

INVESTIGATION 4.1: INTERACTIVE MAP OF COLORADO

LESSON SNAPSHOT

- ☑ Observe
- ☑ Question
- ☑ Investigate
- ☑ Question



30
MINUTES

MATERIALS

PER STUDENT

- Computer, Chrome book, tablet or smartphone (ideally each student will have their own device to work on).
- **Student Sheet 6: Interactive Map of Colorado**
- **Student Reading 3: Career Connections. Donald McCreer – Dam Operator** (optional)

PER GROUP

- Computer, Chrome book, tablet or smartphone (if each student can't have their own device, have students share in the smallest groups possible).

PER CLASS

- Projection of the **Online Interactive Map of Colorado**.

STUDENT OUTCOMES

- Students will understand that data can help answer questions about water, people and land in Colorado.
- Students will develop their own questions from this investigation to guide their exploration of **Section 4**.

INQUIRY QUESTIONS

- How does data help us better understand water in Colorado?
- How can I ask and answer my own questions about water in Colorado?
- How do water, people, and land interrelate?

OVERVIEW

Students will use the **Online Interactive Map of Colorado** (denverwater.org/werg) to generate questions to further investigate throughout the section. Students will use this investigation to become familiar with all the components of this map and how it works. Students should explore the map by turning layers on and off and observing how they relate.

TEACHER BACKGROUND INFORMATION

This map is a compilation of data about water, water use and population in Colorado, including:

- locations of rivers and reservoirs
- watershed boundaries
- the location of the Continental Divide
- precipitation and snowfall data
- Denver Water's collection area
- major highways
- population centers
- water-use data for domestic, agricultural/ranching and industrial use

This map will be referenced throughout **Section 4**, so this investigation is an opportunity for students to explore and become comfortable with the information and the ways in which they can use this map.

Things to note about the Online Interactive Map of Colorado:

- Population circles will show the population of the city or town if you hover over the population circle (or click on it on a touchscreen device). Some of these population circles are quite small (because they have small populations) and are hard to see. So please look carefully for all the population centers that are indicated on the map.
- The layers that have a key associated with them are: precipitation, snowfall, population,
- Domestic water use by county, agricultural/ranching water use by county, and industrial water use by county.
- Click the more info button (*i*) to read more about each layer category.
- There are small “*Ds*” at the top and the bottom of the map. These “*Ds*” indicate where the Continental Divide enters and exits our state.

Please note:

In **Investigation 4.3**, students will predict where the Continental Divide is on the map. They will have seen its location here, but it is assumed they won't remember exactly where it is. Take care not to over-emphasize the location of the Continental Divide so that **Investigation 4.3** will be more meaningful later. If a few students do pay close attention to where the divide is in this investigation, **Investigation 4.3** will still be meaningful.

Make sure that at least one group investigates the relationship between precipitation or snowfall and population. Students should be able to conclude that the majority of the precipitation in the state is not located in the same region as the majority of the population. Approximately 80% of the precipitation falls on the West Slope, but approximately 80% of the population lives on the Front Range. Denver Water and other Front Range water utilities must build and maintain infrastructure to move water from the west side of the Continental Divide to serve demand on the east side.

ENGAGE

WHAT EDUCATOR DOES

Project the following inquiry questions on the board:

- How does data help us better understand water in Colorado?
- How can I ask and answer my own questions about water in Colorado?
- How do water, people, and land interact?

Have students Think-Pair-Share and answer the inquiry questions.

Hand out **Student Sheet 6: Interactive Map of Colorado** and have students answer the questions:

- What do you already know about water in Colorado?
- What questions do you have about water in Colorado?

Project the **Online Interactive Map of Colorado** so all students can see it. Help students navigate to the map.

WHAT STUDENTS DO

Think-Pair-Share about the inquiry questions.

Answer the questions on **Student Sheet 6: Interactive Map of Colorado**:

- What do you already know about water in Colorado?
- What questions do you have about water in Colorado?

Access the **Online Interactive Map of Colorado** at denverwater.org/werg



EXPLORE

WHAT EDUCATOR DOES

Students will spend time exploring the map with the purpose of making observations and questioning. The goal is for each student to have at least one question they can investigate further.

