

Calculating Water Runoff

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Grade Level High School
Duration 2 class periods

Adapted from lesson created by Bonnie Keller, Earth Science teacher
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National Standards

GEOGRAPHY

Element 3: Environment and Society

- 14. How human actions modify the physical environment
- 15. How physical systems affect human systems
- 16. The changes that occur in the meaning, use, distribution, and importance of resources

Element 6: The Uses of Geography

- 18. How to apply geography to interpret the present and plan for the future

NEXT GENERATION OF SCIENCE STANDARDS

HS-ESS2-b. Construct an evidence-based argument about how a natural or human-caused change to one part of an Earth system can create feedback that causes changes in that system or other systems.

AZ Standards

ELA

Writing

Production and Distribution of Writing

9.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

MATHEMATICS

Number and Quantity

A1.N-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays, include utilizing real-world context.

SCIENCE

Plus HS+E.E1U1.5 Obtain, evaluate and communicate on the effect of water on Earth's materials, surface processes, and groundwater systems.

Plus HS+E.E1U3.9 Construct an explanation, based on evidence, for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

Arizona Social Science Standards

GEOGRAPHY

The use of geographic representations and tools help individuals understand their world.

HS.G1.1 Use geographic data to explain and analyze relationships between locations of place and regions.

Human-environment interactions are essential aspects of human life in all societies.

HS.G2.1 Analyze interactions within and between human and physical systems.

HS.G2.3 Evaluate the impact of human settlement on the environment and culture of specific places and regions.

SLOP Elements

Preparation	Scaffolding	Grouping Option
Adapting content Linking to background Linking to past learning Strategies used	Modeling Guided practice Independent practice Comprehensible input	Whole class Small groups Partners Independent
Integrating Processes	Application	Assessment
Reading Writing Speaking Listening	Hands on Meaningful Linked to objectives Promotes engagement	Individual Group Written Oral

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Arizona English Language Proficiency Standards

Grade 9-12

Basic

Speaking and Writing

Standard 3 By the end of each language proficiency level, an English learner can speak and write about grade appropriate complex literary and informational texts and topics.

B-1: deliver short oral presentations that include some details to develop a topic.

B-4: integrate graphics or multimedia when useful.

B-5: use examples of precise language and domain-specific vocabulary within informative texts.

Listening, Speaking, Reading, and Writing

Standard 7 By the end of each language proficiency level, an English learner can conduct research and evaluate and communicate findings to answer questions or solve problems.

B-1: gather information from multiple provided resources to answer questions.

B-2: summarize the main idea using evidence from text or presentations.

B-3: paraphrase observations, information notes with labeled illustrations, diagrams, or other graphics, as appropriate.

Overview

In order for groundwater to be replenished, precipitation must be absorbed by the ground. People, worldwide, realize there is a need for stable and adequate water supplies. Yet, in many countries, including the US, people are creating more urban areas. The development of our rural land into cities is one cause for a lack of a stable and adequate fresh water supply in the future.

Purpose

In this lesson (completed in conjunction with a water unit), students will be guided through a process to show how much absorbable groundwater is lost through runoff created by urbanization. This lesson includes adaptations for diverse learners (ELLs).

Key Vocabulary

infiltrate: soak into

groundwater: water located beneath the earth's surface

convert: to change to something else

conversion: changing measurements using a set formula (1 foot equals 12 inches or 1 foot equals .3048 meters)

absorption: to soak up

Materials

- Student Handout--Calculating Runoff and Answer Key
- Homework—My House and Answer Key
- Assessment Essay Questions
- Vocabulary Cards

- Vocabulary Test and Answer Key
- Calculator
- Ticket Out the Door
- Calculating Runoff PowerPoint
- Drawing paper
- Document camera (optional)
- Computer and projection device

Objectives

The student will be able to:

1. Calculate the volume of yearly runoff created by a parking lot and calculate the loss of water that would have entered the groundwater system.
2. Evaluate the impact of and propose solutions to the issue of urban water runoff.

Procedures

Prior to the Lesson: You will need to gather data such as this below for the location of your school.

