SCHOLASTIC

Classroom Poster and Teaching Guide

Water Works

Science experiments and lessons about pressure, gravity, conservation, and getting water to your tap

STEM materials for grades 3–5 and 6–8

Meets New Jersey Core Curriculum Content Standards

Sponsored by:

NEW JERSEY AMERICAN WATER

Welcome Teachers,

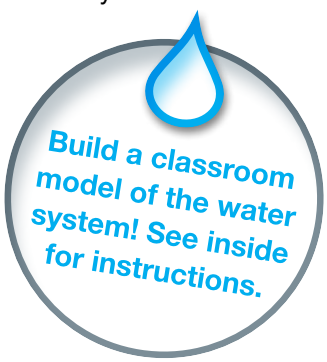
Dive into the magical world of water! **Water Works** will help your students learn how water is cleaned and transported through hands-on experiments about:

- Gravity
- Conservation
- Pressure
- The Water Cycle

Plus, students will put these concepts into practice by building a model water system!

Created by **Scholastic** with the support of **New Jersey American Water**, the STEM lessons and worksheets within this program meet a variety of New Jersey Core Curriculum Content Standards. We hope that they provide a useful and exciting supplement to your existing lessons about the water cycle and earth science.

Enjoy!



The lessons within this program meet the following New Jersey Core Curriculum Content Standards

Standard/Strand	Content Statement	Lesson 1	Lesson 2	Lesson 3
Science Practices: Understand Scientific Explanations	Gr. 3–4: Outcomes of investigations are used to build and refine questions, models, and explanations.	X	X	X
	Gr. 5–8: Core scientific concepts and principles represent the conceptual basis for model-building and facilitate the generation of new and productive questions.	X	X	X
	Gr. 5–8: Predictions and explanations are revised based on systematic observations, accurate measurements, and structured data/evidence.	X	X	X
Science Practices: Generate Scientific Evidence Through Active Investigations	Gr. 3–4: Tools and technology are used to gather, analyze, and communicate results.	X	X	X
	Gr. 5–8: Mathematics and technology are used to gather, analyze, and communicate results.	X	X	X
Science Practices: Participate Productively in Science	Gr. 5–8: Science involves practicing productive social interactions with peers, such as partner talk, whole-group discussions, and small-group work.	X	X	X
Physical Science: Forces and Motion	Gr. 3–4: Earth pulls down on all objects with a force called gravity. Weight is a measure of how strongly an object is pulled down toward the ground by gravity. With a few exceptions, objects fall to the ground no matter where they are on Earth.		X	
	Gr. 5–6: Magnetic, electrical, and gravitational forces can act at a distance.	X	X	
	Gr. 5–6: Sinking and floating can be predicted using forces that depend on the relative densities of objects and materials.	X		
	Gr. 7–8: Forces have magnitude and direction. Forces can be added. The net force on an object is the sum of all the forces acting on the object. An object at rest will remain at rest unless acted on by an unbalanced force. An object in motion at constant velocity will continue at the same velocity unless acted on by an unbalanced force.	X	X	
Earth Systems Science: Biogeochemical Cycles	Gr. 3–4: Most of Earth's surface is covered by water. Water circulates through the crust, oceans, and atmosphere in what is known as the water cycle.	X		X
	Gr. 5–6: Personal activities impact the local and global environment.		X	

Source: State of New Jersey Department of Education

The following lessons include recommendations for adding an additional layer of difficulty for more advanced classes.

Lesson 1: Water Works

Objective: Explore the role that engineering and science play in clean drinking water.

Materials: river, lake, or tap water that has been "dirtied" with sand, pencil shavings, etc.; funnel or empty soda bottle with the wide end cut off; cotton ball; one cup each of sand and gravel; one empty cup; **Water Works Student Worksheet 1**

Time required: 40 minutes

Getting Started:

1. Place the cap on the soda bottle or use a piece of tape to block the end of the funnel. Insert the following into the funnel in this order:
   a. Cotton ball (wedge into the thinnest part of the funnel or bottle)
   b. Layer of sand
   c. Layer of gravel
2. Show students the dirty water. Ask: *Does this look like water that comes out of our faucet*? (No) Explain that this is what water looks like before it has been cleaned and filtered for drinking.
3. Remove the funnel's cap and slowly pour the water over the top of the gravel layer. Watch the dirty water slowly filter through the layers and catch the "cleaned" water in the empty cup.
4. Explain that this **Water Works** program will allow students to learn how water is pumped out of the ground, filtered and cleaned, and then delivered to homes and businesses.

