WHERE'S OUR WATER?

Water Conservation — *in the Southwest*

DESCRIPTION

Students analyze graphs to construct an argument about water shortages in the Southwest. They see methods used to conserve water for thousands of years, then design, build, and test their own water conservation system.

PHENOMENON

How can we address water shortages in the Southwest?

GRADE LEVEL

6 – 8

OBJECTIVES

Students will:

- Analyze graphs of drought severity, per-person water use, and population.
- Make an argument about the future of water in the Southwest using evidence.
- Design, build, and test a water conservation system.

TIME

45 MINUTES

COMMON CORE STATE STANDARDS

English Language Arts

ELA-LITERACY.RST.6-8.3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

ELA-LITERACY.RST.6-8.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context

ELA-LITERACY.RST.6-8.7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

ELA-LITERACY.WHST.6-8.1.B. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.

Math

MATH.CONTENT.6.SP.B.4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots.

MATH.CONTENT.6.SP.B.5: Summarize numerical data sets in relation to their context.

NEXT GENERATION SCIENCE STANDARDS

Performance Expectations

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Engaging in Argument from Evidence Constructing Explanations and Designing Solutions Analyzing and Interpreting Data	ESS3.C Human Impacts on Earth Systems	Patterns Cause and Effect

BACKGROUND

Climate change is increasing global temperatures and changing precipitation patterns, and the American Southwest is particularly impacted by this (Gonzalez et al., 2018). Scientists expect higher temperatures, increased evaporation, and seasonal changes in precipitation will lead to more frequent and prolonged periods of drought. As water becomes even more scarce, it becomes increasingly important, and demand for it increases. Both humans and the natural environment tend to use more water during hotter periods, mainly through increased electricity use and increased evapotranspiration.

Drought and water scarcity are not new challenges in the southwestern United States. People have found many solutions to live in arid environments. One example of this is waffle gardens, which the Zuni people in Arizona and New Mexico use to direct water towards crops. Rooftop rainwater harvesting is another method used to collect water that has been used in different forms over thousands of years. Acoma Pueblo in New Mexico has stone cisterns that collect water from the roofs of buildings. Modern systems include gutters and piping that direct water into a tank. Capturing and using rainwater for planting, cleaning, and construction decreases the demand for water from other sources. It also reduces runoff, which can carry pollutants to surface water like lakes and rivers.

Note: This lesson is described as an in-class lesson but can also be done remotely or as homework. Educators can use Edpuzzle to insert questions that make videos interactive, and students can complete the assignment as a fillable PDF (provided), Google Doc, or Word Document. Specific suggestions for implementing a remote assignment can be found at the end of the educator guide.

MATERIALS

- Computer and projector
- *Where's Our Water Video Part 1* YouTube Link (video transcript available here.)
- *Where's Our Water Video Part 2* YouTube Link (video transcript available here.)
- *Where's Our Water?* handout [1 per student]
- A large assortment of craft and recycled household supplies to be used for projects such as:
  - Cups, cans, bowls, plastic or paper containers, etc.
  - Straws, popsicle sticks, etc.
  - Cardboard or paperboard
  - Tape or glue
- Access to a patch of bare soil outdoors
- Small shovels

PREPARATION

1. Set up a computer and projector to display the YouTube videos.
2. Prepare the craft and recycled household supplies for student use. If you have space, it's helpful to lay the supplies out on a surface so students can quickly assess available supplies and develop project ideas.
3. Before this lesson, students should understand the concept of drought and climate change. Visit www.asombro.org/climate for lessons that introduce climate change.

PROCEDURES

Part 1: Water Shortages in the Southwest

1. Pass out a Where's Our Water? handout to each student.
2. Show the *Where's Our Water Part 1 video* to introduce the concept of water scarcity in the Southwest. Students will analyze images and graphs about drought levels, population changes, and per-person water use.
3. Pause the videos at the indicated times and discuss the following questions as a class:
   a. (0:55) The water level at Lake Mead has decreased over the past 20 years. What do you think caused this change?
   b. (2:44) Has the Southwest gotten wetter, drier, or stayed the same?
   c. (3:28) What's happened to the population of the Southwest since 1985?
4. After watching the video, direct students to answer questions 1 – 3 on page 1 of their handout. They should use the graphs on page 2 of the handout to answer the questions.
   a. In question 1, students make a claim or statement about whether or not the Southwest will have enough water in the future. Student responses will vary.
   b. In question 2, students should provide evidence for the claim they made in question 1. They should include evidence from at least one of the graphs on page 2.
   c. Question 3 asks students to explain their reasoning, or how the evidence they listed in

question 2 supports their claim. They should use this space to elaborate on the factors they think will affect future water supply.