Here is the website for Arizona data on rainfall.

<http://www.currentresults.com/Weather/Arizona/yearly-average-precipitation.php>

If you cannot find local data on absorption rates and average size of shopping areas, it is possible to use the same information as Williams, AZ.

Data for Williams, Arizona:

Williams, AZ has an annual average rainfall of about 22.3 inches.

The average ground absorption rate is 50%.

The average shopping mall and surrounding parking areas is 25 acres.

1 acre = 43,560 feet (208 feet x 208 feet)

Prerequisite Knowledge: Students know the water cycle.

SESSION ONE



Calculating Water Runoff

Engage:

1. Show the YouTube video on Storm Water Runoff (5 min)

<https://www.youtube.com/watch?v=kyH02NjyfPA&index=1&list=PLEwpKwhjVdDVYN61LXAPAIvzshviRfgTu> (**Application: Promotes engagement**)

2. Show slides 1 to 6 as an introduction to the lesson. (**Preparation: Linking to background, Linking to past learning; Application: Promotes engagement, Meaningful**)

3. Distribute Vocabulary Cards and have partners quiz each other on the definitions for several minutes. (**Grouping Option: Partners; Application: Promotes engagement, Meaningful**)

Explore:

1. Review how to calculate volume by showing slides 7-15.
2. Practice several examples as a class. Use the Williams data for one of your practices. (**Scaffolding: Guided practice; Grouping Option: Whole class**)
3. Show slide 16. Have students pair up and share for 1 minute what surprised them the most about water runoff. (**Integrated Processes: Listening, Speaking**)

Explain:

1. Post the data for your local area (information to do the conversions). Have students complete the My Local Area Runoff section of the Student Handout and the Conclusion Questions. (**Grouping Option: Independent or Partners; Integrated processes: Writing**) If time, discuss the Conclusion Questions as a class. (**Grouping Option: Whole class**)

Elaborate:

1. Show Slide 17 and assign the Homework—My House section of the worksheet. Explain how to measure their home and its yard. (**Scaffolding: Comprehensible input**)
2. Show Slide 18 and have students complete the Ticket Out the Door. (**Assessment: Individual**)

SESSION TWO

Evaluate:

1. Have several students share their home runoff statistics with the class. (**Integrated Processes: Listening, Speaking**)
2. Partner up the students. Give each partner group a sheet of copy paper. Ask them to design a machine, a way of landscaping a housing site, a way of building houses, a gadget, etc., that would decrease the amount of runoff from residential or commercial sites. Give them 20 minutes to

- generate their drawing of how this invention would work. (**Grouping Option: Partners; Application: Hands on, Linked to objectives**)
3. Have students share their innovations with the class using a document camera (if possible). (**Integrated Processes: Listening, Speaking**)

Assessment

Social Studies, Science, and Writing

The Assessment Essay Questions and Ticket Out the Door can be graded for Ideas and Content. A score of 4 or higher on the 6 Traits Writing Rubric will be considered mastery.

The Conclusion Questions can be graded for accuracy. A score of 80% or higher would be considered mastery.

The Vocabulary Test can be given. A score of 80% or higher would be considered mastery.

Mathematics

The Student Handout—Calculating Runoff and Homework—My House can be graded for mathematic accuracy. A score of 80% or higher would be considered mastery.

Extensions

Visit a local water utility company or invite a guest speaker from the utility company to learn how they gather runoff and determine the level of groundwater in your area.

Watch Arizona Project Wet video

<https://www.youtube.com/watch?v=I9TK6N1IPac> to learn how the groundwater system works (10 min).

Sources

Watch Arizona Project Wet video (10 min)

<https://www.youtube.com/watch?v=I9TK6N1IPac>

Storm Water Runoff (5 min)

<https://www.youtube.com/watch?v=kyH02NjyfPA&index=1&list=PLEwpKwhjVdDVYN61LXAPAIvzshviRfgTu>

Arizona data on rainfall

<http://www.currentresults.com/Weather/Arizona/yearly-average-precipitation.php>