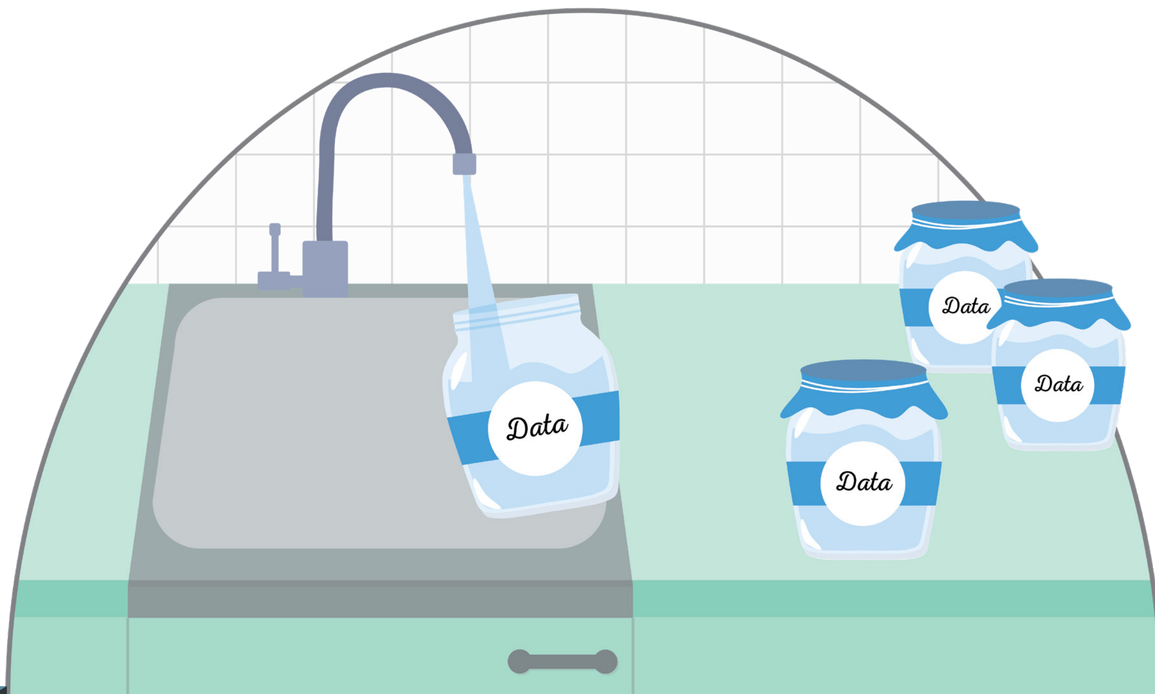
Water Conservation

DATA JAM



Curriculum Unit for 6 - 12 Grade Students

WATER CONSERVATION DATA JAM

Curriculum Unit for 6-12 Grade Students

How to cite this guide:
USDA Southwest Climate Hub. Water Conservation Data Jam: Curriculum Unit for 6-12 Grade Students. Aug. 2023. Web. Date of access. <https://swclimatehub.info/wp-content/uploads/WaterConservationDataJam_FullBook.pdf>

For more information, contact:
Asombro Institute for Science Education
PO Box 891
Las Cruces, NM 88004
www.asombro.org
information@asombro.org

This unit was developed for USDA Southwest Climate Hub by the Asombro Institute for Science Education in collaboration with the USDA-ARS Jornada Experimental Range.

ACKNOWLEDGMENTS

CURRICULUM DEVELOPMENT
Asombro Institute for Science Education
www.asombro.org

We extend heartfelt thanks to Brandon Bestelmeyer and Emile Elias of the USDA-ARS Jornada Experimental Range and Southwest Climate Hub for making this curriculum guide possible.

CONTRIBUTORS
Many thanks to the following educators for pilot testing and reviewing:

Amy Lopeman
Yvette Garza Stevens

We are extremely grateful to these scientists for reviewing science content of one or more activities:

Madeline Buhman, Arizona State University, Tempe, AZ
Parikrama Sapkota, University of Texas, El Paso, TX

DESIGN AND LAYOUT
Abigail Miller

WATER CONSERVATION DATA JAM

Curriculum Unit for 6-12 Grade Students

Welcome! This unit was designed to introduce 6-12 grade students to climate change and water use in the Southwest. The activities in this guide are appropriate for both formal and informal education settings, and they can be modified to fit the needs of students. All activities are aligned to Common Core State Standards and Next Generation Science Standards.

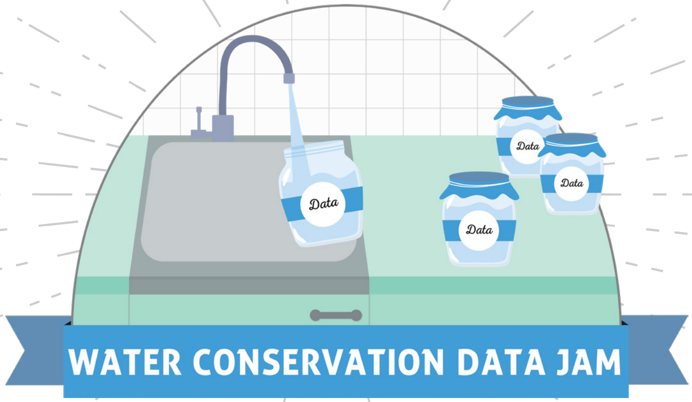
The project aims to increase 6th-12th-grade students' environmental literacy and ability to communicate science and turn knowledge into action that benefits the environment. The unit is centered on the following phenomenon: **data provide evidence for the importance of water conservation in the Southwest, and we can share that information creatively and provide possible solutions.**

Students analyze local water use data and communicate a trend in the data to nonscientists through creative projects such as poems, physical models, and games. They then propose an action based on the data trend they identified to encourage water conservation in the community. Students' Water Conservation Data Jam projects will highlight the need for water conservation and actions that they and others can take to become stewards of our water resources.

The Water Conservation Data Jam is organized as a 5-class period unit, with each activity building on the last. The unit need not be completed in its entirety, however. While the pieces are written to be taught sequentially, teachers may choose to stop the unit at any point. The educator guide assumes 45-minute periods.

The materials required for the activities are minimal and can generally be purchased at a household goods store. Some are items that many educators often have available. The materials section lists the items required to complete the activities, with provided resources, such as handouts and PowerPoint files, listed first. When viewing this guide electronically with an internet connection, the links within the materials section will navigate to each of the listed resources.

We hope that you and your students enjoy this unit! Please contact information@asombro.org with questions and feedback.



DESCRIPTION

Students analyze charts and data to construct an argument about climate change and water in the southwestern United States, develop a creative project to communicate data trends to nonscientists, and create an action project.