Using the Student Worksheet:

5. Distribute **Water Works Student Worksheet 1** and read it together.
6. Discuss the filtration process and complete the writing assignment. Consider watching the video **Water and You: The Treatment Process** at **www.scholastic.com/njaw.**
7. **Explain:** *All life on Earth needs water to survive. It's constantly being used and then recycled through a process known as the water cycle.*
8. Review the water cycle and/or watch the video **Water and You: The Water Cycle** at www.scholastic.com/njaw.

Wrap-up:

9. Build a model water system with your class! Review the **Build a Model Water System** instructions within this program and complete Step 1.

Lesson 2: The Force of Gravity

Objective: Build a working pump and observe the effect of gravity on water.

Materials: two empty plastic cups; straw; soap dispenser pump; dishpan or other basin; tap water; **Archimedes of Syracuse Student Worksheet 2**

Time required: 40 minutes

Getting Started:

1. Place two empty cups in a dishpan. Fill one cup with tap water. Give one student a straw and challenge him or her to pour water from one cup into the other through the straw.
2. Ask the observing students to record their observations and provide suggestions for transferring the water through the straw more efficiently. Ask: *How much water is "lost" into the basin*? *How long does it take*? (Advanced classes: Ask students to take exact measurements using measuring cups, scales, and a timer. Compare the results of different ideas.)
3. Give students a soap dispenser pump. Ask: *How do you think the results will change if we use a pump*? *(Faster, more efficient)*
4. Empty the basin and refill the cups. Use the pump to transfer water from one cup to the other. Record the results.

Using the Student Worksheet:

5. **Ask:** *Where do we use pumps in our everyday lives*? (Soap dispensers, plumbing, gas pump, heating systems, home aquariums, your heart, etc.)
6. Distribute copies of **Archimedes of Syracuse Student Worksheet 2** and build an Archimedes screw-style pump as a class. Explain that a screw pump is a machine made out of an incline plane. Turning the screw lifts the water up. (Advanced classes: Separate students into teams and have each build their own pump.)

Wrap-up:

7. Find a water tank on the classroom map. Explain that water is pumped to the top of these towers by many different kinds of pumps. Explain that water tanks are elevated because height impacts pressure. It would take more pressure to pump water to a house that is at the top of a hill than to one at the bottom of the same hill.
8. Ask: *If your town was 10 miles wide instead of three miles wide, how could you change your water tank to provide more pressure*? (Rebuild on a hill, make it hold more water, make it taller)
9. Build a model water system with your class! Follow the **Build a Model Water System** instructions within this program and complete Steps 2–6.

Lesson 3: Water Conservation

Objective: Learn about New Jersey's water supply and why water conservation is important.

Materials: two empty plastic cups; one cup each of rocks, gravel, and sand; tap water; **Water Wisdom Student Worksheet 3**

Time required: 40 minutes

Getting Started:

