Colorado Drought - Teacher Guide

Setting the Stage

Humans have been affected by severe drought throughout history, which in some cases has led to the collapse of civilizations. While technology has increased our ability to deal with drought, it still causes significant economic damage in the United States today.

Soybeans show the effect of drought.
Photo Credit: Bob Nichols, USDA

Lesson Overview

Students will build understanding of drought in Colorado through the following activities:

- *Part 1 – Engage (10 minutes) Introduction to Drought & Case Study*
  As a class, watch news clips about drought in Colorado and create a list of questions students have about drought.
- *Part 2 – Explore (45 minutes) Investigating Drought Conditions*
  Students begin with an exploration of how drought is measured, and then are divided into expert groups to analyze several datasets of the factors that led to drought in April 2013.
- *Part 3 – Explain (50 minutes) Drought Classification*
  New drought classification student groups (with a student from each group in Part 2 jigsaw) will present information to each other, and work as a group to classify the severity of the drought in April of 2013 in Colorado.
- *Part 4 - Evaluate (50 minutes) The Future of Drought*
  In a class discussion, students interpret two figures that show the history of water supply in the Southwest and projected temperature and precipitation trends in Colorado. Students then write a letter to the editor about current and predicted drought conditions.
- *Extension - Elaborate (25 minutes) Drought Resilience Strategies*
  Students research drought mitigation and resilience strategies and create a social media post advertising the strategy.

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Instructional Overview	
Grade Level	High School
Instructional Time	155 minutes
Unit Driving Question	How can we make our community more resilient to drought?
Lesson Driving Question	What environmental factors contribute to drought? How do scientists expect drought frequency and severity to change in the future?
Building Toward	NGSS: HS-ESS3-1 CDE: HS3.ESS.GLE10
Three Dimensions	Science and Engineering Practices: ● Analyzing and Interpreting Data ● Obtaining, Evaluating, and Communicating Information Disciplinary Core Ideas: ● ESS3.B: Natural Hazards Crosscutting Concepts: ● Patterns ● Cause and effect
What Students Will Do	● Analyze environmental data to classify patterns of drought severity in Colorado. ● Communicate information about the causes and effects of drought in your community.
Materials	❏ Drought Student Worksheet ❏ Part 2 Jigsaw Key ❏ Lesson Slides ❏ Extension: Drought Resilience Strategies Handout
Material Preparation	❏ Computer and internet access are essential for this activity. Ideally each student will have access to a computer or tablet. ❏ Post the Drought Student Worksheet to the class website. Students will need digital access to the worksheets to access the links for each activity.
Vocabulary	Natural hazards are naturally occurring phenomena such as flood, wildfire, extreme heat, or drought, which may disrupt or damage a community. Drought is a prolonged drier-than-normal period in a natural climate cycle that results in water-related problems.
Instructional Strategies	● Jigsaw: A cooperative learning strategy in which each group is responsible for learning one “piece of the puzzle” and then sharing that information with other groups to complete the whole picture. Use Part 3

	for students to present the information they learned at their stations. Teachers can choose to use this strategy if time is limited, and stations can be differentiated for different student abilities and levels of teacher assistance.
Opportunities for Bringing Experts into the Classroom	• Part 1: Kick off the lesson with a farmer, rancher, extension agent, or water conservation board member speaking about drought and water conservation.

Part 1 (Engage) Introduction to Drought & Case Study (10 minutes)

Why is it important to study drought?

Begin the lesson with a warm-up KWL Chart (Know, Want to Know, Learned) on the first page of the student worksheet. Use Think, Pair, Share for students to share out what they already know and what they want to learn.

Use the news clip Drought conditions similar to 2012-13 (2:42) from KOAA 5 to get students thinking about drought. As a class, briefly discuss observations and questions about drought. Write down a list of questions to refer back to throughout the unit.

Optional Videos:

Drought in Colorado with Doug Kluck (4:37)

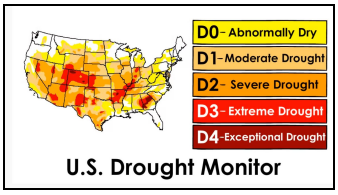
The Big Dry (~10 minutes total)

Part 2 (Explore) Investigating Drought Conditions (45 minutes)

In this activity, students assume the role of scientists working for the United States Drought Monitor to classify drought severity in Colorado in 2013. First, students learn a little more about how drought is assessed, then students break into expert groups to investigate different datasets.