PHENOMENON

Data provide evidence for the importance of water conservation in the Southwest, and we can share that information creatively and provide possible solutions.

GRADE LEVEL 6-12

OBJECTIVES

Students will:

- Construct an argument about the future of water resources in the Southwest
- Analyze long-term, local water use data to identify a data trend
- Develop a creative project to portray a data trend and communicate scientific data to nonscientist audiences
- Develop and implement an action project to address water use issues

TIME

5 HOURS TOTAL OVER 5 DAYS

COMMON CORE STATE STANDARDS

English Language Arts

6.RI.7 Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.
6-8.L.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
6-8.L3 Use knowledge of language and its conventions when writing, speaking, reading, or listening.
9-12.L.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
6-8.WHST.1 Write arguments to support claims with clear reasons and relevant evidence.
6-8.WHST.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to the task, purpose, and audience
9-12.WHST.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to the task, purpose, and audience.

Mathematics

6.RP.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
6.RP.3 Use ratio and rate reasoning to solve real-world and mathematical problems.
6.SP.5 Summarize numerical data sets in relation to their context.
8.SP.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities.
9-12.S.ID.6 Represent data on two quantitative variables on a scatter plot and describe how the variables are related.

NEXT GENERATION SCIENCE STANDARDS

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems (MS, HS) Developing and Using Models (MS, HS) Analyzing and Interpreting Data (MS, HS) Constructing Explanations and Designing Solutions (MS, HS) Engaging in Argument from Evidence (MS, HS)	ESS3.A Natural Resources (MS, HS) ESS3.C Human Impacts on Earth Systems (MS, HS) ETS1.A Defining and Delimiting Engineering Problems (HS)	Patterns (MS, HS) Stability and Change (MS, HS)

AGRICULTURE, FOOD, AND NATURAL RESOURCES (AFNR) CAREER CLUSTER CONTENT STANDARD

CS.04.02 Assess and explain the natural resource-related trends, technologies, and policies that impact AFNR systems.

STRUCTURE

Day 1: Introduction to water resources in the Southwest
Days 2, 3, 4: Water Conservation Data Jam
Day 5 and Beyond: Action project

BACKGROUND

Water is an essential resource, and its scarcity is often apparent in arid southwestern states. The National Integrated Drought Information System uses data to create weekly maps showing the percentage of states and regions experiencing various degrees of water scarcity, ranging from "abnormally dry" to "exceptional drought." Since 2000, vast areas of the Southwest have routinely been abnormally dry, meaning that the soil moisture across the region is low and the danger of possible wildfires is serious (NIDIS 2021).

Climate change is expected to exacerbate water scarcity through higher temperatures, changes in precipitation patterns, and increased evaporation. As temperatures rise, less winter snowpack will accumulate in mountains because early and late precipitation will be more likely to fall as rain rather than snow, and snowpack will start melting earlier. Less snowpack in the spring will mean less water in rivers in the summer when it is most needed for agriculture and domestic use.

At the same time that the Southwest faces prolonged and persistent water scarcity, the human population is steadily increasing by approximately 23% annually in the western United States (US Census 2023). Population increases without massive water conservation efforts increase water demand. Thus, water demand is growing at the same time that water is becoming more scarce.

Water scarcity affects many sectors. Some of the most notable effects are on ecosystems and agriculture. Drought can cause changes in plant communities, which has cascading effects in ecosystems. When drought leads to a lack of surface water for livestock and crops, farmers must drill even further to reach underground water sources to supplement their production, increasing costs. Between 1980 and 2020, 26 droughts cost the United States an estimated $249 billion. Hurricanes were the only costlier weather and climate-related events (Smith, 2020).

Water scarcity is a top concern for local and regional governments. Because local water needs, uses, and resources vary drastically, local and regional water conservation efforts can have large impacts. Many jurisdictions choose to combat drought risk through public education campaigns to raise awareness of drought conditions and provide recommendations for conserving water. The Water Conservation Data Jam aligns perfectly with this strategy. Empowering students to learn about water issues, interpret and communicate water use data, and propose water conservation actions will help our leaders of tomorrow ensure a livable future in the southwestern United States.

MATERIALS

- Water Conservation Data Jam handout- fill out the data table on page 3 before making copies for students.
- Water Use Scenario Cards [1 set per 3-5 students]
- Meter sticks
- Calculators
- PowerPoint presentation
- Computer and projector/screen
- A variety of craft supplies for creative projects
- Optional: How Much Water Do You Use? handout

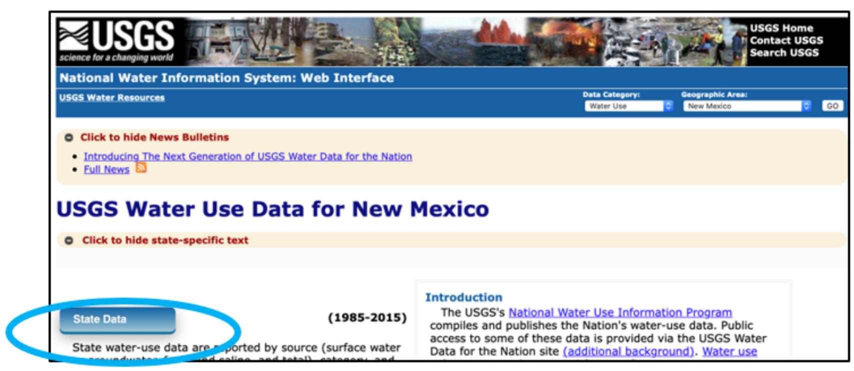
PREPARATION

1. Optional Introduction activity: How Much Water Do You Use? Educator Guide and Handout.
2. Prepare the water use dataset using the instructions below. Download the PDF of the Water Conservation Data Jam handout and fill in the table on page 3.
3. Note: We suggest providing students with data on Domestic and Irrigation water use. However, teachers may want to include data relevant to their area and community (ex: livestock or mining).
4. Print and cut out Water Use Scenario Cards.
5. Gather materials for creative projects on days 2-4.

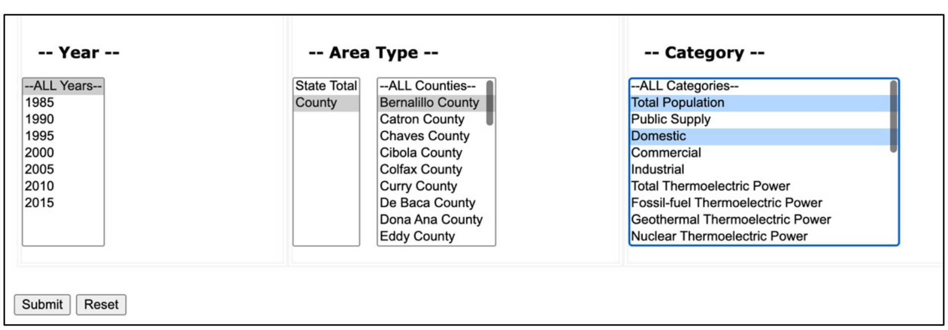
GATHERING WATER DATA

1. Go to the *USGS Water Use Data for the Nation* webpage: https://waterdata.usgs.gov/nwis/wu
2. Select a state from the **Geographic Area** drop-down menu in the upper right.

