

INVESTIGATION 6.1: HOW MUCH WATER DO I USE?

LESSON SNAPSHOT

- ☑ Brainstorm
- ☑ Estimate
- ☑ Collect Data
- ☑ Analyze
- ☑ Reflect



1
50-MINUTE
PERIOD

**NOTE: The ENGAGE segment of the investigation (approximately 10 minutes) should be done the day before the rest of the lesson. The students will need to go home and gather some information so they can have a more accurate account of their daily indoor water use. Students will use the information they gather in Investigation 6.2 as well.*

MATERIALS

PER STUDENT

- **Student Sheet 14: Water Use Data Collection**
- Computer, Chromebook, tablet or smartphone
- Pencil

PER CLASS

Students may need help visualizing the volume of water that is the water efficiency goal for indoor water use in this investigation. The goal is 40 gallons per capita (person) per day (40 GPCD). Good examples are:

- 1 gallon milk jug – “40 or fewer milk jugs is what we should use every day indoors.”
- 5 gallon bucket – “Just eight 5-gallon buckets of water are our budget every day.”

STUDENT OUTCOMES

- Students will know that humans have control over how much water they use.
- Students will understand that there are many ways to protect and efficiently use our available water.
- Students will learn that even small changes can have big impacts.
- Students will know the difference between conservation (reducing water use) and efficiency (minimizing the amount of water used to accomplish a task).

INQUIRY QUESTIONS

- What behaviors can I change to control how I use water?
- How are conservation and efficiency related? How are they different?

OVERVIEW

Students will perform an audit to gather information about their indoor water usage and calculate an estimate of their total daily water use. Using this data, they will determine what steps they can take to become more water efficient. Students will investigate the difference between conservation and efficiency and understand that individual changes in behavior can have a large impact on water savings.

TEACHER BACKGROUND

Approximately 1.4 million people live in Denver Water’s service area. If each of those 1.4 million people saved one gallon of water every day by changing their water use behaviors, the savings would amount to half a billion gallons of water per year. Denver Water promotes both conservation and efficiency.

Oftentimes, efficiency is easier and more sustainable to practice than conservation. Efficiency is about getting the same results with less water. For instance, a high-efficiency showerhead that uses 1.5 gallons per minute will get you just as clean as an old, inefficient 5-gallon-per-minute model, using just 30% of the water over the same

amount of time. New research suggests that the goal for a single family home is **40 gallons per person per day (40 GPCD) for indoor use and 12 gallons per square foot of**

irrigated area (12 GSF) annually outdoors. Every individual can change behaviors and practice efficiency in order to meet these goals.

ENGAGE

WHAT EDUCATOR DOES

Pose the question: "In what ways do we use water inside our homes and school in our daily lives?"

Record student ideas in a viewable space (i.e., whiteboard, chart paper, etc.).

Have students estimate how many gallons of water they use per day. Have students think about the different ways they, personally, use water.

- Looking at their list, how would students reduce the total amount of water they use?
- Are their choices realistic?

Show the visual demonstration with the milk jug or bucket and tell students that the goal for all individuals is to use 40 gallons per person per day or less. If they meet or exceed this goal, they are considered "water efficient."

You can choose to display a table showing average use for individual items in the house. For example: Water-efficient toilet = 1.5 gallons/flush; one load of laundry with a high-efficiency washing machine = 27 gallons per load; etc.

This information is listed on **Student Sheet 14: Water Use Data Collection.**

Pass out **Student Sheet 14: Water Use Data Collection** and explain that students will need to complete Step One and Step Two of the sheet. Review the two steps with the students to be sure they understand what information they will need to collect at home.

WHAT STUDENTS DO

Brainstorm ways in which we use water in our daily lives.

Estimate how many gallons of water you use per day. Think about how much water you drink, how long you take a shower, how many times you go to the bathroom, etc.

Looking at the different ways you use water, how could you reduce the total amount of water you use?

Review **Student Sheet 14: Water Use Data Collection** in order to determine the data and information you will need to collect. The data collected will be used for the next step in the investigation.

Estimates will work fine.



ENGAGE

WHAT EDUCATOR DOES

The more accurate the students' data collection, the more accurate their estimated water use will be. However, this is ultimately an estimate and it is more important for students to go through the exercise than to be perfectly accurate. When in doubt, estimate!