5. If time allows, have students share their arguments with the class.

Part 2: Water Conservation in the Past and Present

1. Tell students that they will be designing a water conservation system to address water shortages in the Southwest. First, they will watch a video to explore two examples. Before showing the video, ask students what they already do to conserve water at home or school.
2. Show *Where's Our Water Part 2 video*, which introduces two methods of water conservation used for thousands of years in the Southwest. Land contouring is any method of shaping the land to direct water to plants; examples include berms around trees, terrace farming, and Zuni waffle gardens. Rooftop rainwater harvesting systems collect water in cisterns to be used later, shown by examples from Acoma Pueblo, New Mexico and the Chihuahuan Desert Nature Park.

Part 3: Design a Water Conservation System

1. Tell students that it is their turn to design, build, and test their own water conservation system. Using what they learned in the video about land contouring and rooftop rainwater harvesting systems, they'll design something to collect water and combat water shortages in the Southwest. Students can work alone, in pairs, or in small groups.
2. Have students choose which option they would like to build (land contouring system on page 4 or rooftop rainwater harvesting system on page 5).
   Note: you may choose to give students only one option based on your supplies and outdoor space available. You will probably want to test student designs outside to avoid spilling water inside.
   a. Students who chose a land contouring system investigate how land contouring can help farmers conserve water by maximizing availability to crops. This experiment must be done outside. They will use a patch of bare soil to design and build land contours (waffle gardens or another shape of berm). Land contours can be any height but should be at least one inch tall to collect water. An example project (Figure 1) shows a waffle garden about one square foot with berms roughly two inches tall. After building their land contours, students will hypothesize if their design will help direct water to their crops. They'll slowly pour a cup of water over their land contours to model rain and pour an equal amount of water on a patch of bare soil nearby as a control. After five minutes, students will compare the results at both locations, explain where the "rainwater" collected in their garden, and then describe their design. Finally, students will evaluate their design and describe one way they would improve their water conservation system.
   b. Students who chose a rooftop rainwater harvesting system are investigating how rainwater harvesting can collect water. First, they'll gather supplies to build a house (plastic container, cardboard box, etc.), rainwater harvesting system (straws, rulers, bowls, cups, cans, etc.), and cistern to collect water (cups, cans, other containers, etc.). Then they will design and build their rainwater harvesting