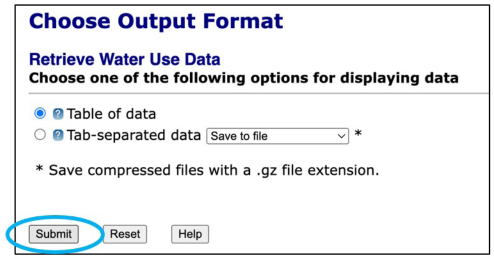
3. Click the **State Data** button to enter the data portal.



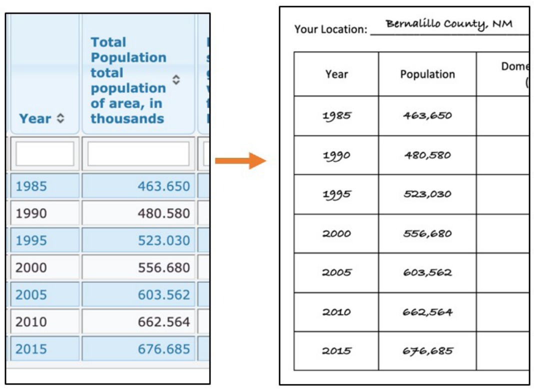
4. Select Year (ALL Years), Area Type (State Total or choose a County), and Categories (**Total Population, Domestic,** and **Irrigation, Total**), then click Submit. Use Command+Click (Mac) or Ctrl+Click (Windows) to select multiple categories.



5. You can view the **data table** online or download the data as a **tab-separated data file**, then click **Submit**.



6. On page 3 of the student handout, record Years in column 1 of the data table. Record the total population in column 2. Note that the population is given in thousands, so you need to convert these data by replacing the decimal point with a comma.

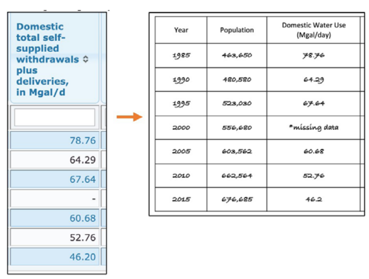


Year	Total Population total population of area, in thousands
1985	463.650
1990	480.580
1995	523.030
2000	556.680
2005	603.562
2010	662.564
2015	676.685

Your Location: Bernalillo County, NM

Year	Population
1985	463,650
1990	480,580
1995	523,030
2000	556,680
2005	603,562
2010	662,564
2015	676,685

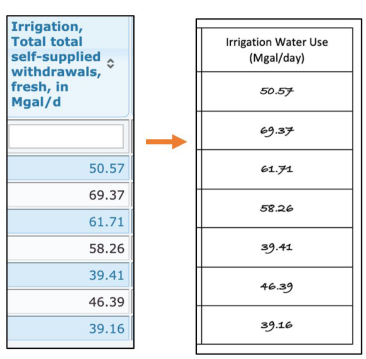
7. In column 3 of the data table, record domestic water use data. This is listed as "Domestic total self-supplied withdrawals plus deliveries in Mgal/day." This includes self-supplied water (water sourced by an individual user from groundwater [such as via a private well] or surface water instead of from the public water supply) and deliveries from public supply. **1 Mgal/day = 1 million gallons per day**



Domestic total self-supplied withdrawals plus deliveries, in Mgal/d
78.76
64.29
67.64
-
60.68
52.76
46.20

Year	Population	Domestic Water Use (Mgal/day)
1985	463,650	78.76
1990	480,580	64.29
1995	523,030	67.64
2000	556,680	*missing data
2005	603,562	60.68
2010	662,564	52.76
2015	676,685	46.2

8. In column 4 of the data table, record irrigation (total) water use data. This includes totals for crops and golf courses. Record "Irrigation total self-supplied withdrawals, fresh, in Mgal/day." Note: if any values are given for saline, add that value to fresh.



Irrigation, Total total self-supplied withdrawals, fresh, in Mgal/d
50.57
69.37
61.71
58.26
39.41
46.39
39.16

Irrigation Water Use (Mgal/day)
50.57
69.37
61.71
58.26
39.41
46.39
39.16

PROCEDURES

DAY 1 - INTRODUCTION TO THE WATER CONSERVATION DATA JAM

1. Introduce climate change and water use in the Southwest.
   a. Watch Where's Our Water? Part 1 video (4:46), video transcript. Pause the video at the indicated times and discuss the following questions as a class:
      i. (0:54) The water level at Lake Mead has decreased over the past 20 years. What do you think caused this change? [Drought, growing populations, and higher water use]
      ii. (1:47) What is happening to temperatures where you live? How might this affect the amount of water in the Southwest? [Help students make the connection between higher temperatures and increased evaporation and aridity]
      iii. (2:39) Has the Southwest gotten wetter, drier, or stayed the same? [drier]
      iv. (3:59) What's happening to snowpack in the western U.S.? How will this affect the amount of water in the Southwest? [snowpack is decreasing, which means there will be less water flowing into rivers and lakes, like Lake Mead]
   b. After watching the video, direct students to answer questions 1-3 on their handout. They should use the graph and maps on their handout to answer the questions.
   c. If time allows, have students share their arguments with the class.
2. Get to know the dataset.
   a. Introduce the variables students will be using for their Data Jam project.
      i. Discuss where (state, county, or region) these data are from and the year and population columns.
      ii. Explain that these data come from the United States Geological Survey (USGS). The USGS estimates and publishes water use data for the entire country every five years. State-level estimates have been published since 1950, and county-level estimates since 1985.
      iii. Our dataset gives an estimate for two categories – domestic (or household) and irrigation (for crops, golf courses, parks, etc.), but point out that those are just a few of the water uses in our communities.
3. Understand water use categories.
   a. Pass out the Water Use Categories Definition page from the scenario cards and have students read the definitions of water use categories; discuss if needed. The students have a simplified version of the definitions from https://www.usgs.gov/mission-areas/water-resources/science/water-use-united-states
   b. Split students into groups of 3 to 5 and give each group a set of Water Use Scenario Cards. Students will try to match each water use with the correct water use category. The answer key can be found here.
   c. Set a timer for 4 minutes, and see how many scenarios they can sort into the correct water use categories. If time allows, go over the answers.
4. Introduce the Water Conservation Data Jam project.
   a. Slide 2: scientists around the world are collecting vast amounts of data every day. However, the general public often learns very little, if anything, about the information that scientists have amassed. There is a gap in the communication of scientific information to nonscientists.
   b. Slide 3: the goal of a data jam is to design a creative project and presentation that explains water use data to an audience not familiar with this information.
   c. Slide 4: here is an example of an effective way to communicate data. This infographic is interesting and easy to understand because it puts data into a context most people in the continental United States can relate to. Simply stating that Major League Baseball players ran a total of 1,245 miles in 2006 may be considered by some to be a dry statistic. However, scaling a baseball diamond to represent 1,245 miles and overlaying it on a map of the continental United States may help people understand how large the distance is and inspire them to take an interest in the statistic.
   d. Slide 5: this is an example of using music to communicate data. A University of Minnesota student, Daniel Crawford, created a song to represent the increase in average global temperatures since 1880. He was looking for a method to communicate scientific data in a way that would be more appealing to nonscientists and "people who would get more out of [a song] than maps, graphs, and numbers." His video may inspire students to be creative with their projects. (essential information at 0:35-0:50, the song starts at 1:32)
   e. Slide 6: here is an example of a student using painting to communicate data. The amount of paint used in the artwork was scaled to reflect the amount of solar radiation, soil temperature, air temperature, and precipitation over several 4-year periods in Las Cruces, New Mexico.
   f. Slide 7: this is an example of a student using dance to communicate data. The height of the student's foot was scaled to represent the amount of precipitation received every two years in Las Cruces, New

