the CEED

THE CENTER FOR ENERGY EFFICIENT DESIGN

# ~~Land, Forest, and Rain~~Title: 1) Land Management: Getting to Know Your Land

| **Grade Level** | 7th | **Subject** | Science |
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**Objective(s):**

Students will identify ways, in a continuation of lessons, that abiotic components of an ecosystem affect the biotic components so that they can come to an understanding of the nature of how much water runoff flows from the school parking lot, down a sloping hill and into woods that adjoin our school and why it is damaging the nature trail year after year.~~.~~

**SOL Addressed:**

LS.6 The student will investigate and understand that organisms within an ecosystem are dependent on one another and on nonliving components of the environment. ~~Key concepts include:~~

~~the carbon, water, and nitrogen cycles;~~

~~interactions resulting in a flow of energy and matter throughout the system;~~

~~complex relationships within terrestrial, freshwater, and marine ecosystems.;~~

**Next Generation Science Standards**

**MS.I Interdependent Relationships in Ecosystems**

Students who demonstrate understanding can:

**MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.**[Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]

**MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.***
[Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]

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| **Materials Needed** ~~**Per Class of 30**~~ ~~**and**~~ ~~**Prior Knowledge**~~ | • **Chart paper**<br>• **Marking pens for recording observations**<br>• **Trowel or stick**<br>• **Photographic light meter or photsensitive paper**<br>• **Thermometer**<br>• **Small strip of paper**<br>• **2 compasses**<br>• **Bottle of tap water**<br>• **Copies of student page**<br>• **Plant identification books**<br>• **Animal identification books**<br>• **Topographical map of the area (optional)**<br>• **Access to CEED dashboard (See CEED Building Application/ Sensor Data on page 6)** |
| **Ways to differentiate this lesson plan** | • **EXTENSION:** (for older or more advanced students)<br>○ Have students re-v~~V~~isit each site again at a different time of year and repeat ~~your~~ their investigations. ~~Compare~~ Have them compare ~~your~~ their results: How has the soil changed? The temperature? The wind? The plants and animals? What factors influenced change?<br><br>• **MODIFICATIONS:** (for younger or students with more significant learning needs)<br>○ Assign students roles in groups (who should be recording, in charge of procedures, etc.)<br>○ Provide students with all necessary materials and a procedural guideline; include any equations or conversions, as well as animal or plant field identification guides they will need to use throughout the project.<br>○ Provide a template for data collection and conclusions.<br>○ ~~It's easier than you think to bring the outdoors inside.~~If outdoor, hands-on experiences are not available at your school, c~~C~~reate a class terrarium of a local ecosystem, or have teams of students create terrariums of various ecosystems. |
| **Introduction/ Anticipatory Set** | ***Anticipatory Set:***<br><br>The woods that border the edge of our school building get washed out by the rain (precipitation) that falls onto the parking lot and ~~then~~ runs down the grassy hill into the woods. The problem is that the woods contain a nature trail that keeps getting washed out by the force of the rain runoff. The nature trail has been built and repaired over and over but it keeps getting damaged and ruined. We need to study the problem in more detail beginning with gaining a true understanding of our school's ecosystem from the bottom up so that we can solve this problem once and for all.<br><br>**Questions to ask students:** |
| | **Introduction:**<br>An ecosystem is a community of different species interacting with each other and with the chemical and physical factors making up its nonliving environment. It is a system of interrelationships among~~s~~ organisms, and between organisms and the physical environment.<br><br>Plants and animals in an environment inter~~e~~act with each other in various ways. For example, plants may depend on insects or birds to pollinate flowers and on ~~on~~ earth~~ht~~worms to aerate the soil; anim~~as~~ls may depend on plants for food or shelter. However, plants and animals also inter~~e~~act with the nonliving |

