

Water Citizen Science

Ashlynn S. Stillwell

Civil and Environmental Engineering, University of Illinois Urbana-Champaign

ashlynn@illinois.edu

Supply list

- Research notebook: Researchers keep notes of data and findings in a research notebook as a way to document what they learn.
- Pen: It's a good idea to write notes in pen instead of pencil, just in case your research notebook gets wet on accident.
- Measurement tools: You'll need a stopwatch, gallon-size container, funnel, and thermometer to take measurements. After you've taken measurements, you might want a calculator to complete your analysis.

Water We Doing Here? Learn About Residential Water Use

In most U.S. homes, all of the water piped into homes is fresh drinking water. That water was either treated at a drinking water treatment plant and pumped through a distribution system to our homes, or perhaps that water was pumped from a private groundwater well. In a drinking water treatment plant, engineers and operators use a combination of physical and chemical treatment processes to make water safe for humans to drink.

Once water gets to our homes, it moves around in pipes inside the home. Those pipes are known as premise plumbing. Premise plumbing pipes can be made of many different materials, such as copper, plastic, brass, galvanized iron, or stainless steel, depending on the age and location of your home. Water in homes travels through pipes to different end uses in appliances (like a dishwasher or clothes washer) and fixtures (like a faucet or showerhead).



Copper

Plastic

Brass

Galvanized iron

Stainless steel

Once we're done using water, it becomes wastewater that drains through a sewer system to a wastewater treatment plant or septic tank. In a wastewater treatment plant, engineers and operators use a combination of physical, biological, and chemical treatment processes to clean wastewater so it's safe to return to the environment.

Get to know the water in your home.

- Make a list of all of the appliance and fixtures in your home that use water. Record your list in your research notebook.
- Inspect the water pipes in your home. What material are they made of?

Science and Engineering Skills: Measure Water Use

The average U.S. home uses about 95 gallons of water per person per day¹. How much water do you use in your home? Let's estimate water use at some common end uses.

Toilet

Residential toilets typically use drinking water, stored in the tank behind the bowl, to flush waste. Take the lid off a toilet tank and check out the flushing mechanism, typically a chain connecting the flush lever to a flapper at the bottom of the tank that allows water to flush waste from the bowl. After flushing, the bowl refills until a float makes the water flow stop.

How much water a toilet uses is typically printed on the bowl just behind the seat, such as 1.6 gpf (gallons per flush).

If we count the number of flushes, we can estimate total water use for toilet flushing:

Find this value on your toilet

Count this value for one day

$$\boxed{} \text{ gpf} \times \frac{\boxed{} \text{ flushes}}{\text{day}} = \boxed{} \text{ gal/day}$$

For example, if you flush the toilet 6 times per day and each flush uses 1.6 gpf, you use:

$$1.6 \text{ gpf} \times \frac{6 \text{ flushes}}{\text{day}} = 9.6 \text{ gal/day}$$

Try it yourself:

- Count the number of toilet flushes for one day. Estimate the total water use for toilet flushing for that day, and record the value in your research notebook.

¹ DeOreo, William B., Peter Mayer, Benedykt Dziegielewski, Jack Kiefer. (2016). *Residential End Uses of Water, Version 2*. Water Research Foundation.

Shower

We often take warm showers, and that means showers use both water and energy (for water heating; more on that later). Let's focus on water. Different showerheads have different flow rates, or amounts of water that come out of the showerhead. Sometimes showerhead flow rates are printed on the showerhead itself, and modern showerheads use 2.5 gpm (gallons per minute) or less.

If we time the length of a shower, we can estimate total water use for showering:

Find this value on your showerhead

Use a stopwatch to time a shower

$$\boxed{} \text{ gpm} \times \boxed{} \text{ sec} \times \frac{\text{min}}{60 \text{ sec}} = \boxed{} \text{ gal}$$

If you can't find a value, use 2.5 gpm

For example, if you use a stopwatch to time your shower, and the reading is 678 seconds, you use:

$$2.5 \text{ gpm} \times 678 \text{ sec} \times \frac{\text{min}}{60 \text{ sec}} = 28.25 \text{ gal}$$

Try it yourself:

- Use a stopwatch to time the length of your shower. Estimate the total water use for your shower, and record the value in your research notebook.