How is drought measured? (15 minutes)

What different environmental and social factors are taken into account when meteorologists measure drought severity? First, watch Assessing Drought in the United States (6:05).



Next, explore the US Drought Monitor Drought Classification table and read about drought indicators and caveats on the use of the US Drought Monitor. Students will use this table to assess drought conditions in April of 2013 in Colorado.

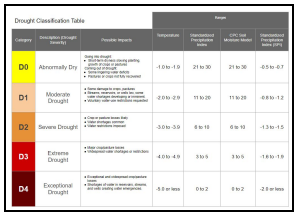
What environmental factors indicate that drought is occurring? (30 minutes)
This activity is designed as a jigsaw. Divide students up into four groups to interpret the datasets and become experts. Give groups 30 minutes to do their research and create their slides. Alternatively, if class time allows, have all students complete all investigations.

Begin by asking students: Based on the evidence, which drought severity classification should Colorado receive in April 2013? Next, direct students to the drought expert team instructions on pages 2-7 of the student worksheet. Groups are asked to create 2-3 slides to present their findings to their drought classification team in Part 3.

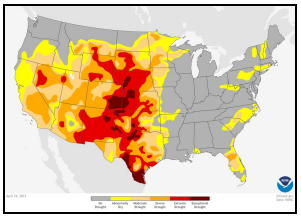
Part 3 (Explain) Drought Classification (50 minutes)
Based on the evidence, which drought severity classification should Colorado receive in April 2013?

For Part 3, students will work in new groups, or drought classification teams. Each flood planning team is made up of one student from each of the jigsaw groups, so that the team consists of students that collectively completed each of the Part 2 investigations. Give each student 5 minutes to present their slides, while the rest of the group use the Drought Classification Table (pages 8-9 of the student worksheet) to categorize the drought severity based on the data. Have students go circle the appropriate box for each category.

As a class, share out what drought classification groups decided for the level of drought in April of 2013. Show slide 11 of the lesson slides with the map of the drought conditions in April 2013, and compare and contrast students' classifications with the drought classification from the US Drought Monitor Map.

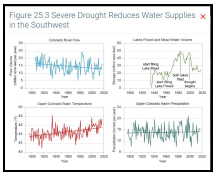


This discussion is a great opportunity to discuss the challenge of drought classification, as explained in the Assessing Drought in the United States video. While students were asked to estimate drought for the entire state of Colorado to keep it simple, in reality, drought classifications vary throughout the state.



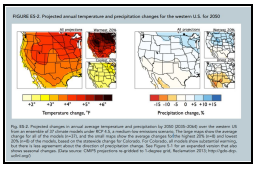
Part 4 (Evaluate) The Future of Drought (50 minutes)

How do scientists expect the frequency and severity of Colorado's droughts to change in the future?



As a class, interpret Figure 25.3: Severe Drought Reduces Water Supplies in the Southwest from the Fourth National Climate Assessment on slide 12 of the lesson slides.

Class Discussion Question:
If the Upper Colorado Basin Precipitation has slightly increased in the last 100 years, why is the Colorado River Flow decreasing?



Next, as a class, interpret Figure ES-2 (page 3) from the Climate Change in Colorado Executive Summary report on slide 13 of the lesson slides.

Class Discussion Question:
If precipitation stays the same, but temperatures get warmer, what effects will that have on water supply?

Based on current data, what kind of drought conditions do we expect in the near future?
In a summary of what students have learned throughout the lesson, students write a Letter to the Editor. Direct students to use page 10 of the student worksheet.

Optional Extension: Drought Resilience Strategies (25 minutes)
How can we mitigate the impacts of drought?

Students will investigate several resilience strategies for responding to drought, and then put together a social media post that explains a strategy as if they were a local water utility encouraging water conservation. The post should include an image and a descriptive sentence no longer than 280 characters. The Drought Resilience Strategies Handout gives students instructions.

Find more HEART Force Curriculum here:
https://cires.colorado.edu/outreach/projects/HEARTForce