WE CARE ABOUT WATER.
IT'S WHAT WE DO.®

INDIANA
AMERICAN WATER

Source to Tap

The Source, Processing and Delivery of Drinking Water

- **Grade Level:** 7-12
- **Objective:** Students will gain an understanding of different types of water sources, water treatment processes and the importance of investing in water and wastewater systems.
- **Subjects:** Biology, Environmental Studies, Mathematics, Chemistry, Writing

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INTRODUCTION

The origins of the municipal water supplies in the United States are as diverse as the cities and communities that dependent on it. Changes in access and delivery of water service has occurred over time to maintain the quality and quantity of water needed by millions of Americans. Though the water bill is one of the lowest utility bills paid by a household*, we shouldn't take this essential service for granted. Aging infrastructure and dwindling supplies can not be ignored.

For example, the Environmental Protection Agency estimates that more than $335 billion in capital spending is needed nationwide by 2027 to replace aging water infrastructure and comply with stricter water quality standards, and the amount needed for our wastewater systems is even greater.

Ensuring the sustainable use of our drinking water resources is key. To do this, we must start by:

- understanding where our water comes from.
- being accountable, personally, for ways we can promote sustainable use and conservation of our drinking water resources.
- realizing the true value of water service and what it takes to treat, monitor and deliver it to customers.
- taking the steps necessary to ensure the upkeep of our nation's water and wastewater systems.

To get a true picture of what's involved with the treatment and delivery of your drinking water, contact your water service provider and ask them to visit your school or civic group to discuss specifics about your drinking water. They can provide you with information on your drinking water source, water quality, the water treatment process, conservation, watershed protection and more.

* For most American Water customers, a gallon of tap water is about a penny a gallon.

DID YOU KNOW?

According to the EPA, it costs more than $3.5 billion to operate water systems across the U.S. each year.

MATERIALS NEEDED

- Piece of paper
- Pen or pencil
- Calculator
- Enclosed data sheets

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EXERCISE

For each metro region listed below, students will research the water sources, typical treatment processes and potential environmental concerns. Students will also take a closer look at the three systems' data sets to calculate trends and generate discussion about use and cost.

TASK 1: SOURCE WATER

Each metro area draws its drinking water from different sources: groundwater/aquifer, surface water/river, and seawater/desalination. For each source:

- Define each source and their key characteristics
- Identify potential sources of contamination
- Discuss some of the ways these resources can be protected from contamination

TYPICAL SOURCES OF DRINKING WATER

☐ **Groundwater/acquifer**

☐ **Surface Water (River, lake, stream, reservoir)**

☐ **Seawater/Desalination**

TASK 2: WATER TREATMENT

1. Define each step of the water treatment process listed below in the space provided. In what order do they typically occur? Place the number accordingly in the box beside the step.
2. Research and diagram the typical water treatment process for surface water, groundwater and seawater. Discuss the similarities and differences of each. Based on your research, discuss which is most challenging and least challenging to treat.
3. Research what expertise is required to treat and deliver water?

TYPICAL STEPS IN WATER TREATMENT

☐ Filtration

☐ Storage/Distribution

☐ Floculation

☐ Source Water

☐ Disinfection

☐ Clarification

TASK 3: DISTRIBUTION, USE AND COST

From the metro area data charts to the right, produce a column graph in Excel for each of the following data points:

- Population
- Water use per family of four per year
- Total water use per metro area per year
- Cost of annual water supply per family of four
- Total cost of annual water supply for the metro area
- Total miles of water mains requiring replacement
- Total cost per metro area to replace the water mains (While in true life, this would vary based on a number of factors, including type and size of main, location of the pipeline, soil conditions and more, for the purposes of this exercise, we will use a cost of $175.00 per foot to install the main.
- Cost per capita to replace water mains (divide total cost by the metro population)

Note: The data provided in this task is not representative of a specific metro area in the state. It was created for the purposes of this exercise only.

WASHINGTON METRO AREA

Drinking water source	Surface water (River)
Population	170,000
Ave. per capita (per person) water use per day	65
Miles of water main	325
% of pipes in need of replacement	35
Ave. cost per 1,000 gallons of tap water	$10.10

KANSAS METRO AREA

Drinking water source	Groundwater aquifer
Population	100,000
Ave. per capita (per person) water use per day	90
Miles of water main	250
% of pipes in need of replacement	40
Ave. cost per 1,000 gallons of tap water	$8.40

FLORIDA METRO AREA

Drinking water source	Seawater/ Desalination
Population	325,000
Ave. per capita (per person) water use per day	125
Miles of water main	420
% of pipes in need of replacement	30
Ave. cost per 1,000 gallons of tap water	$12.25

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QUESTIONS

1. What factors could explain why the price of water varies in different regions?
2. What could account for the differences in the average water used per person?
3. Which water supply represents the greatest potential for sustainable use? Explain.
4. Why is it important to invest in water infrastructure?
5. Is it economically feasible to replace all the pipe? What would the impact be on the customer's rates for each system? If you were in charge of replacing the pipe, but you couldn't complete all the projects due to funding, what would be your criteria for prioritizing the projects?
6. For some municipalities, it can be challenging to determine the state of their water infrastructure. What are some of the possible reasons?

EXTENSIONS

- Reference your water bill to determine how much you pay per gallon of tap water. Is it a good value?
- Water main replacements are just one of the costs of running a water system. What other types of investments or expenses are incurred?
- Research the source of your community's drinking water. In some cases, it could be a combination.
- What programs are available to educate the public about water supply issues? If there are none, contact your local municipal water source facility and put together a program for educating residents.
- Visit your water utility's website. Do they invest in their water treatment and distribution facilities?

NOTES

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DEFINITIONS

- **Aqueduct:** It is a water supply or navigable channel (conduit) constructed to convey water from one location to another.
- **Aquifer:** Porous, water-saturated layers of sand, gravel or bedrock that can yield a significant amount of water.
- **Desalination:** The process of removing excess salt and other minerals from water.
- **Water Infrastructure:** The basic physical and organizational structures needed for the treatment and delivery of water to a municipality or region. This includes, but is not limited to the treatment plant, mains, water storage tanks, pumping stations, valves, fire hydrants and service lines.
- **Salt Water Intrusion:** The movement of saline water into freshwater aquifers. This is more common in coastal locations with high demand and access to groundwater supplies.
- **Watershed:** Land area that delivers the water, sediment and dissolved substances via small streams to a major stream (river).
- **Xeric:** Referring to landscapes, natural or anthropogenic, that require only a small amount of moisture.

RESOURCES

- www.EPA.gov
- www.usgs.gov – enter search word of choice

COMMENTS

We want to know what you think. Feedback and/or suggestions for improving this lesson plan can be e-mailed to joi.corrado@amwater.com.

In a world where everything we touch frequently changes, water is our constant. We've never stopped needing it to drink, to cook, to clean, to live. We'll always need it for sanitation, for fire protection, for watering our lawns and washing our cars.

It's easy to take water for granted. And because so many do, we don't.

We are scientists, environmentalists, innovators, and protectors. We are also residents and employees in the communities we serve. We understand how important, how precious, and how critical water is to daily life.

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Join us this year as we celebrate 125 years of service to our customers and our communities.

Visit **www.amwater125.com** to learn more about our company and our years of tradition of reliability, responsibility, service, innovation and excellence.

A special thanks to Ron Smith for developing the core content of this lesson plan. Ron Smith, a science educator from NJ, has been teaching biology, environmental science and interdisciplinary studies in the classroom, lab and field for 18 years. It was important for us that our lesson plans be crafted by an educator for educators. We appreciate his hard work.

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