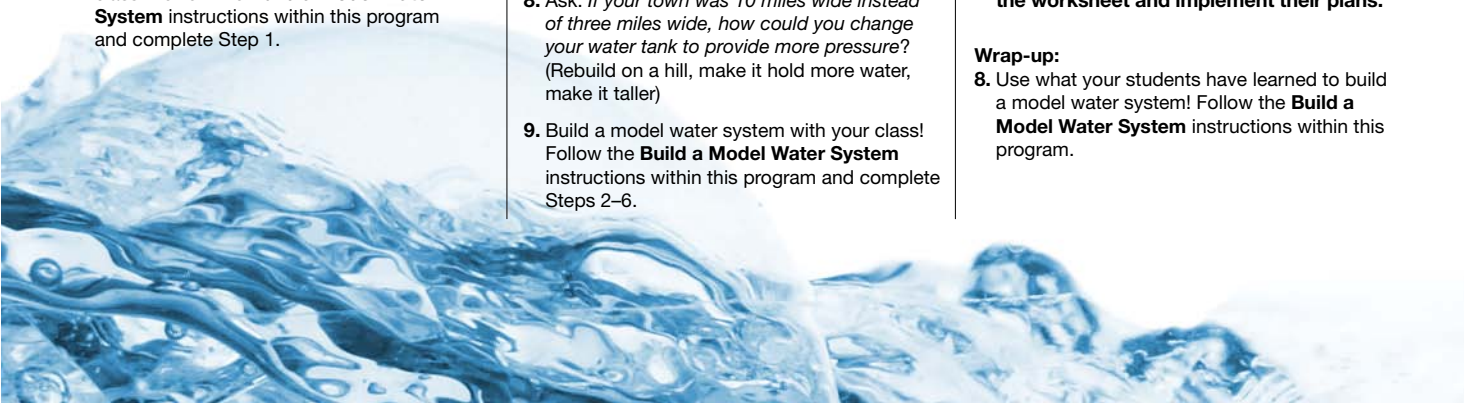
1. Place two clear plastic cups on a table at the front of the class. Ask students to create three layers of sediment in one of the cups: rocks (bottom), gravel (middle), sand (top). The cup should be filled $^{2}/_{3}$ of the way. Fill the other cup with tap water.
2. Pour the tap water (slowly) into the sediment-filled cup. Ask students to write down their observations: *Does the water flow more quickly through certain layers? Can you see the water in between the rocks, gravel, or sand*? (Advanced classes: Separate students into teams for this activity. Have each team make a hypothesis before starting.)

Using the Student Worksheet:

3. Write the word *aquifer* on the board and explain that an aquifer is nature's way of storing water underground. When rainwater seeps into the ground, it squeezes through layers of earth until it is stopped by a layer of porous rock (rock with pores or holes) or sediment (sand or gravel) and collects into an underground reservoir.
4. **Ask:** *What is a drought*? (A water shortage) *Have you ever had to reduce the amount of water that you use due to shortages*? Moderate a classroom conversation about recent water restrictions in New Jersey. (Advanced classes: Conduct an online search for more information about your local aquifer.)
5. Separate students into groups and distribute **Water Wisdom Student Worksheet 3**. Read the worksheet together.
6. **Ask:** *Do you think New Jersey is running out of water*? **Explain that the number of people living in New Jersey has outgrown what the local aquifers can support. In addition, saltwater and pollution have damaged the water supply and reduced the amount of drinkable water.**
7. **Encourage students to get the word out about the importance of conservation! Provide class time for groups to complete the worksheet and implement their plans.**

Wrap-up:

8. Use what your students have learned to build a model water system! Follow the **Build a Model Water System** instructions within this program.



Student Worksheet 1

Name: _____

Water Works

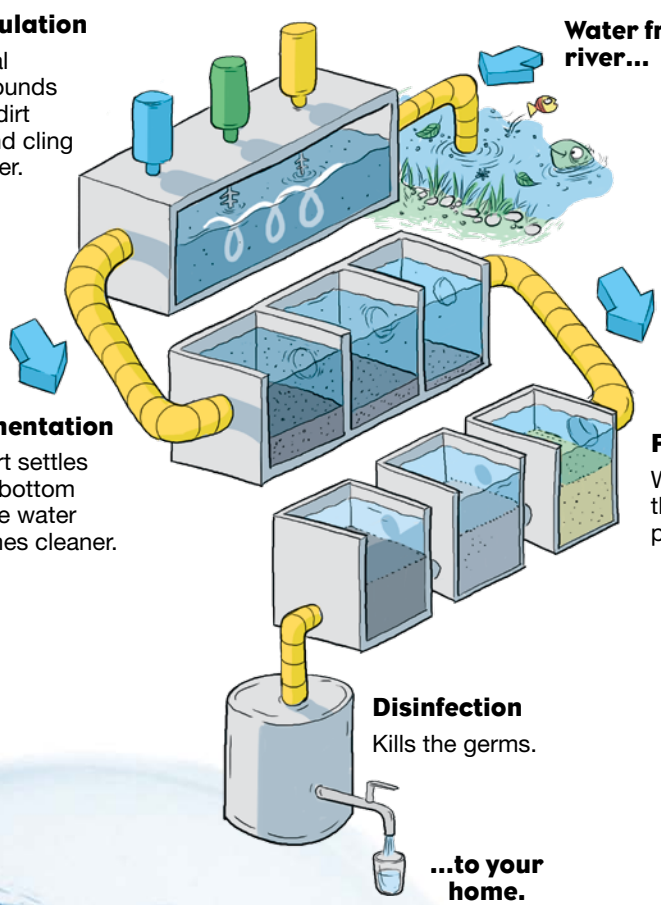
It takes some very cool science to get clean water into your kitchen, bathroom, and neighborhood fire hydrant!