WHAT STUDENTS DO

**BREAK: For homework, students should observe and record estimates of the time they spend using water during the day at home and at school. They will need to find out the flow rate of household fixtures and determine if the fixtures at school are water-efficient or not. This can be done by looking for clues on fixtures that clearly state the gallons per minute used, are labeled with "WaterSmart" or are new within the last five years.*



EXPLORE

WHAT EDUCATOR DOES

Have students retrieve their completed **Student Sheet 14: Water Use Data Collection**. Walk through Step Three with students and complete a couple of examples as a class. Give students time to complete the calculations individually or in small groups.

Students who have not completed their data sheet can estimate their usage, work with a partner who did their homework, or you can provide information from your house (prepared ahead of time).

Ask students if anything surprised them about their water use? Did they learn something that they didn't previously know?

Post the following discussion questions and have students discuss them in small groups. Have them write answers to the questions in their science notebook or on a sheet of paper.

1. Are you water-efficient? How do you know?
2. Where are you most water-efficient? Where are you least water-efficient?
3. In what ways could you decrease your indoor water use?
4. How can you become more efficient with your indoor water use?

WHAT STUDENTS DO

Complete the calculations in Step Three of **Student Sheet 14: Water Use Data Collection**.

Discuss with your group:

1. Are you water-efficient? How do you know?
2. Where are you most water-efficient? Where are you least water-efficient?
3. In what ways could you decrease your indoor water use?
4. How can you become more efficient with your indoor water use?



EXPLORE

WHAT EDUCATOR DOES

Confer with students and ask probing questions such as:

- How did your results differ from others in the group? Why did the answers differ?
- What can you deduce about others in the group based on their data?
- What things can you do to become more water efficient?
- What can you suggest to others in your home so they can become more efficient?
- What might you suggest to others in your group about their water use?
- If you are efficient, can you still conserve? If you are conserving, can you become more efficient? How?

WHAT STUDENTS DO



EXPLAIN

WHAT EDUCATOR DOES

In small groups or individually, students should research and brainstorm ways to conserve water and be more efficient with their water use. Have students answer the following inquiry questions based on their research and brainstorming ideas:

- What changes can I make to impact my daily water use?
- What water uses do I have control over?
- How are conservation and efficiency related? How are they different?

Make sure to highlight the differences between conservation and efficiency. Students can research this or lead this discussion about the differences.

WHAT STUDENTS DO

Based on your individual results and research, brainstorm ways to save water (conserve) and to become more efficient. Make sure to answer the inquiry questions:

- What changes can I make to impact my daily water use?
- What water uses do I have control over?
- How are conservation and efficiency related? How are they different?



DEBRIEF AND REFLECT

WHAT EDUCATOR DOES

Bring the class back together.

Have students declare whether they are water-efficient or not (either by moving to opposite sides of the room, raising hands, standing up, etc.).

Have students pair up: one nonefficient with one efficient water user (make adjustments based on the population of your class).

Have students discuss the questions and write an exit ticket to turn in at the end of class.

Have students answer one or two additional questions from the inquiry questions for their exit ticket.

WHAT STUDENTS DO

Write an exit ticket that answers one of the following questions:

- For students who are efficient: Is there a behavior that stands out as the one that makes the difference for you in being water-efficient or not? If you were to change one or two behaviors, would that make you water-inefficient?
- For students who are NOT efficient: What could you do to become more efficient? What change(es) can you make in your behavior that is sustainable and will make a difference in your water use?

Individually or as a group, answer one or more of the following questions:

- How do I control my water use?
- How are conservation and efficiency related? How are they different?



ASSESSMENT OPTIONS

Collect the exit ticket.

AS AN EDUCATOR YOU ARE LOOKING FOR:

- Efficient students — to identify the one or two behaviors they have now that could easily push them over the line into the inefficient category if they stopped doing them. The idea is for students to see that one or two behaviors can really make a difference in water use. They need to stay vigilant and continue to practice these water-saving habits.
- Inefficient students — to identify sustainable changes they can make in their behavior to conserve or become more efficient with water. What are realistic and sustainable changes?