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| | • Have you ever noticed the woods that border our school?<br>• How steep is the bank?<br>• What type of plants grow on the bank?<br>• Have you ever watched where the runoff goes once it hits the parking lot?<br>• What do you think the benefit is of having a nature trail at our school?<br>• How much does it rain at our school? | elements of their environment.<br><br>In a local environment~~s~~, physical factors such as sunlight, moisture, temperature, wind, and water flow influence the suitability of an area for particular organisms. Those factors determine the kinds of plants and~~s~~ animals that live there. Physical factors may be determined by the environment's geography, such as its proximity to water, its elevation, or its geological features. In addition, the resident organisms (particularly plants) may affect the sunlight, moisture, temperature, and wind of the area. For example, the tall trees of a mature forests tend to block the sunlight and thus create a dark, moist environment or microclimate on the forest floor that is suitable for shade-loving plants but is too shady for other kinds of plants. Microclimate refers t-o special conditions of light, moisture, and temperature that occur in a narrowly restricted area within an ecosystem, for example, under a bush or in a small woodland opening. |
| **Guided Practice** | **Questions to ask students:**<br>• Ask students to think of a place they enjoy visiting.<br>• Ask them to think about these~~s~~ questions: 1) What was it that you really liked about this place? Was it the people? Was it the physical space? 2)What did you do when you were there? 3) What living things made this place enjoyable?<br>• Ask students to name any nonliving things that made their~~your~~ place enjoyable. (Water, mountains, climate, etc.)<br>• The teacher will help students see that any place has both living and nonliving parts that work together to make an ecosystem.<br>• The teacher will explain that students will investigate the ecosystem next to our school to find out how living and non-living elements affect each other.<br><br>**Discussions to have with students:**<br>• Be sure to discuss appropriate outdoor behavior with the students. All living things, including plants, are to be respected and not injured in any ways. Talk with students about following the rules: Respect all living things, including plants. Look, learn, and leave alone. | |

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| **Independent Practice** | **Divide the class into teams.**<br>Explain that each team will investigate and record observations of a different component of the hill leading down to the forest and into the forest next to our school. If you have a large group, assign two teams to study each component and then average their data. Give students instructions, a copy of the student page, and materials as described below. Later, teams will transfer their observations to the class ~~data chart~~spreadsheet.<br><br>**Team 1 – Soil**<br>Ask this team to determine the soil moisture at the study sites. Alsp ask this team to measure the site in a *wide* variety of places and levels. Students can use a trowel or a stick to scrape the surface of the ground and to obtains a small sample of soil from underneath the surface. By feeling the soil, they should be able to tell whether it s wet, moist, or dry. (Moist soil will stick together.) They should examine the soil for other characteristics such as texture, color, and smell. They should also note plant material or organisms in the soil.<br><br>**Team 2 – Sunlight and Wind**<br>Ask this team to determine wind movement and how much sunlight reaches the ground at each study site. For the wind, one student can hold the small strip of paper away from their body, while the others observe whether it hangs straight down or blows at an angle. They can use the compass to determine the direction from which the wind seems to be blowing. To determine light intensity students may use a photographic light meter, or photosensitive paper i~~. I~~f the light meters~~se items~~ are not available.<br><br>**Team 3 – Temperature**<br>Ask this team to measure the site in a *wide* variety of places and levels, 1” (2.5 cm) deep in the soil, and at 1 yard (.9 m) above the ground.<br><br>**Team 4 – Lay of the Land**<br>Ask this team to determine where the site is flat or slopped and to record any other land features that affect the study site (such as a parking lot, tall buildings, woods, cliffs, banks). This team will also determine which direction water flows from the site. They can do so by slowly pouring water onto the ground and observing where it goes. They can use the compass to determine the direction of the flow. If possible, also have them study a topographic map to locate the site and to determine the body of water into which the site drains.<br><br>**Team 6 – Animal Life**<br>Ask this team to record the various kinds of animals at each site (insects, birds, reptiles, fish, frogs, or tadpoles). Students should include evidence of animals such as scat, tracks, burrows, or leaves that have been chewed. They should use animal identification books of various types to help them be successful in these endeavors.<br><br>**Team 7 – Plant Life**<br>Ask this team to record the types of plants found on the hill that connects the parking lot to the woods, as well as the types of plants found in the woods. They should be able to identify most nonvascular and vascular plants using plant identification books. |

**Extended Lesson- Stake Your Claim**

1. Attach index cards to sticks or stakes. Prepare enough of these markers so that each student has two. Write one of the following labels on each marker: Most Soil Moisture, Least Soil Moisture, Most Sunlight, Least Sunlight, Highest Temperature, Lowest Temperature, Most Wind, Least Wind, Most Plants, Least Plants, Most Animals and Least Animals.
2. Mark off the area of study with string or rocks. Divide the class into pairs, and give each pair "most" and "least" markers for each environmental factor listed above. Invite teams to explore the study area and determine which location has the most and least of each factor. For example, a team studying plants should decide which part of the site has the most plants and which site has the least. Students will indicate their choices by placing their markers in the ground.
3. After all the students have marked their choices, examine the entire area to see where the markers of each type are located. According to the markers, which spot had the most or least sunlight? Moisture? Heat? Which spot did most animals seem to prefer? What makes you think animals prefer that spot? Did that spot have the most or least of any other factors? Which spot did most plants prefer? Which makes you think plants prefer that spot?

