the national park to their current location in 1953. They represent some of the types of buildings found on mountain farms at the beginning of the 20th century.



PRE-SITE ACTIVITY

INVERTEBRATE STUDY VOCABULARY



Grade Level: Sixth Grade

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 (page 9)
- 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.

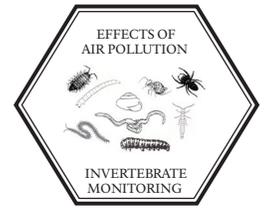
Procedure:

Have the students read over the vocabulary associated with the terrestrial invertebrate lesson (page 9). 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.

ON-SITE ACTIVITY

TERRESTRIAL INVERTEBRATE STUDY



Grade Level: Sixth Grade

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:

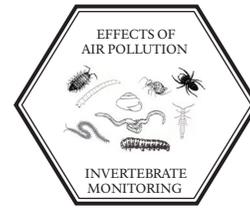
The students will be assisting in monitoring the population of terrestrial invertebrates in a special area set up for that purpose. They will study the species richness or diversity (what species are here) and the species evenness or density (how common are those species). All plants and animals are 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

FOOD CHAIN GAME AND PODCAST



Grade Level: Sixth Grade

Subject Area: Science

Activity time: 45 minutes

Setting: Classroom

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:

- Computer(s) with internet connection

Objectives:

- 1) be able to create a computer generated food web
- 2) understand the term “Stewardship”
- 3) learn how each student can become a steward of their own school and community.

Background:

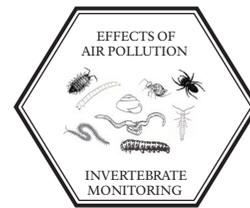
The students during the field trip were able to see how different terrestrial invertebrates have their place within the food chain. This web-based activity will recap how each plant and animal are important to the food chain.

Procedure:

To play the Connecting the Chain game go to <http://www.thegreatsmokymountains.org/eft/10modules.html>. Turn the microscope knob that appears on the computer screen to Section 5, A Connected Web. Click “Play Game” and follow instructions.

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.

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