INQUIRY QUESTIONS:

- The first question will vary from student to student, but students should recognize that they have control over their own behaviors and can make water-conscious choices based on that knowledge. Students may not have control over the fixtures in their house, but they can do things that will help reduce overall water use (for example, filling a bucket while the shower heats up and using that water for plants, for cleaning or to flush the toilet).
- Conservation vs. efficiency: Student answers should embody the points below:
 - Conservation: Beneficial reduction in water loss, waste or use. Water conservation includes all of the policies, programs and practices designed to help us use less water. The goal is to use only the water we need. For example, turning off the water when you brush your teeth, or only running the dishwasher when it's full.
 - Efficiency: Minimizing the amount of water used to accomplish a function, task or result. Water efficiency means doing more with less water. For example, washing dishes or flushing the toilet with the least amount of water necessary to get the job done. This incorporates advancements in technology that enable appliances and fixtures to use water differently.

EXTEND

Have students commit to a water-saving behavior change for at least one week and reflect on how this change affected them. Was it easy? Was it difficult? Can you continue this change or make more modifications to positively impact your water use?

ADDITIONAL RESOURCES

Online resource suggestions are available at denverwater.org/werg



INDOOR WATER USE DATA COLLECTION

A lot of information is needed to calculate how much water we use. Use the following steps to help you collect data on how much water you use each day. Complete Step One and Step Two at home with the help of a parent or guardian.

STEP ONE: DIRECT WATER USE DATA COLLECTION

Use the table below to collect the data you will need to calculate the amount of water you use each day. Data that you will be collecting includes: length of time you do an activity using water; the number of times you do an activity using water; and the flow rate of the fixture you are using.

TABLE 1: INDIVIDUAL WATER USES DATA

	A	B
WATER USE ACTIVITY	LENGTH OF TIME OR NUMBER OF TIMES PER DAY	FLOW RATE OF FIXTURE* OR AMOUNT USED
Shower		
Bath		
Toilet		
Bathroom faucet(s)		
Kitchen faucet(s)		
Water for drinking		
Dishwasher		
Laundry		

TABLE 2: FAMILY WATER USES DATA

WATER USE ACTIVITY	NUMBER OF TIMES PER WEEK	GALLONS PER CYCLE
Dishwasher		
Laundry		

**If you aren't sure of the flow rate of a fixture, there are a few things you can do to find out.*

1. LOOK FOR LABELS. Some faucets and toilets will have labels identifying how much water is used. Look for these labels above and below the sink.

2. TIME IT.

a. For a faucet: Get a large bowl and a timer. Set your timer for 10 seconds. Turn the faucet on full blast and insert your bowl under the flow at the same time you start your timer. After 10 seconds turn off the water. Count the number of 1-cup measures you have collected in the bowl, convert to gallons and multiply by 6 (see example below, then use the table below to decide if your fixture is efficient or not. Use the water in the bowl to water plants, fill your bath or clean. Don't pour it down the drain.

Example: You collect 7 cups of water
Your calculations will look like this:
7 cups of water x 8 ounces per cup = 56 ounces
56 ounces ÷ 128 ounces per gallon = 0.4375 gallons
0.4375 gallons x 6 (number of 10 second blocks per minute) =
2.625 gallons per minute (GPM)

SOME HELPFUL CONVERSIONS:
1 CUP = 8 OUNCES
128 OZ = 1 GALLON

b. For toilets: Calculate the volume of the toilet tank with a tape measure or ruler by measuring the length, width and depth (in inches) of the toilet tank. Divide the answer by 231 to get the number of gallons.

Example: 13 inches x 14 inches x 3 inches = 546 cubic inches
546 cubic inches ÷ 231 = 2.4 gallons

3. ASK YOUR PARENTS IF THEY KNOW. They may have purchased water-efficient fixtures deliberately or know which year they were installed. Most fixtures purchased and installed after 1990 are water efficient.

4. ESTIMATE. Use the chart below to estimate the flow rate of fixtures in your house. Generally, if you live in an older home (built before 1990), fixtures are less efficient (unless they have been recently replaced) than fixtures in newer homes.