NOTE: Make sure that at least one group investigates the relationship between precipitation or snowfall and population. Students should be able to conclude that the majority of the precipitation in the state is not located in the same region as the majority of the population. Approximately 80% of the precipitation falls on the West Slope, but approximately 80% of the population lives on the East Slope. Denver Water and other Front Range water utilities must build and maintain infrastructure to move water from the west side of the Continental Divide to serve demand on the east side of the Continental Divide.

WHAT STUDENTS DO

Investigate the **Online Interactive Map of Colorado** and answer the questions:

- What do you notice about the data on the **Online Interactive Map of Colorado**?
- What other questions do you have about water in Colorado because of this data? Circle the question(s) you will investigate further.



EXPLAIN

WHAT EDUCATOR DOES

Explain that students will use the data and the **Online Interactive Map of Colorado** to answer their question(s). Each student should have a statement that explains how at least two categories relate to each other.

Clarify student understanding while they interact with the map. Ask probing questions to further student thinking.

WHAT STUDENTS DO

Investigate the question you chose. Use data from the **Online Interactive Map of Colorado**, information provided in the “more information” buttons on each category and other resources from previous lessons to develop a claim supported by evidence that can be made about the question(s) you have.

Write your claim and your evidence for your thinking on **Student Sheet 6: Interactive Map of Colorado**.



DEBRIEF AND REFLECT

WHAT EDUCATOR DOES

Have students discuss their claims and the evidence they found to support their claim(s). Choose a routine that will work for your class:

- Hand up – Stand up – Pair up
- Hosted Gallery Walk
- Peer Critique/Praise, Question, Suggestion
- Another routine/protocol that you use in your class

WHAT STUDENTS DO

Debrief and reflect on what you have learned about water, people and land in Colorado while using the **Online Interactive Map of Colorado**.

ASSESSMENT OPTIONS

- The exit ticket is the answer to the questions and their statement. Have students turn in **Student Sheet 6** for assessment. Assess for understanding how two or more layers interrelate and the quality of the evidence they provide.
- Use the bullet points from the Next Generation Science Standards as a guide.

CONSTRUCTING EXPLANATIONS AND DESIGNING SOLUTIONS

- Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena.
- Construct an explanation using models or representations.
- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
- Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.
- Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.

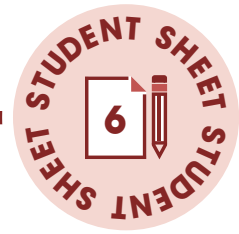
CAREER CONNECTIONS

Student Reading 3: Career Connections Donald McCreer – Dam Operator

ADDITIONAL RESOURCES

See **Section 2: Additional Resources**

INTERACTIVE MAP OF COLORADO



1. What do you already know about water in Colorado?

2. What questions do you have about water in Colorado?

3. What do you notice about the data on the interactive map?

**Note: You can turn layers on and off by clicking on the "x" or "✓," and you can find out more information by clicking the "i" info circle. Turn layers on and off to compare data.*

4. What other questions do you have about the water situation in Colorado because of this data?
Circle the question you will investigate further.

5. Write a statement about water in Colorado supported by evidence from the map:

ANSWER KEY

INTERACTIVE MAP OF COLORADO



1. What do you already know about water in Colorado?

Example: I know that Colorado is a relatively dry state.

2. What questions do you have about water in Colorado?

Example: How much precipitation do we get in Colorado?

3. What do you notice about the data on the interactive map?

**Note: You can turn layers on and off by clicking on the “x” or “√,” and you can find out more information by clicking the “i” info circle. Turn layers on and off to compare data.*

Example: I notice that most of the population of the state is around the Denver-metro area.

4. What other questions do you have about the water situation in Colorado because of this data?
Circle the question you will investigate further.

Example: What are the connections between domestic water use and population?

5. Write a statement about water in Colorado supported by evidence from the map:

Example: Domestic water use is higher near population centers. The interactive map shows large circles and greater populations near the Denver-metro area. Adding up populations of a few of the cities in and around Denver yields more than 2.8 million people. Using the key, I can see that total domestic water use is 70–121 million gallons per day in the counties around Denver and Colorado Springs. The lightest shading of 0–4 million gallons per day designates the counties around the state where there are very few people according to the Population Centers layer.

CAREER CONNECTIONS

DONALD MCCREER – DAM OPERATOR FOR DILLON RESERVOIR



Donald McCreer *Dam Operator for Dillon Reservoir*

WHAT DO YOU DO FOR DENVER WATER?