All across New Jersey, dams, reservoirs, pumping stations, water treatment plants, water tanks, and pipes pump, clean, and distribute water 24 hours a day, seven days a week. Right now, deep under your feet, pipes are carrying freshwater and wastewater across the state. Many of them are more than 100 years old! The smallest of these pipes is two inches in diameter, and the largest is 72 inches. That's a lot of water.

Every day teams of engineers, scientists, and environmental experts use science to design ways to make water delivery more energy efficient and pumps, gravity, friction, and magnetism all play important roles. Look at your classroom poster and trace the path of raw water into treatment plants and then into homes, businesses, and schools.

Now let's look at how science transforms raw water into clean, drinkable water.

Water Treatment Process



THINK ABOUT IT:
New Jersey American Water produces 330 million gallons of water a day. That's enough to fill Giants Stadium.

Student Worksheet 2

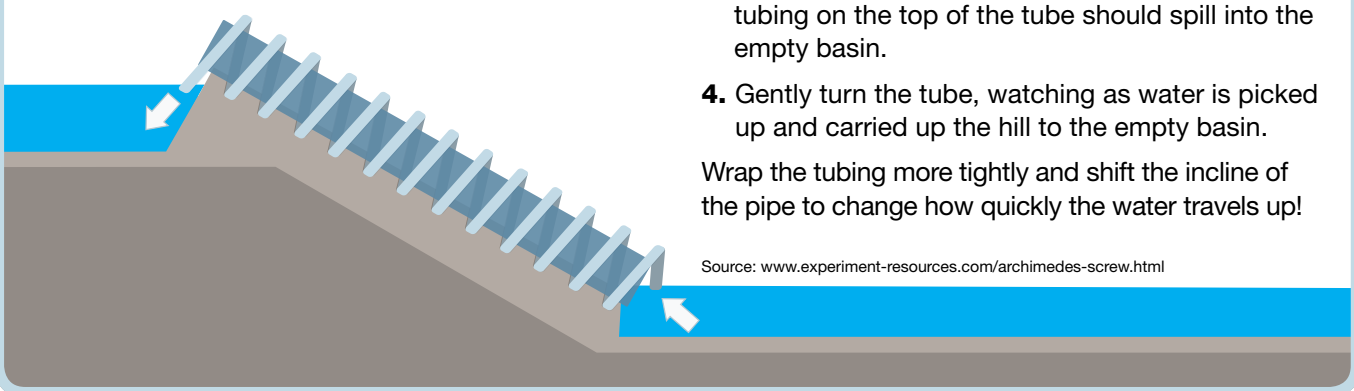
Name: _____

Archimedes of Syracuse

Archimedes of Syracuse was a mathematician and inventor who lived in Italy during the 3rd century BC. He studied the mathematics of pulleys and levers and is best known for inventing a pump that is still used today.

As with many inventions, Archimedes' greatest invention was born of necessity. The King of Syracuse asked Archimedes to build a luxury ship, but once it was built the ship began to leak! Archimedes needed a fast and easy system for draining the hull.

To solve the problem, Archimedes created a new kind of pump that could be operated by just one person. First, he wound a hollow tube around a larger core. Then he placed the tubes at an angle and rotated the entire device. With each rotation, a little bit of liquid was picked up, carrying it up and out of the boat.



Now try creating a pump yourself!

Materials:

- ½-inch-diameter pipe (12 inches long)
- 4 feet of clear vinyl tubing (⅜-inch outer diameter x ¼-inch inner diameter)
- tape
- water
- two empty basins

1. Carefully wrap the tubing around the pipe. Leave about ¼-inch of tube hanging off both ends of the pipe.
2. Use books to place one basin higher than the other. Fill the lower basin with water.
3. Place the wrapped tube in the lower bowl. The tubing on the top of the tube should spill into the empty basin.
4. Gently turn the tube, watching as water is picked up and carried up the hill to the empty basin.