WATER USE ACTIVITY	INEFFICIENT		EFFICIENT	
Shower	5 gallons per minute (GPM)	2.5 GPM	2 GPM	1.5 GPM
Toilet	3 gallons per flush (GPF)	1.6 GPF	1.28 GPF	1.1 GPF
Faucet	5 GPM	2.5 GPM	1.5 GPM	1 GPM
Bathtub	40 gallons, standard tub	70 gallons, jet tub	N/A	
Dishwasher	6 gallons per cycle (GPC)		4 GPC	
Clothes Washer	36 GPC, standard top-load		22 GPC	14 GPC

STEP TWO: INDIRECT WATER USE DATA

Answer the following questions to help you calculate your water footprint (the total of your direct and indirect water use). You will use this information in an online water calculator and learn more about your water footprint in Investigation 6.2.

1. Estimate how many miles your family drives each week. _____ miles
2. How often does your family wash their car/s. _____ times each (circle one)
week month
3. Estimate how much of your household power comes from alternative sources (Circle One)
100% solar/wind or alternative 50/50 100% power plant
4. How often do you and members of your family shop (don't include grocery shopping) (Circle One)
Just the basics (1-2 times per week) Like to shop (3-6 times per week)
Love shopping (6 or more times per week)
5. What items do you typically recycle as a family? (Circle One)
Paper Glass Steel/Aluminum Clothing Electronics None
6. If you have a pet, estimate how much money is spent on pet food each month. _____
7. Are you an **Omnivore** or **Vegetarian**? (Circle One)
 If you are an omnivore, estimate the number of times per day your family eats meat. _____.

STEP THREE: DIRECT WATER USE DATA ANALYSIS

Using the data collected in Step One, calculate your water usage using the tables below. You will add your water usage from Table A and Table B to figure out whether you are water efficient.

TABLE 3: INDIVIDUAL WATER USE DATA ANALYSIS

WATER USE ACTIVITY	COLUMN A (FROM STEP ONE)	MULTIPLY	COLUMN B (FROM STEP ONE)	C
	LENGTH OF TIME OR NUMBER OF TIMES PER DAY		FLOW RATE OF FIXTURE OR AMOUNT USED	INDIVIDUAL WATER USE (IN GALLONS)
Shower		X		
Bath		X		
Toilet		X		
Bathroom faucet(s)		X		
Kitchen faucet(s)		X		
Water for drinking		X		
TOTAL				

EXAMPLE:

WATER USE ACTIVITY	COLUMN A (FROM STEP ONE)	MULTIPLY	COLUMN B (FROM STEP ONE)	C
	LENGTH OF TIME OR NUMBER OF TIMES PER DAY		FLOW RATE OF FIXTURE OR AMOUNT USED	INDIVIDUAL WATER USE (IN GALLONS)
Shower	15 min	X	4 gallons/min	60 gallons
Water for drinking	3 times per day	X	12 oz water bottle	36 ounces (36 ÷ 128 oz/gallon = .28 gallons/day)
TOTAL				60.28 GALLONS

TABLE 4: FAMILY WATER USES DATA ANALYSIS

WATER USE ACTIVITY	COLUMN A (FROM STEP ONE)	MULTIPLY	COLUMN B (FROM STEP ONE)	TOTAL WATER USAGE PER WEEK	NUMBER OF DAYS PER WEEK	DAILY WATER USAGE	NUMBER OF FAMILY MEMBERS	C
	NUMBER OF TIMES PER WEEK		FLOW RATE OF FIXTURE					INDIVIDUAL WATER USE (IN GALLONS)
Dishwasher		X			÷ 7		÷	
Laundry		X			÷ 7		÷	
TOTAL								

EXAMPLE:

WATER USE ACTIVITY	COLUMN A (FROM STEP ONE)	MULTIPLY	COLUMN B (FROM STEP ONE)	TOTAL WATER USAGE PER WEEK	NUMBER OF DAYS PER WEEK	DAILY WATER USAGE	NUMBER OF FAMILY MEMBERS	C
	NUMBER OF TIMES PER WEEK		FLOW RATE OF FIXTURE					INDIVIDUAL WATER USE (IN GALLONS)
Dishwasher	5	X	6 GPC	30 GALLONS	÷ 7	4.3	÷ 4	1.075 GALLONS

The industry standard for a water efficient individual is **40 gallons per day**.

_____ gallons + _____ gallons = _____ gallons

**TABLE 3 TOTAL
(COLUMN C)**

**TABLE 4 TOTAL
(COLUMN C)**

**DIRECT WATER
USE TOTAL**

Are you water efficient?

YES

I use 40 gallons per day or less

NO

I use more than 40 gallons per day