Mexico. The ribbon tied to her foot helps visualize the differences each year.

g. **Slide 8**: discuss the expectations and guidelines for the Water Conservation Data Jam project.
   i. Students may work individually or in teams of up to three students. Larger groups are not recommended for this project because of the difficulties of ensuring that all group members are equally involved.
   ii. Students should develop a creative project to represent the data and appeal to nonscientists. The project should not be a graph or table. Instruct students to use their imaginations to design an attention-grabbing and appealing project. Example products could include songs, demonstrations, poems, children's stories, newscasts, physical models, infographics, and skits.
   iii. Students must scale the data to represent the numbers from the data table accurately.
h. **Slide 9**: a good Data Jam project is clear in that it accurately represents the data in a way that is understandable to nonscientists. The data must be scaled correctly, and a legend explaining how the data are represented must be included. The project should also be creative. Think of an imaginative way to get the attention of nonscientists. Finally, the project should be concise. Focus on one important trend, and explain it well.
i. **Slide 10**: present the timeline of each step of the project. Today, we introduced the project and the data we will be using. Next, we will find data trends, make a creative project, and plan and conduct presentations. Teachers can choose to have students give short formal presentations to the entire class, or set up a gallery walk with half of the groups presenting and half of the groups listening, then switch. Last, we will create an action project to address the water use problems identified in our Data Jam project.

DAY 2 - PROJECT PREPARATION

1. Understanding Our Units
   a. **Slide 11**: Ask students to look at the data table and identify the units for water use: Mega gallons per day, or one million gallons per day.
   b. Ask students to picture a gallon milk jug in their heads and hypothesize how many gallons of water could fit in their classroom. Consider showing an actual gallon jug as a visual.
   c. Have students measure the length, width, and height of the classroom in meters (or convert feet to meters). You can work as a class to save time or allow students to work in small groups to measure and calculate the volume of the room.
   d. On their worksheets, students multiply the length x width x height to get a volume measurement in m^3. Then follow the equations on the worksheet to convert from m^3 to mega gallons.
      i. 1 m^3 = 1000 liters (multiply room volume value times 1000 to get liters)
      ii. 1 liter = 0.264 gallons
      iii. 1 gallon = 0.000001 Mgal
2. Remind students about the data jam project and ask students to look at the data table to find a data trend.
   a. **Slide 12**: A data trend is a sentence that summarizes a graph. A data trend might sound like this: In New Mexico, water use for irrigation is decreasing.
      i. Use the graphs to complete the 2 data trends shown in the slide
         1. Since 1895, drought severity in the southwestern U.S. has [increased]
         2. From 2000 to the present, water levels in Lake Mead have [decreased]
   b. Emphasize that students should represent a trend or trends in the data in a creative way rather than making a graph. For example, water use for a specific year could be represented in a physical model with multiple water drops that each represent 100 Mgal/day of water instead of simply stating that the county used Mgal/day of water.
   c. Ensure that students understand the word **trend** by asking for a volunteer to define it [answer: the general direction in which something is changing. For example, our county is increasing in population but decreasing in the total amount of water used for irrigation.]
   d. Students may go beyond the data and begin to examine the implications; however, their projects must also include representations of the data trend. For example, a student could write a rap song with a hypothesis about why the amount of water used for irrigation is decreasing in their county. Still, they must also incorporate a clear, accurately scaled description of the trend in the data.
3. Give students the rest of class to find a data trend and come up with a creative way to show it.
   a. Start the data jam project by filling out the brainstorming section on the worksheet.
   b. Have students graph the data (by hand or use Excel/Google Sheets, etc.) if they aren't noticing data trends.
   c. Have them fill out the Presentation section of the

handout as a checklist for their project.

d. By the end of this class, groups should have selected a data trend.
e. Provide guidance while students are planning their creative projects. This may take several forms, and the level of support needed will vary by group. Students may need help with interpreting data, scaling, project ideas, technical issues, and obtaining materials.

DAY 3 - PROJECT PREPARATION

1. Give students time to put together their creative projects and plan their presentations.

DAY 4 - PRESENTATIONS

1. Give students a little time to put the finishing touches on their projects.
2. Give each group five minutes to present their project or set up a gallery walk with half of the groups presenting at one time while the others rotate through groups, then switch roles and give the other half of the groups time to present.
3. Optional extension: have students give peer feedback.