Wrap the tubing more tightly and shift the incline of the pipe to change how quickly the water travels up!

Source: www.experiment-resources.com/archimedes-screw.html

WATER TANKS

All across New Jersey, water tanks tower over homes and roads. Why are they there? It's all about gravity.

Gravity is a force that attracts two objects. When an object, such as water, is placed high above the ground in a tank, pressure is exerted on the water, pushing it down toward the ground.

This is the reason that water tanks exist. They provide the pressure to push water through miles of water pipes to homes, schools, and businesses. More importantly, however, water tanks make sure that there is enough water and pressure to get through emergencies—like fires.

GUESS WHAT!
New Jersey American Water has 45,000 fire hydrants across the state.

Student Worksheet 3

Name: _____

Water Wisdom

Seventy-five percent of New Jersey's drinking water comes from underground aquifers. Over thousands of years, New Jersey's aquifers have gathered the water we use today for drinking, cooking, and bathing.

However, our state's growing population drains our aquifers more quickly than rainwater can replenish them. In addition, more and more water becomes polluted every year, making it undrinkable. The New Jersey Clean Water Council believes that New Jersey will be in a severe drought by 2020. Even a pinhole leak in your toilet can waste 25,000 gallons in one month—enough water to fill a swimming pool. That's why it's important to think about the water we use and find ways to conserve it.

Work with your group to answer these questions and campaign for getting the word out about the importance of water conservation.

1. Research and list five ways that your family, friends, and/or community could conserve water.

_____

_____

2. Everyone should conserve water but great campaigns talk to specific kinds of people such as other kids, your families, or local businesses. Who would you like your campaign to speak to?

_____

_____

3. What tools could you use to get your message out? Consider websites, posters, brochures, radio, podcasts, social media, etc.

_____

_____

4. How will you launch your campaign? Consider a special day like Earth Day, on a community day, or at a sporting event.

_____

_____

5. What do you want to say? Be specific and choose one or two actions you want people to take.

_____

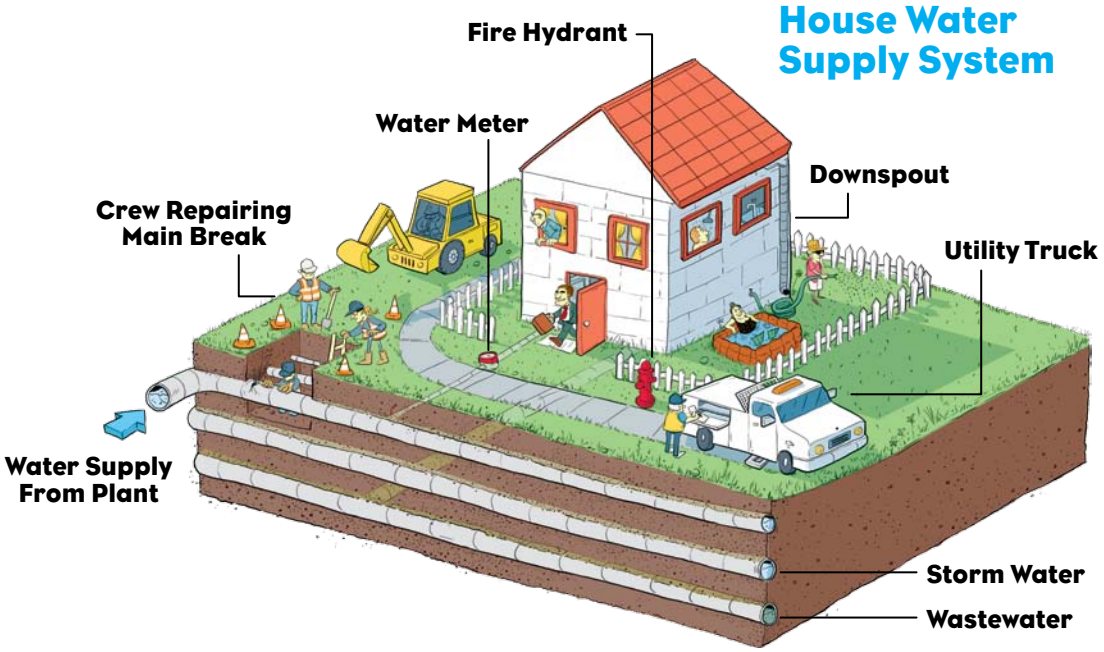
_____

MILES OF PIPE

The pipes that New Jersey's water travels through are always being checked and repaired. New Jersey American Water's 8,600 miles of pipe cover one-third of the state. These pipes have 170,000 valves that have to be regularly turned and checked.

