the CEED

THE CENTER FOR ENERGY EFFICIENT DESIGN

Where Does the Water Go?

Grade Level	Upper Elem, Middle, High School	**Subject**	Science, Math

Objective(s):

- Students will describe relationships among precipitation, runoff, and water conservation –
- Students will correlate these relationships with living organisms in and out of aquatic habitats.
- Students will measure and solve US standard and/or metric equations concerning area and volume.

SOL Addressed:

BIO.8 The student will investigate and understand dynamic equilibria within populations, communities, and ecosystems. Key concepts include
a) interactions within and among populations including carrying capacities, limiting factors, and growth curves;
b) nutrient cycling with energy flow through ecosystems;
d) the effects of natural events and human activities on ecosystems
BIO.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which
c) variables are defined and investigations are designed to test hypotheses;
d) graphing and arithmetic calculations are used as tools in data analysis;

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
a) the carbon, water, and nitrogen cycles;

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

4.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which c) appropriate instruments are selected and used to measure length, mass, volume, and temperature in metric units;
4.9 The student will investigate and understand important Virginia natural resources. Key concepts include
a) watersheds and water resources;

Math:
4.4 The student will
a) estimate sums, differences, products, and quotients of whole numbers;
b) add, subtract, and multiply whole numbers;

4.7 The student will
a) estimate and measure length, and describe the result in both metric and U.S. Customary
units; and
b) identify equivalent measurements between units within the U.S.

	Customary system (inches and feet; feet and yards; inches and yards; yards and miles) and between units within the metric system (millimeters and centimeters; centimeters and meters; and millimeters and meters). 4.8 The student will a) estimate and measure liquid volume and describe the results in U.S. Customary units; and b) identify equivalent measurements between units within the U.S. Customary system (cups, pints, quarts, and gallons). 5.7 The student will evaluate whole number numerical expressions, using the order of operations limited to parentheses, addition, subtraction, multiplication, and division. 5.8 The student will a) find perimeter, area, and volume in standard units of measure; b) differentiate among perimeter, area, and volume and identify whether the application of the concept of perimeter, area, or volume is appropriate for a given situation; c) identify equivalent measurements within the metric system; d) estimate and then measure to solve problems, using U.S. Customary and metric units;
	Next Generation Science Standards: MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem

<table>
<tr><td>Materials Needed Per Class of 30

and

Prior Knowledge</td><td colspan="2">Anticipatory – 20 minutes; Guided Practice – 30 minutes

Investigation: (2) 45 to 60 minute sessions

Writing materials
Rain gauge or access to Weather Station
Local Rainfall data
Meter sticks for students in groups – yard sticks will work but students will need to convert!
Optional – calculators

Calculation of area (Area = Length x Width), volume
Knowledge of water cycle

Key words: runoff, precipitation, volume, area, weight (mass), point vs nonpoint source</td></tr>
<tr><td>Ways to differentiate this lesson plan</td><td colspan="2">• EXTENSION :
• Tie into how much water is absorbed by different surfaces, soils.
• What plants serve as good ground covers and/or water retention organisms?</td></tr>
<tr><td>Introduction/ Anticipatory Set</td><td>Anticipatory Set: Have students brainstorm on the many different uses for water.
#2 – Categorize those uses dependent upon different water quality standards. E.g. – domestic and industrial use; recreation for total body contact (swimming); recreation for partial body contact (fishing); aquatic organisms; agriculture; commercial (hydroelectric power), others.</td><td>Introduction:
• Review water cycle –
• Watershed models – local Soil & Water Conservation groups often have an education staff and watershed models to share</td></tr>
<tr><td>Guided Practice</td><td colspan="2">Ask students to brainstorm examples of data sets – where/what are ways we can collect data about water? Ex. Monthly precipitation levels for a year, water bills, etc.
-Using the example of monthly precipitation levels throughout the year, have students brainstorm different groups that are affected by the amount of monthly precipitation that falls. (Construction workers, aquaculturalists, farmers, skiers) – How does this amount of precipitation affect these groups independently?

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How does the runoff of the watershed affect these activities? What is included in the runoff? How much water can be measured from a certain watershed?</td></tr>
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Independent Practice	Students may investigate different areas of the schoolyard, a park, different elevations …. Guided Independent Practice: 1. Determine the total area of the study site. (There is no need to subtract any dwellings on the site). Use metrics if at all possible! 2. Using a tape measure or string – students mark every meter (3 feet) – How are you going to do that? (marker, knot) – measuring the length of the chosen site and the width. - Frustration may occur if the site is abnormally shaped! – Students may need to use some simple geometry to measure triangles, smaller rectangles, etc. 3. Once the area of the site has been established, determine the amount of rain that falls in the area. (Independent practice – students may calculate the amount of rain that falls in a given storm or annually using information from resource agencies (weather bureau, soil conservation service, local newspapers – the CEED complex!), use of a rain gauge in the chosen area. This calculation provides students with the value for the depth of rainfall on the surface of the land. 4. Calculate the volume of rainfall. Volume = area of site x annual rainfall. 5. Knowing the volume , the students can now calculate the weight of the rain. Water weighs 62.5 pounds per cubic foot (1,000 kilograms per cubic meter). So the volume x weight. 6. All the measurements and calculations are intended to impress upon students that there are remarkable volumes and weights of water moving through the water cycle.
Closure (Summary of Lesson)	What are some human activity impacts that affect the quality and quantity of water that eventually may reach aquatic habitats? What conservation measures can you and your family put into place to assist with conserving the amounts of water that run off and/or are carrying inappropriate chemicals, items into the water tables?
CEED Building Application/ Sensor Data	Study the mechanisms and benefits of incorporating gray water management/storages systems as used and displayed at the CEED building.
Assessment	Have students present their findings and compare data that might illustrate different elevations of study sites, different soil types, variances in resource data for rainfall collection. Have students present possible solutions in a presentation answering the following questions: 1. Describe at least two relationships among aquatic habitats, precipitation, runoff, and surface water. 2. Identify two human activities that have: (a) affected the quality of runoff, (b) affected the quantity of runoff.

	3. Identify two ways that runoff can affect humans. 4. Identify two ways that runoff can affect aquatic wildlife. 5. Develop a list of steps/extensions to this activity to assist others in protecting the quantity and quality of runoff water.

Background: To understand the water cycle, students must develop an understanding of precipitation and runoff. Rainfall is one form of precipitation and one form in which water enters aquatic habitats. Once rain falls upon a surface, water begins to move both laterally outward and vertically downward. Lateral movement is runoff and finds its way into streams, rivers, and lakes. Vertical movement seeps into the soil and porous rock and recharges ground water supplies.

Runoff waters are necessary to renew the many aquatic habitats that depend on the inflow of water for continuity. Inflow supports aquatic life by preventing lakes from shrinking because of evaporation and by preventing streams from going below minimum flow levels.

Runoff is the dominant way that water flows from one location to another. It is in runoff that many pollutants find their way into moving waters. These types of pollutants are known as "non-point" sources. Garden insecticides, automobile oils and transmission fluids, paints, exhaust and such are washed by runoff into stream, rivers, lakes, and ocean. Eventually, this water could become part of an aquatic habitat – or it could be recycled!!!

Runoff is also responsible for erosion, transportation and the deposition of sediments scoured from the land's surface. Substandard land practices along with development often leave bare ground ready for the topsoil to be washed away.