DAY 5 AND BEYOND - ACTION PROJECT PLANNING

1. You will not be able to get through all these stages in one day; the engineering process goes through stages of planning, execution, and evaluation. You can choose to make this action project as large or small as you like. You may ask students to make a plan but not execute it. If you do not require students to execute the plan, encourage them to think big. If you want students to carry out their plan either inside or outside of class, set constraints for the students (time, cost, materials, etc.). Work through each stage below, giving students time to work between each stage.
2. Based on the data trends students identified on days two and three, discuss why conserving water in the Southwest is important.
3. Watch the [Where's Our Water Part 2 video](#) (4:09) [video transcript](#).
   a. Extension or alternative to complete action project: Where's Our Water Engineering Project, see Extension #3 below.
4. Students will create an action project to solve a water issue related to the data trend they presented in their data jam project. For example, if a student's data trend showed that irrigation water use was increasing, their action project should aim to decrease water use for irrigation.
   a. Slide 13: When engineers work to solve problems, they go through an eight-step engineering design process. We will use a simplified version of this process to design and implement our projects. Notice that stages 3, 4, and 5 have two-way arrows. This symbol means that groups should move freely between these stages according to the results and needs of their projects.
   b. Slide 14: Stage 1: Identify the Problem and the Constraints. Students should be thinking about the problem they are trying to solve throughout the planning process. The problem should be related to the data trend they saw in the water use data or should relate to conserving water in the future of climate change. <u>Have students write the problem they are trying to solve on #1 of the Action Project section of their handout.</u>
      i. Students should also consider what constraints will be in place as they move forward. Teachers should set the project constraints, which can be broad (e.g., public attitude) or specific (e.g., location, time, cost, materials). They should include details such as group size, amount of money available for the projects, locations, deadlines, etc. <u>Have students write these constraints on question #2 of the Action Project section of their handout.</u>
   c. Slide 15: Stage 2: Brainstorm and Select the Best Solution: While we have found that students feel empowered when allowed to participate in the project brainstorming and decision-making process, this may not be realistic in your classroom based on time or other constraints. Another option is to have ideas that you present to your students as their options for projects.
      i. Follow the link for example water conservation projects that classes have implemented: [Examples](#)
      ii. If your students choose their projects, remind them to make sure their projects solve the problem we identified and work within the framework of the constraints you outlined.
   d. Slide 16: Stage 3: Plan the Prototype Project. We encourage students to plan before executing their projects. Detailed planning may be unfamiliar to many students. Here are some considerations for guiding your students through project planning:
      i. Have students make a list of every task that needs to be completed. If each task has a specific deadline, it can keep the project moving forward. There is an example on this slide.
      ii. It may be worthwhile to require students to submit a plan and have it approved before executing their project.
      iii. Encourage students to assign specific group members to tasks. This way, everybody has a role

in making the project a success.

iv. Remind students that plans change, and while they will likely be adding and removing things from their plan as challenges arise, starting with a framework for how they will solve the problem identified in Stage 1 is vital.

e. **Slide 17**: Stage 4: Execute the Project. Once students have planned their project, they are ready to execute it. Here are some things to consider when supporting your students in project execution:
   i. Encourage communication within groups. Communication could be daily or weekly check-ins regarding the status of their project. If students are in sub-groups, each sub-group needs to report to the whole group on their tasks. Bigger groups require more intentional communication.
   ii. Remind students that their plans may change as they execute their project, which is a normal part of project planning.
   iii. Encourage students to keep their problem and proposed solution in mind and constantly evaluate if they are on track to meet their end goal.

f. **Slide 18**: Stage 5: Evaluate Progress Throughout and Identify Ways to Improve the Project. Let students know they should constantly evaluate their project and look for ways to improve it. This step is a critical component of engineering design. The Action Project section of their handout instructs students to reflect on successes (#6) and challenges (#7) at least once during the project period. Still, you should encourage students to improve their projects as they execute them.
   i. At the end of the project, students should evaluate their project's success in solving the problem they identified in Stage 1 (#8). They should provide evidence to support their claim. Finally, students should reflect on changes they would make if they were starting their project again.

EXTENSIONS

1. Modification for high school students: let students use the USGS website to choose their location and water use categories.
2. Have students track their water use over one day with this worksheet: How much water do you use?
3. Where's Our Water Engineering project: Have students design, build, and test their waffle gardens or a model rooftop rainwater harvesting system after watching the Where's our Water? Part 2 video. Handout pages 3 and 4.
4. Depending on space and tools, teachers can choose to have students do either the land contouring experiment or the rooftop rainwater harvesting design or give students a choice if possible.
5. Give students time to explore real water conservation projects in the Southwest on the Water Adaptation Techniques Atlas, an interactive map created by the USDA Southwest Climate Hub of recent or ongoing water conservation projects and their outcomes. The atlas uses jargon, so this may not be an appropriate tool for middle schoolers.
6. Research existing local laws, regulations, or guidelines for water use to understand what is already being done to promote water conservation.

ADDITIONAL RESOURCES

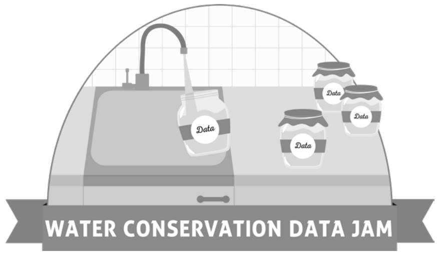
Environmental Protection Agency (EPA). Drought Resilience and Water Conservation. Updated Sept. 2020. Web. Accessed 15 Apr. 2021.

National Integrated Drought Information System (NIDIS). U.S. Drought Monitor. Updated 21 March 2023. Web. Accessed 13 March 2023.

Smith, Adam. NOAA Climate.gov. 2010-2019: a landmark decade of US billion-dollar weather and climate disasters. 08 Jan. 2020. <https://www.climate.gov/>

United States Geological Society (USGS). Water Use Data for the Nation. Updated 07 Nov. 2022. Web. Accessed 07 Nov. 2022. <https://waterdata.usgs.gov/nwis/wu>

Name: ______________________________ Date: ____________________ Period: ____________



Part One - Where's Our Water?

1. Examine all 3 graphs, and then make a claim. How will climate change affect the amount of water in the Southwest? (Example claim: There will be more/less water available in the southwest in the future because of climate change.)

Figure 1. Average Temperature in the Southwestern United States, 2000 - 2020 Versus Long-Term Average