Faucets

Different faucets have different flow rates. Outdoor faucets often have high flow rates, while handwashing sinks often have low flow rates.

Choose a faucet, either inside or outside your home. Using a stopwatch, time how long it takes to fill up a 1-gallon container, like an empty milk jug. A funnel can be helpful. Using the time information, we can calculate the flow rate of that faucet:

$$\frac{1 \text{ gallon}}{\boxed{} \text{ sec}} \times \frac{60 \text{ sec}}{\text{min}} = \boxed{} \text{ gpm}$$

Use a stopwatch to time how long it takes to fill your 1-gallon container

For example, if it takes 14 seconds to fill your 1-gallon container, the faucet flow rate is:

$$\frac{1 \text{ gal}}{14 \text{ sec}} \times \frac{60 \text{ sec}}{\text{min}} = 4.3 \text{ gpm}$$

Try it yourself:

- Select a faucet, either inside or outside your home. Use a stopwatch to time how long it takes to fill a 1-gallon container. A funnel can be helpful. Estimate the flow rate of the faucet, and record the value in your research notebook.

In Hot Water: Your Home's Water Heater

Many water uses in our homes use hot water, like warm showers and baths. Water heaters use different sources of energy, such as electricity, natural gas, or propane, to heat the cold water that enters our homes. Some water heaters collect energy as heat from the sun or from underground sources. The most common forms of water heaters are storage tank water heaters, which store hot water in a large cylindrical tank, and tankless water heaters, which heat water on demand.



Storage tank
water heater



Tankless
water heater

Water heaters use an energy source to heat water to a set point temperature, which is the hot water temperature. The set point temperature should be hot enough to provide suitably hot water, but not so hot to be unsafe. The recommended residential water heater set point temperature is 120°F (49°C). Higher temperatures (around 140°F (60°C)) can help prevent biological growth in water; however, high temperatures present a scalding risk, especially in young children.

Use Resources Wisely: Water heating is the third highest use of energy in U.S. homes, on average, behind air conditioning and space heating². That means any time you save hot water, you're saving both water and energy.

With the help of a caring adult, learn more about your home's water heater:

- Find out what energy source your home's water heater uses. The most common options are electricity, natural gas, and propane, but other options are possible.
- Find your water heater's set point temperature. Set point temperatures are typically between 120-140°F (49-60°C). You can read more about adjusting the set point temperature here: <https://www.cnet.com/how-to/how-to-adjust-the-temperature-of-your-water-heater/>.
- Using a thermometer, measure the temperature of hot water at a faucet. Allow the water to run until hot water flows out of the tap. Record the temperature in your research notebook and compare it with the set point temperature. Discuss the temperatures you recorded with other members of your troop.

Safety-Wise: **Hot water can be really hot!** Water at 150°F (66°C) can cause third-degree burns in as little as 2 seconds.

² Energy Information Administration. (2020). *Residential Energy Consumption Survey*. U.S. Department of Energy. Available: <https://www.eia.gov/consumption/residential/>.

Take Action: Water Conservation Challenge

Challenge yourself and your family to reduce water consumption at home. For one month, try some or all of the water conservation ideas below:

- Take shorter showers or take showers instead of baths.
- Wash dishes in a dishwasher instead of by hand.
- Reduce outdoor watering and/or collect rainwater for outdoor plants.
- Wash only full loads of laundry.
- Flush the toilet less often: "If it's yellow, let it mellow. If it's brown, flush it down."

Then, with the help of a caring adult, compare water bills (if available) from a 'normal' month to your 'conservation' month. How much did you save? Record your 'before' and 'after' values in your research notebook and compare values with other members of your troop.

If you or your troop would like to share data for research purposes, contact Dr. Ashlynn Stillwell at ashlynn@illinois.edu.

Water Career Exploration

Learn about different career options in the water sector.

- Plumber
- Utility manager
- Engineer

Research different water careers or invite a water professional to talk to your troop.