~~**All Teams - Combine Data**~~

~~Ask the teams to enter their data into a spreadsheet. Use the spreadsheet as a basis for discussing differences between the locations and any interactions students observed among the elements. Ask the following questions:~~

- ~~Which parts of the site had the wettest soil? The moist soil? The dry soil?~~
- ~~Which parts of the site had the most sun? The least? In between?~~
- ~~Which parts of the site had varying amounts of wind? Describe the different speeds? What direction or direction was the wind blowing at each of these sites?~~
- ~~Which parts of the site had the highest air temperature? The lowest? Do the plants seem to affect the light intensity, air temperature, and soil temperature at the site?~~
- ~~Describe the lay of the land. What is the direction of water flow?~~
- ~~What plants are found on the site?~~
- ~~What type of invertebrates and vertebrates were located at this site?~~
- ~~How does water seem to influence the soil temperature, air temperatur, and soil mositure?~~
- ~~What relationship does light seem to have with air temperature? With soil moisture? With plants?~~
- ~~How might water flow affect soil moisture and plants?~~
- ~~Which of the elements we studies seems most important for determinng the character of the environment at each site? What makes you say so?~~

~~All Teams - Combine~~
~~Students should look up data on the CEED dashboard in order to get background knowledge on how much it rains/snows in our area, as well as when we tend to get the most preciptation. (Note: Our school is about a mile from the CEED building.)~~

~~**Each Team Presents to the Class**~~
~~Each team will work together to form a presentation to the class on their findings.~~

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| | ~~**Extended Lesson- Stake Your Claim**~~<br>~~1. Attach index cards to sticks or stakes. Prepare enough of these markers so that each student has two. Write one of the following labels on each marker: Most Soil Moisture, Least Soil Moisture, Most Sunlight, Least Sunlight, Highest Temperature, Lowest Temperature, Most Wind, Least Wind, Most Plants, Least Plants, Most Animals and Least Animals.~~<br>~~2. Mark off the area of study with string or rocks. Divide the class into pairs, and give eah pair "most" and "least"markers for each environmental factor listed above. Invite teams to explore the study area and determine which location has the most and least of each factor. For example, a team studyingplants should decide which part of the site has the most plants and which site has the least. Students will indicate their choices by placing their arkers in the ground.~~<br>~~3. After all the students have marked their choices, examine the entire area to see where the markers of each type are located. According to the markers, which spot had the most or least sunlight? Moisture? Heat? Which spot did most animals seem to prefer? What makes you think animals prefer that spot? Did that spot have the most or least of any other factors? Which spot did most plants prefer? Which makes you think plants prefer that spot?~~ |
| **Closure (Summary of Lesson)** | Now that you have gotten to know our little corner of the world by studying the soil, sunlight, wind, temperature, land, animal life, plant life, and its rain history, it is time to focus on soil erosion, including the different types and ways to control it. |
| **CEED Building Application/ Sensor Data** | **All Teams - Combine**<br>Students should look up data on the CEED dashboard (http://dashboard.intellergy.us/ceed/index.php) in order to get background knowledge on how much it rains/snows in our area, as well as when we tend to get the most precipitation (http://dashboard.intellergy.us/ceed/advanced/water.php).<br><br>(Note: Our school is about a mile from the CEED building.) |
| **Assessment** | **Part 1: Collect Data**<br>Students should collect and document data from their team.<br><br>**Part 2: Class Spreadsheet**<br>Students should combine their team's data with all of the others team's data on the class spreadsheet.<br><br>Use the spreadsheet as a basis for discussing differences between the locations and any interactions students observed among the elements. Ask the following questions:<br>• Which parts of the site had the wettest soil? The moist soil? The dry soil?<br>• Which parts of the site had the most sun? The least? In between?<br>• Which parts of the site had varying amounts of wind? Describe the different speeds? What direction was the wind blowing at each of these sites?<br>• Which parts of the site had the highest air temperature? The lowest? Do the plants seem to affect the light intensity, air temperature, and soil temperature at the site? |

- Describe the lay of the land. What is the direction of water flow?
- What plants are found on the site?
- What type of invertebrates and vertebrates were located at this site?
- How does water seem to influence the soil temperature, air temperature, and soil moisture?
- What relationship does light seem to have with air temperature? With soil moisture? With plants?
- How might water flow affect soil moisture and plants?
- Which of the elements we studies seems most important for determining the character of the environment at each site? What makes you say so?