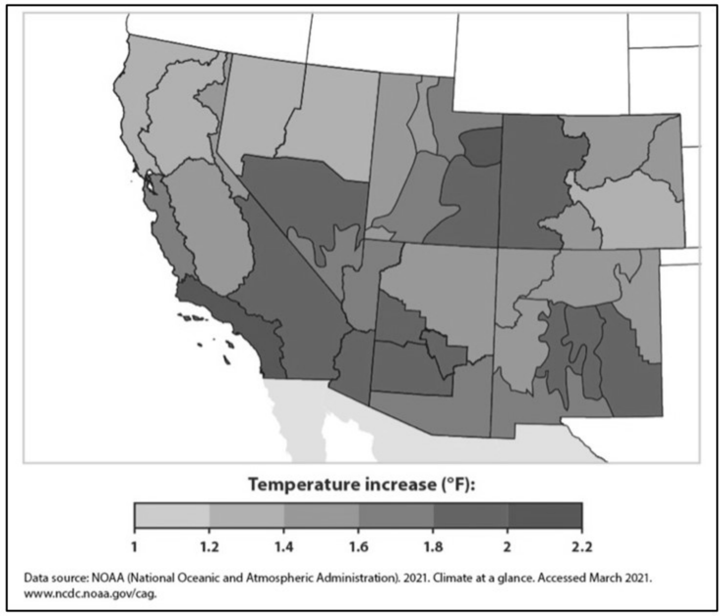


Figure 2. Drought Severity in the Southwestern United States, 1985 - 2015

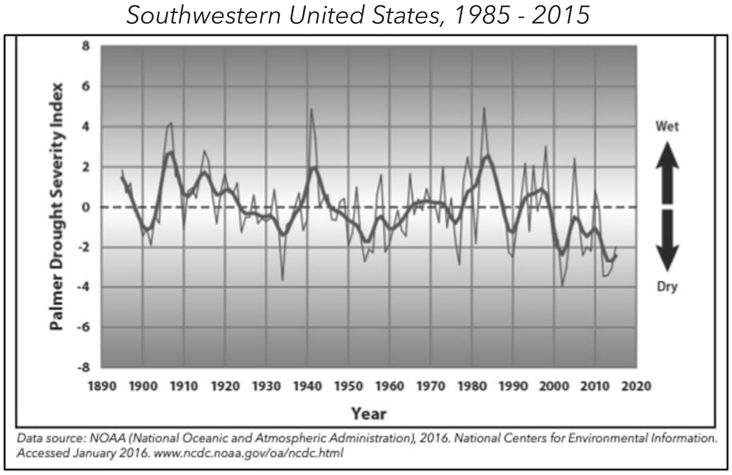
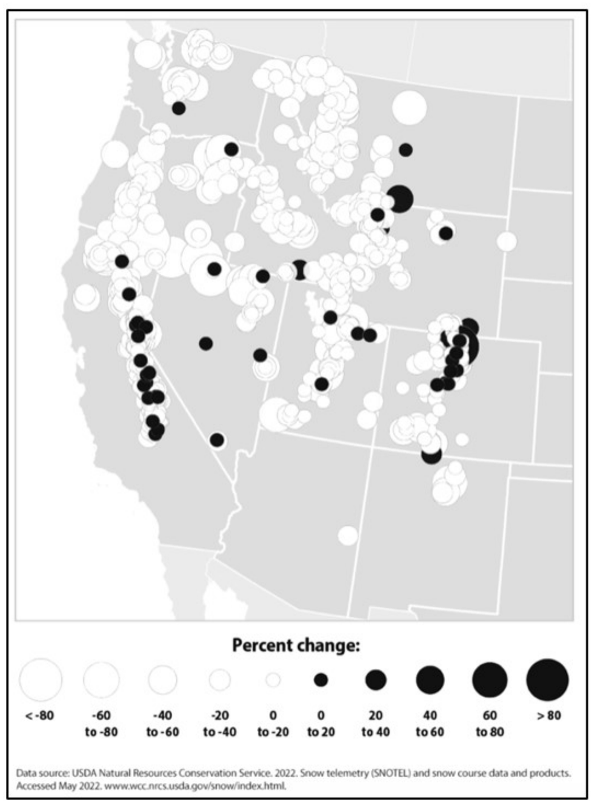
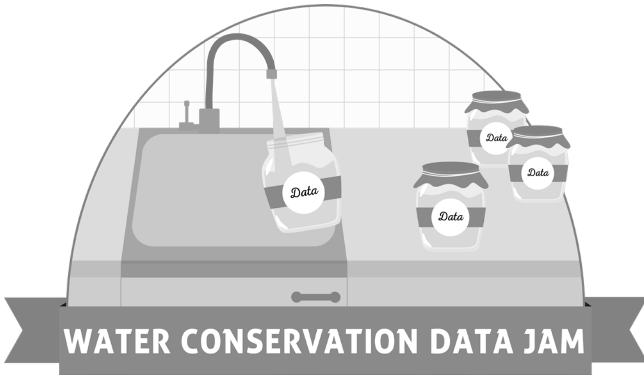


Figure 3. Trends in April Snowpack in the Western United States, 1955 - 2022



2. Provide evidence for your claim. What specific data from the graphs and/or maps do you observe that can support your claim?

3. Explain your reasoning.



WATER USE DATA FOR: ____

YEAR	POPULATION	DOMESTIC WATER USE (MGAL/DAY)	IRRIGATION WATER USE (MGAL/DAY)

HOW BIG IS A MEGA GALLON?

Hypothesis: How many gallons can fit inside the classroom? ________________________

1 meter³ = 1000 liters *1 liter = 0.264 gallons*

Classroom Length: ______________ Classroom Width: ______________ Classroom Height: ______________

Classroom Volume = ______________ x ________________ x _________________
Length Width Height

Classroom Volume: ______________ m³ x 1000 l/m³ x 0.264 gal/l = ______________ gal

______________ gal ÷ 1,000,000 gal/Mgal = ______________ Mgal fit inside this classroom

DATA TREND - BRAINSTORMING SPACE

- Look at the data carefully and list some trends you might like to explain to your audience. If you get stuck, try graphing some of the data. You will choose one trend for your project.

- List some possible ways to represent the data (song, rap, interpretive dance, infographic, etc.). Think about the positive and negative aspects of each one.

DATA JAM PRESENTATION

1. Introduce all of the students who worked on this project.

2. Give the **title** of your project. Make sure it is descriptive.

3. Explain the **data trend** you are trying to get across in your project.

4. Showcase your **creative project**. For example, read your poem, act out your play, or give a tour of your physical model. Make sure to explain your legend (how the data are represented).

5. Explain how climate change will affect water use in the county or region.

ACTION PROJECT

Stage 1 - Identify the Problem and Constraints

1. What problem are we trying to solve?

2. What constraints do we need to keep in mind?

Stage 2 - Brainstorm and Select the Best Solution

3. What are some projects we could do to help solve the problem?

4. After discussion and careful consideration of the project constraints, here is our best solution idea. This is what we will do for our project:

Stage 3 - Plan the Prototype Project

5. Fill in the project planning table with the tasks needed to complete your project, the team member responsible, and the deadline.

TASKS	WHO WILL BE IN CHARGE OF THIS TASK?	DEADLINE

*use an additional piece of paper if there are more than 8 steps in your project plan.

Stage 4 - Execute the Project

Carry out your project plan. When completing your project, you will likely run into obstacles and setbacks. Be sure to return to your project plan (Stage 3) and alter it as issues arise, including adjusting deadlines.

Communicate as a team. Check-in often as a group so team members can report on their tasks and everybody can remain on the same page.

Stage 5 - Evaluate Progress and Identify Ways to Improve the Project

6. Which parts of your project are going well?

7. Which parts of your project are not going well? What can you do to change these parts before the end of the project?

8. At the end of your project, evaluate your action project.

   a. Did your project help solve the problem you wrote in #1? Provide evidence for your answer.

   b. What would you do differently if you were starting on this project again?

Water Use Category - Domestic

Water use includes indoor and outdoor uses at residences, including drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, watering lawns and gardens, and maintaining pools. Self-supplied domestic water use is typically withdrawn from a private source, such as a well, or captured as rainwater in a cistern.

