the CEED

THE CENTER FOR ENERGY EFFICIENT DESIGN

Title: 3) Land Management Practices: Water, Water Everywhere!

Grade Level	6-12	**Subject**	Life Science (Could also apply to Biology, Ecology and Environmental Science)

Objective(s): The student will :

1. Survey the school grounds to identify patterns of water movement across the landscape.
2. Measures designated areas, such as the parking lot and school roof to calculate the amount of runoff produced from these areas.
3. Calculate the surface area and volume using conventional methods and technological methods (ex. Google Maps and CEED Dashboard).

SOL Addressed:
LS.1, 6, 11

LS.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations

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.

LS.11 The student will investigate and understand the relationships between ecosystem dynamics and human activity.

Common Core Standards:
MS-LS2-5 and MS-LS2-2
MS. 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

<table>
<tr><td colspan="2"></td><td colspan="2">include scientific, economic, and social considerations.]</td></tr>
<tr><td>Materials Needed Per Class of 30

and

Prior Knowledge</td><td colspan="3">Materials:
1. Clipboards
2. Pencils/Colored Pencils
3. Map of School Yard/Google Earth Map of School Campus
4. Graph Paper
5. Average Rainfall Data
6. Measuring Tools (meter sticks, yarn, rope, measuring wheel, etc.)
7. Calculators

Prior Knowledge:
The purpose of this activity is to promote students' deeper understanding of the patterns of water movement and erosion on their school campus and its impact on the local watershed. This activity will provide first-hand experience that will encourage students to think critically about issues related to storm water and erosion. Using the information collected from this activity, the students will determine ways to reduce the amount of runoff leaving the school parking lot, thereby improving the local watershed. In addition to prior knowledge related to water runoff and erosion, students will need to be familiar with how to determine surface area and volume.</td></tr>
<tr><td>Ways to differentiate this lesson plan</td><td colspan="3">• EXTENSION for Higher Level Learner
o Reduce guided practice; if students have prior knowledge of surface area/math concepts
o Have students determine the necessary equipment/measuring tools, find Google Earth Maps and determine rainfall data (ex. if it rains at a rate of/per hour, how much rain will have fallen?)
• MODIFICATIONS
o Increase guided practice/ work with surface area and volume
o Provide students with the appropriate measurement tools OR with the measurements of the surface area they are required to find the rainfall data for instead of having them complete this as independent practice
o Provide students with the volume of rainfall for a portion of the area and have the students determine the overall rainfall data
o Alternate between guided and independent practice between each step.
o Intermediate: instead of providing all data, provide students with a step-by-step checklist for how to determine the measurement data</td></tr>
<tr><td>Introduction/ Anticipatory Set</td><td colspan="2">Anticipatory Set: Provide students with a scenario and show a video clip to generate ideas and access their background knowledge related to rainfall and storm water runoff.</td><td>Introduction:
Sample Scenario: The forecast is calling for the local area to receive 2 inches of rain overnight. Predict what is going to happen to the water that falls onto the parking lot.

Questions to ask students:
• Where is the water going to go? (short term and long term).
• How is the water going to get there (route)?
• What happens if the soil is already saturated?</td></tr>
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		• What happens to the water that lands on the ground covered by grass compared to water landing on the impervious surfaces (parking lot/roof)? • How would the slope of the land affect the runoff? • What barriers might the water encounter on its way to the watershed?
Guided Practice	**Guided Practice:** 1. Teacher models how to measure the surface area of a regular shaped object such as a rectangular table/desk. 2. As a small group, students would predict how to calculate the area of the classroom. They would also determine what tools/instruments/units they would be using. 3. Students will brainstorm ways that they would be able to calculate the area of the parking lot and the school roof. **Sample Facilitator Questions for the Activity:** 1. Now that we know how to calculate the area of a small area, how will we apply this knowledge to calculate the area of the school roof/parking lot? 2. Will you use the same tools/techniques? 3. Are there any technology based tools that could make this process easier? 4. Which one would you predict to be more accurate-your physical measurements or your measurements based on technology?	
Independent Practice	**Independent Practice:** 1. Students will be provided with equipment/measuring tools, Google Earth Maps and rainfall data. 2. The students will be challenged to calculate the surface area of their school roof and parking lot using both the map and the tools they were provide with. (Students will determine which tools/method will be the most accurate and they will be directed to find the area.) 3. Once students have calculated surface area they can use the rainfall data to determine the volume of water coming off the parking lot and roof. **Notes/Special Equations:** 1. Expect this process to take a lot of time, trial, and error. 2. Determine the area of your selected site (roof, parking lot, etc.); multiply length by width to obtain the area in square feet. For example, 30 ft. x 50 ft. = 1500 sq. ft. If using a Google Map, use the scale provided. 3. Determine the volume of rain falling on your site; multiply the area by the rainfall depth for a sample storm. In this example, 2 inches of rain fell during the storm.	

Closure (Summary of Lesson)	1. Have students compare their data/accuracy. 2. Have students determine sources of experimental error. 3. Discuss strategies that were effective/not effective.
CEED Building Application/ Sensor Data	Reduce the amount of erosion and soil erosion. Compare the amount of rainfall collected using a small roof (at the CEED building) to the large roof and parking lot at the middle school.
Assessment	1. Final calculations of surface area/volume. 2. Determine ways to reduce soil erosion from the storm water. 3. Compare CEED data with data collected at our school. 4. Write a story from the viewpoint of a drop of water which lands on the school parking lot. The story should include the path the water droplet takes and any obstacles it runs into.

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
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 invention, introduction, and formation	Explain	Critical-thinking questions lead to the 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