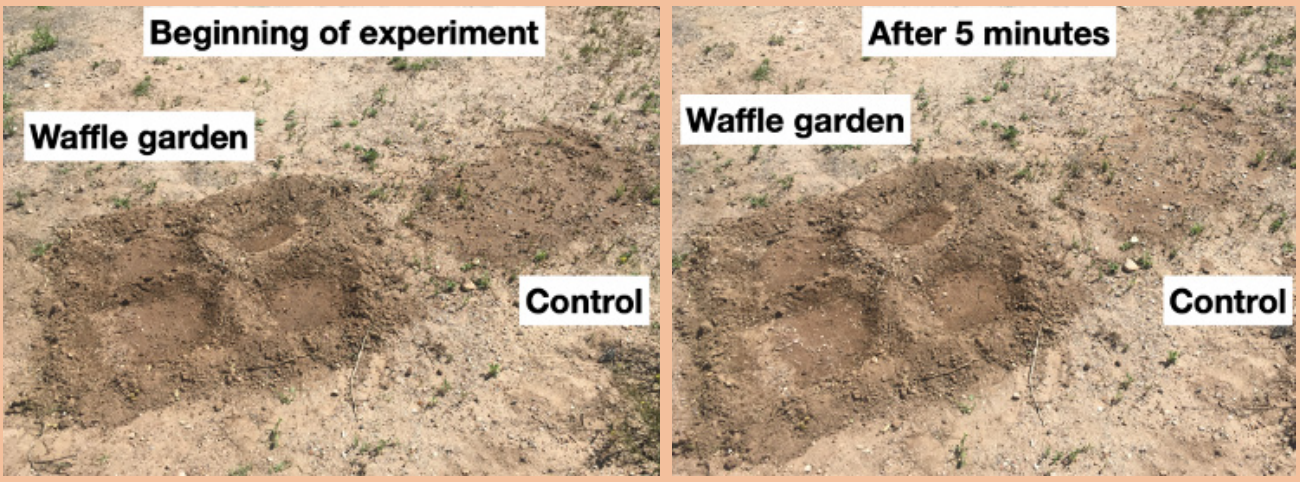

Figure 1. Land contouring example waffle garden

Figure 2. Rooftop rainwater harvesting system example

system and make a hypothesis about whether or not it will collect water. An example project (Figure 2) shows a possible design. Students will test their design by pouring a cup of water over it to model rain and seeing how much water was collected in the cistern. If supplies allow, students can measure how much water they poured and how much water was collected using a graduated cylinder or measuring cup. Then they will describe or sketch their design and evaluate it by describing one way they could improve their system.

MODIFICATIONS FOR REMOTE LEARNING OR HOMEWORK ASSIGNMENT

1. This lesson can be implemented in a remote learning setting or as a homework assignment. See below for suggestions and tools for making these modifications.
2. The Where's Our Water? student handout can be printed and sent home with students or you can use the Online Handout, which includes the video links. Students can type directly in the worksheet and submit it online.
3. *Part 1: Water Shortages in the Southwest*
   a. Instead of watching the Where's Our Water Part 1 video on YouTube, give students an Edpuzzle video assignment that requires them to answer questions throughout the video. Questions can be open-ended or multiple-choice and integrated with a learning management platform such as Canvas.
   b. The linked Edpuzzle video includes the following questions, and you are welcome to add or delete questions as needed.
      i. (0:55) The water level at Lake Mead has decreased over the past 20 years. What do you think caused this change? [open-ended]
      ii. (2:44) Has the Southwest gotten wetter, **drier**, or stayed the same? [multiple choice; wetter, drier, stayed the same]
      iii. (3:29) What's happened to the population of states in the Southwest since 1985? [multiple choice; **increased**, decreased, stayed the same]
   c. After students have watched the video and answered the corresponding questions, they can answer questions 1 – 3 on the student handout
4. *Part 2: Water Conservation in the Past and Present*
   a. No modifications are needed. If desired, educators can also use Edpuzzle to create interactive video questions.
5. *Part 3: Design a Water Conservation System*
   a. Students can complete either investigation using household materials or a patch of dirt near their home.

EXTENSIONS

1. Every week, the U.S. Drought Monitor posts a map quantifying the amount of drought in each state. Have students go to https://droughtmonitor.unl.edu/Maps/ComparisonSlider.aspx. Under "Area Type," select "USDA Climate Hubs." Under "Area," select "Southwest" to view data from Arizona, California, New Mexico, Nevada, and Utah. For the left side of the slider, select a week from the past. The right side is automatically set to the current week (i.e., left: March 20, 2001, right: March 23, 2021). Use the slider to compare between weeks and discuss potential causes and impacts of any differences they might see.
2. After learning about two water conservation methods, have students brainstorm other strategies they may have heard of (greywater recycling, xeriscaping, water-efficient appliances, etc.). Ask students what they can personally do to help conserve water in their community.

PAIR THIS LESSON WITH OTHER WATER CONSERVATION LESSONS FROM ASOMBRO:

From Water Conservation Data Jam:

- How Much Water Do You Use?
- Water Allocation

From Climate Change and the Water Cycle:

- Evaporation Investigation

ADDITIONAL RESOURCES

Gonzalez, P., G.M. Garfin, D.D. Breshears, K.M. Brooks, H.E. Brown, E.H. Elias, A. Gunasekara, N. Huntly, J.K. Maldonado, N.J. Mantua, H.G. Margolis, S. McAfee, B.R. Middleton, and B.H. Udall, 2018: Southwest. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 1101–1184. doi: 10.7930/NCA4.2018.CH25 <https://nca2018.globalchange.gov/chapter/25/>