Build a Model Water System

Guide your class through building a working model of a water system. Use the classroom poster for inspiration!



Objective: Use what students have learned to build a model water system.

Materials: flat sheet of cardboard; cardboard boxes and tubes; four plastic basins; scissors; straws; tap water; books; paper; duct tape; Archimedes screw pump (see Lesson 2) or soap dispenser pump

Time required: 90 minutes

What to do:

1. Place a sheet of cardboard on two stacks of books, creating "aboveground" and "belowground" workspaces. Use cardboard boxes, tubes, a plastic basin, and paper to build a simple model of a town including:
   a. **Aboveground:** a reservoir, at least two buildings, a water treatment plant with two basins to hold "raw" and "clean" water, and a tall water tank.
   b. **Belowground:** aquifer (use a dishpan or large bowl). Underground and aboveground pipes will be added later.
2. Use scissors, straws, and electrical or duct tape to create a system of pipes that connect:
   a. The reservoir to the "raw" water area at the water treatment plant.
   b. The houses to the water tank. The straws coming from the water tank should come down to the underground pipes at a steep angle.
3. Poke small holes into the straws under each house to simulate a "tap."
4. Fill the "clean" water basin with tap water. (Advanced classes: Instead, build a simple water filter using gravel, sand, and a cotton ball. Filter the "raw" water as it flows down into the "clean" basin.)
5. Use your Archimedes screw pump to take water from the clean water basin up to the water tank. If your class didn't make a screw pump, use a soap dispenser pump. (Advanced classes: Invite students to build a pump that is powered by running water, wind, or a motor. Also, challenge them to create a second Archimedes screw pump that pulls water out of the aquifer or reservoir and into the water treatment plant.)
6. Observe how gravity presses down on the water in the water tank, pushing water through your model pipe system!

Unravel the Mysteries of Water!

Invite a water expert into your classroom for an exciting, hands-on experience

Where does New Jersey's water come from? What is water conservation? Now you can tap into the knowledge and enthusiasm of New Jersey American Water's experts! Just invite a water professional into your classroom to help your students unravel these mysteries. Each visit will be tailored to your specific curriculum needs with workshops like these:

Water Conservation

Is New Jersey running out of water? Find out and learn what kids can do to help conserve.

Where's the Water?

Look at maps to find the local rivers, lakes, reservoirs, or aquifers that provide your drinking water. Where are they? How much water is in them? How is it cleaned?

The Puddles Experience

Reserve New Jersey American Water's traveling van, "Puddles," for outdoor science or sports events.

Water Works

Use the "Jerseyscape," a model water system, to see how the water cycle works and how water is pumped, cleaned, and transported across New Jersey.

Contact New Jersey American Water to plan an exciting classroom visit today!

Scan this code and a representative will be in touch right away.
Or you can call us at (856) 782-2391; or email us at puddles@amwater.com.

We care about water. It's what we do.®

NEW JERSEY
AMERICAN WATER

SCHOLASTIC

Water Works

Find out how water gets from rivers, reservoirs, and aquifers to your tap!

Water Treatment Process

Coagulation
Special compounds make dirt clot and cling together.

Water from river...

Sedimentation
The dirt settles to the bottom and the water becomes cleaner.

Filtration
Water passes through filters to purify it further.

Disinfection
Kills the germs.

...to your home.

Utility Worker

House Water Supply System

Fire Hydrant
Water Meter
Downspout
Crew Repairing Main Break
Utility Truck
Water Supply From Plant
Storm Water
Wastewater

Unconfined Aquifer
Nonporous Material
Confined Aquifer
Deep Well
Saltwater Intrusion
Atlantic Ocean

Invite a Water Expert!

Scan this code to speak to New Jersey American Water about creating an exciting classroom experience! Or visit **www.scholastic.com/njaw**.

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