Water Use Category - Irrigation

Water use includes water that is applied by an irrigation system to sustian agriculture. Irrigation also includes water that is used for pre-irrigation, frost protection, chemical application, weed control, field preparation, crop cooling, harvesting, dust suppression, and leaching salts from the root zone. It includes water that is lost to evaporation before or after irrigation.

Water Use Category - Livestock

Water associated with livestock watering, feedlots, dairies, and other on-farm needs. Livestock includes dairy cows, beef cattle, sheep, goats, pigs, horses, and poultry. Other livestock water uses include cooling of facilities for the animals and products, dairy sanitation and wash-down of facilities, animal waste-disposal systems.

Water Use Category - Industrial

Water used for such purposes as creating, processing, washing, diluting, cooling, or transporting a product; incorporating water into a product; or for sanitation needs within the manufacturing facility. Some industries that use large amounts of water produce such commodities as food, paper, chemicals, refined petroleum, or metals.

Water Use Category - Mining

Water used for the extraction of minerals in the form of solids, such as coal, iron, and gravel; liquids, such as crude petroleum; and gases, such as natural gas. The category includes quarrying, mining, injection of water (such as hydraulic fracturing), and other operations associated with mining activities.

EVAPORATIVE COOLING IS USED IN ARIZONA TO AIR CONDITION AN INDOOR POULTRY FACILITY.	A TRUCK DELIVERS WATER TO A STOCK TANK IN A REMOTE CATTLE GRAZING LOCATION.
TO DESTROY PATHOGENS IN MILK, HOT WATER IS USED TO HEAT MILK AS PART OF THE PASTEURIZATION PROCESS.	WATER IS USED TO COOL THE REACTOR AT A NUCLEAR ENERGY FACILITY.
BEFORE BEING SEALED, WATER IS ADDED TO A VARIETY OF CANNED VEGETABLES LIKE GREEN BEANS AND CORN.	BEFORE LEAVING FOR WORK, A PERSON FILLS AND STARTS THE DISHWASHER IN THEIR KITCHEN.
A MAN FILLS THE BIRDBATH IN HIS GARDEN.	A RURAL FARMER DRAWS DRINKING WATER FROM THE WELL ON HER PROPERTY.
A BARE FIELD IS SPRAYED WITH WATER TO SUPPRESS DUST.	WATER EVAPORATES FROM AN IRRIGATION DITCH ON ITS WAY FROM A RIVER TO FARMLAND.

SAND WHICH IS MINED FOR USE IN CEMENT IS WASHED WITH WATER IN ORDER TO REMOVE CONTAMINANTS.

IN MINERAL PROCESSING, GROUND ORES ARE PLACED IN WATER TO SEPARATE THE VALUABLE MINERALS FROM THE FLOATING TAILINGS.

A CROP-DUSTING AIRPLANE SPRAYS WATER MIXED WITH PESTICIDES ON A FIELD OF COTTON.

Water Use Scenario Answer Key

DOMESTIC

- Before leaving for work, a person fills and starts the dishwasher in their kitchen.
- A man fills the birdbath in his garden.
- A rural farmer draws drinking water from the well on her property.

IRRIGATION

- A bare field is sprayed with water to suppress dust.
- Water evaporates from an irrigation ditch on its way from a river to farmland.
- A crop-dusting airplane sprays water mixed with pesticides on a field of cotton.

LIVESTOCK

- Evaporative cooling is used in Arizona to air condition an indoor poultry facility.
- A truck delivers water to a stock tank in a remote cattle grazing location.

INDUSTRIAL

- To destroy pathogens in milk, hot water is used to heat milk as part of the pasteurization process.
- Water is used to cool the reactor at a nuclear energy facility.
- Before being sealed, water is added to a variety of canned vegetables like green beans and corn.

MINING

- Sand which is mined for use in cement is washed with water in order to remove contaminants.
- In mineral processing, ground ores are placed in water to separate the valuable minerals from the floating tailings.

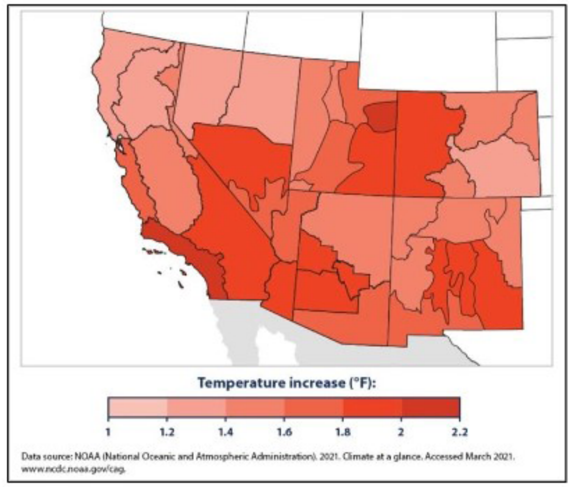
WHERE'S OUR WATER PART 1 - VIDEO TRANSCRIPT

Brought to you by The Asombro Institute for Science Education, with support from the USDA Southwest Climate Hub.

This is a photo of Lake Mead outside of Las Vegas, Nevada in 2001 and 2015. What do you see when you compare the two photos? Here's another photo taken in July of 2015. The white rocks are covered in minerals deposited by water. In wet years, like 2000, water reached the top of the white minerals. This dashed line shows how low the water level is in 2015 when this photo was taken. You can see from these photos that water levels have been low in recent years. What do you think caused this change?

The water levels at Lake Mead and many other reservoirs around the Southwest have been low for years, and this is just one example of the effects of climate change on our water supply. Scientists all over the world study the effects of climate change on water, and analyzing data is an important piece of their work. Today we'll think more about what's affecting the water levels at Lake Mead, then you'll use data to construct an argument about the future of the southwest's water supply.

Figure 1. Average Temperatures in the Southwestern United States, 2000 – 2020 Versus Long-Term Average

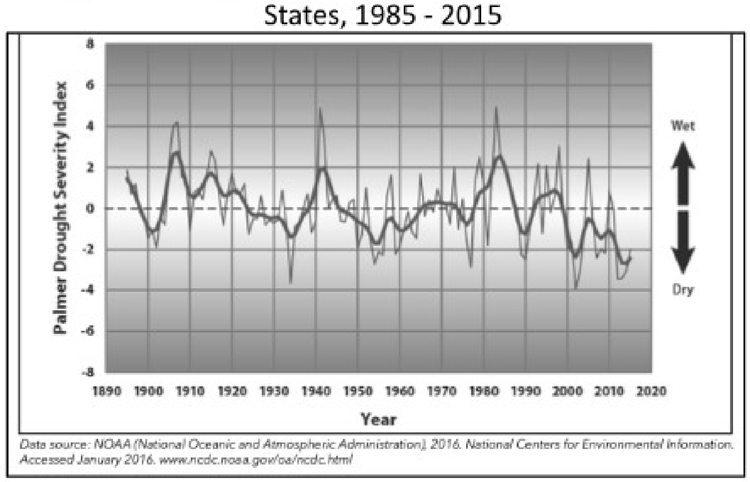


Across the globe temperatures are rising due to climate change. This map shows change in temperature across the Southwest. The darkest red color indicates temperatures that have risen by over 2 degrees Fahrenheit. Look for your state on the map. What's happening to temperatures where you live? How might this affect the amount of water in the Southwest?