Here is a list of what my days/weeks entail:

- Every morning we obtain the high, low and observation temperature from a digital recording thermometer. We also get a measurement of precipitation from a collection can and observe current atmospheric cloud conditions. We put this data in our records and report it online to the National Weather Service.
- We access the United States Geological Survey stream gauge website for the Blue River below Dillon Reservoir and record data for the previous 24-hour period into our records as well.
- I, or one of the other caretakers, visit our facility below the reservoir and perform a security check of the area, including the dam, stream gauge, river and entrance to the hydroelectric power plant. Safety and security of our facilities is our top priority.
- Once I enter the plant, I look for anything out of the ordinary like unusual odors or sounds and note any leaks or graffiti on the building.
- Then I gather and record a series of power plant readings, such as temperatures and electrical generation rates.
- I check computed current reservoir storage and 24-hour average reservoir inflow and outflow. It's important that we send this information to our water resources group in Denver before 8:30 a.m. because it will tell them if we need to release more water from the reservoir into the Blue River.
- I also help maintain the power plant, which includes cleaning the facility, checking the levels on the battery banks, checking our vaults for anything unusual and many other duties. Even though the power plant creates electricity, we use large batteries to control the generator. That way, if there's a problem with the generator or the electrical grid, we have power available immediately so the unit can shut down safely.

- Every Sunday morning, I make sure our backup diesel generator is working properly. We use it to power the rest of the facility's lights, electrical outlets, and more in case of a power outage.
- We also have a monthly plant maintenance checklist for other items that don't need to be monitored as often.
- We must complete a quarterly plant maintenance checklist at the beginning of every quarter of the year, which includes greasing certain valves, checking smoke detectors and completing other maintenance projects.
- We also have daily projects. Currently, we are remodeling our Dillon office. In the winter months, we do quite a bit of snow removal. Since I started this job, I have done many tasks that you might not expect a dam operator to do, such as installing an egress window, pouring concrete pads for new sheds, installing doors in a house, digging a trench for a fiber optic line for our shop and lots more. For one week each July, caretakers from other Denver Water reservoirs help spray for weeds on their all-terrain vehicles. We also spend plenty of time in the water on our Boston whaler boat and pontoon boat, doing security checks or general maintenance. Recently, for example, we fixed a buoy line that broke after ice pushed it around.

WHAT IS YOUR FAVORITE PART OF YOUR JOB OR WHAT DO YOU FIND MOST INTERESTING?

I started my career in the city working on water mains, fire hydrants, meter pits and other parts of the distribution system. Now I get to be in the collection system at the source of where all of the water comes from that ends up in your faucet. I also enjoy measuring snow each winter, which provides planners with information about how much water Denver will have in the coming year.

WHAT GOT YOU INTERESTED IN YOUR CAREER FIELD?

After being with Aurora Water for about 14 years, I took interest in becoming a caretaker for Denver Water. It all started when I went to my friends' barbecue in Waterton Canyon. He was a caretaker at Denver Water's facility

there at the time and showed me around and explained what the job entailed. I immediately took interest. One thing in particular that sparked my interest was the fact that the work took place in remote locations. I am an outdoorsman, and I knew I'd fit in just fine up in the mountains at Dillon. I love that my backyard is all U.S. Forest Service land, where I go hunting, and across the highway from me is Dillon Reservoir, where I often take my kids fishing.

WHAT DID YOU STUDY IN SCHOOL OR WHAT WORK HAVE YOU DONE TO PREPARE YOU FOR THIS JOB?

I originally went to school for a public service degree to become a firefighter. I became an emergency medical technician and went through some basic firefighting courses. I volunteered for the fire department in Elizabeth, Colorado. I then took a job with Aurora Water as a maintenance worker. I began to move up very quickly by getting all of my water distribution system certifications. I went from an entry-level worker to a senior maintenance worker on up to a heavy-equipment operator. I was an operator for eight years. I would go on call often to fix water breaks. I usually had a crew of five that I was responsible for.

WHAT WOULD PEOPLE BE SURPRISED TO KNOW ABOUT YOU AND/OR YOUR JOB?

I think the one thing that surprises people most about my job is the free company housing. All of the caretaker jobs require you to live on site at your facility. That's because most of the facilities are so remote. Places like Williams Fork Reservoir and Cheesman Reservoir don't have schools, grocery stores or hospitals nearby.