**Part 3: CEED Dashboard**

Each team should look up data on the CEED dashboard in order to get background knowledge on how much it rains/snows in our area, as well as when we tend to get the most precipitation. (Note: Our school is about a mile from the CEED building.)

**Part 4: Lab Report**

Each team should write a lab report from this experiment and their conclusion should explain the data and show an understanding of their results and how they can be applied to the current situations our area of study.

**Part 5: Each Team Presents to the Class**

Each team will work together to form a presentation to the class on their findings.

~~The data sheets, spreadsheets, and team presentations will be graded.~~

~~Examples for me to follow:~~

~~Part 1: Students should collect and document data from their team.~~

~~Part 2: Students should combine their team's data with all of the others team's data. Each team should go to the CEED website to get a history of how much it rains in our area. From this each team prepares a presentation to make to the class.~~

~~*Part I: Students should document – draw, count, provide mathematical calculations to support their hypothesis regarding the number of stoma on the different leaves. Students should then provide a conclusion as to how and why different leaves have different numbers of stoma and how that relates to environmental conditions. An extension conclusion is to recommend what type of plants should be used for "green roofs".*~~

~~*Part II: Students should document and write a conclusion based upon their hypothesis as to what plants may intake more carbon dioxide than others – basing decisions upon environmental factors as an extension. What types of plants should be used in "green roofs" in different areas – residential, urban, climate, etc?*~~

~~Students should write a lab report from this experiment and their conclusion should explain the data and show an understanding of their results and how can be applied to current situations of building and landscaping.~~

~~*Graphs of CEED data should be labeled with proper units and spacing.*~~

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| | ~~*http://dashboard.intellergy.us/ceed/index.php*~~ |
| **Source** | Adapted from: American Forest Foundation. *PLT: Pre K-8 – Environmental Education Activity Guide*. Washington, DC: 2009. Print |

## ~~INQUIRY LEARNING RESEARCH PROCESS GUIDELINES~~

~~The following table is just one guideline to use for developing your own inquiry materials. The seven steps in the Learning Research Process include not only how people learn but also how research is conducted. The heart of the design, the three-stage learning cycle of exploration, concept invention or formation, and application is embedded in the middle. In addition to these three stages, this design takes into account that learners need to be motivated to spend the time required for understanding complex subjects and that learners need to build this new knowledge onto prior knowledge. These are similar to the 5E and 7E learning models.~~

### ~~The Learning-Research Process~~

| ~~Steps in the Learning-Research Process~~ | ~~7E Equivalent~~ | ~~Component of the Activity~~ |
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| ~~1. Identify a need to learn.~~ | ~~Engage~~ | ~~An issue that excites and interests is presented. An answer to the question *Why?* is given. Learning objectives and success criteria are defined.~~ |
| ~~2. Connect to prior understandings.~~ | ~~Elicit~~ | ~~A question or issue is raised, and student explanations or predictions are sought. Prerequisite material and understanding is identified.~~ |
| ~~3. Explore~~ | ~~Explore~~ | ~~A model or task is provided, and resource material is identified. Students explore the model or task in response to critical-thinking questions.~~ |
| ~~4. Concept~~ | ~~Explain~~ | ~~Critical-thinking questions lead to the~~ |

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| **invention, introduction, and formation** | | identification of concepts, and understanding is developed. |
| **5. Practice applying knowledge.** | | Skill exercises involved straightforward application of the knowledge. |
| **6. Apply knowledge in new contexts.** | Elaborate and Extend | Problems and extended problems require synthesis and transference of concepts. |
| **7. Reflect on the process** | Evaluate | Problem solutions and answers to questions are validated and integrated with concepts. Learning and performance are assess |

Hanson, D. (2006). POGIL Instructor's Guide to Process-Oriented Guided-Inquiry Learning. Lisle, IL: Pacific Crest