Even just a small increase in temperatures is enough to affect our water supply by increasing the rate of evaporation. Have you ever noticed a puddle dry up quickly on a hot day? In the southwest where the climate is already dry, rising temperatures are expected to lead to longer and more extreme droughts. Drought is a lack of moisture bad enough to have economic, environmental, or social impacts.

This graph shows drought levels in the southwest since 1895. Look at the Y-axis. Positive numbers represent wet years, and negative numbers represent dry years. Over the past 120 years, does the data show that the Southwest has gotten wetter, drier, or stayed the same?

Figure 2. Drought Severity in the Southwestern United States, 1985 - 2015



The graph shows us that it's getting drier in the southwest, which means we're experiencing more drought. What does that mean for important water sources like Lake Mead?

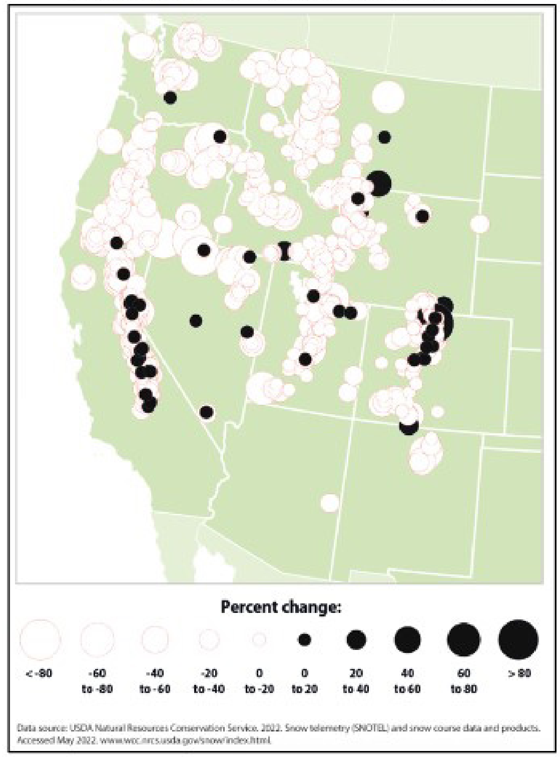
The photos of Lake Mead in 2001 and 2015 are both from relatively dry years. When temperatures increase, evaporation from this reservoir also increases, lowering water levels, and the water becomes unavailable to people.

Another impact of climate change on water resources has to do with snowpack, which builds up during the winter in high elevation areas. When warm spring weather arrives, the snow melts, filling rivers and percolating through the soil to replenish groundwater supplies. As the climate warms, precipitation will fall more often as rain instead of snow. This map shows the change in April snowpack throughout the western U.S. The bigger the dot, the bigger the change in snowpack. Red dots indicate decreases in snowpack, and blue dots indicate increases. What's happening to snowpack in the western U.S? How will this affect the amount of water in the Southwest?

Let's take a look at those first photos we looked at of Lake Mead and explain what we're seeing. Climate change is causing increased temperatures. Increased temperatures cause drought, and water from Lake Mead evaporates. Increased temperatures also cause decreased snowpack which stops new water from filling the emptying reservoir.

Consider the evidence you've gathered from the three charts and make a claim. How will climate change affect the amount of water in the Southwest? Does this mean we need to conserve water?

Figure 3. Trends in April Snowpack in the Western United States, 1955 - 2022



WHERE'S OUR WATER PART 2 - VIDEO TRANSCRIPT

Brought to you by the Asombro Institute for Science Education, with support from the USDA Southwest Climate Hub.

Drought is not a new challenge in the southwest. For thousands of years, people have found creative ways to conserve water. Some water conservation relies on individual people, but when implemented by entire communities, they have large-scale impacts.

Have you ever seen a circle around a tree like this? This is an example of land contouring, when people shape the land so that rainwater flows to where plants can use it. The dirt wall around the tree creates a bowl so water collects around the tree's roots where it needs it the most.

Terrace farming is also a form of land contouring. When it rains on a hill, water tends to run down the hill without being absorbed by the plants. In terrace farming, people shape the land by cutting steps into the side of a slope and planting crops on top of them. When it rains, the steps slow down the water so it gets absorbed by plants and reduces soil erosion.

The Zuni people in New Mexico and Arizona used a form of land contouring here in the Southwest. Waffle gardens are gardens with berms, or raised dirt mounds around them to hold water. The Zuni people made waffle gardens a thousand years ago and the methods are still used today. Ancestral puebloans would make waffle gardens at the base of a cliff or mesa to catch the rain that came off of it.

Another method of water conservation is rooftop rainwater harvesting systems. Rooftop rainwater harvesting is simply a way of collecting rain that falls on a rooftop so people can use it later. Acoma Pueblo in New Mexico is the oldest continually inhabited community in North America. The people of Acoma have been collecting rain that falls on rooftops or impermeable surfaces like rock for hundreds of years. They channel the rain that falls on their buildings into natural stone cisterns like this rock pool, to be used later for building and cleaning.

Today, people use gutters and barrels to collect water off of rooftops, like this model house, where rain on the roof is directed to a holding container by the gutters. Let's check out an example that can be found at the Chihuahuan Desert Nature Park in Las Cruces, New Mexico. Our rainwater harvesting system is made up of the roof, the gutter, and the rain barrel. Rain falls on the roof and flows downslope to a gutter. This gutter directs all the rain towards a barrel, where it can be stored and used later. It's not clean enough to drink, but it can be used to water plants, mix concrete, or clean. Pretty simple and effective.

I hear what you're saying. That's nice, but it's a small roof, could it really collect that much water? Let's do the math.

We get about 10 inches of rain in New Mexico per year. This roof is 96 inches by 168 inches. 96 times 168 times 10 is 161,280 inches cubed, or about 700 gallons.

You use about 50 gallons during a 10 minute shower. If you took a 10 minute shower every day, it would take you two weeks to use that much water, and that's just from this one little roof. Imagine if this was the roof of your home or your school.

We just showed you several examples of water conservation systems that have been used by people for thousands of years. Now it's your turn to come up with an action project that would help conserve water where you live.