

Essential H₂O

Every living thing, from the largest animal to the smallest microorganism, needs water to survive. Without it, there would be no life on Earth. Even though Earth's surface is nearly 70% water, it is considered one of our planet's most precious resources. This is because around 97% of all the water on Earth is salt water, which is undrinkable. Salt water is found in the oceans and is also found inland in seas and lakes, like the Great Salt Lake in Utah and the Sea of Japan. Taking the salt out of the water uses a lot of energy, leaves behind salt as a byproduct, and is expensive and very time consuming. The remaining 3% is fresh water, though most cannot be used directly for drinking or agriculture because it is frozen in polar ice caps. Tiny amounts of fresh water are also found in the form of water vapor in the atmosphere. What does this all boil down to? Less than 1/3 of all the fresh water is available for use. Most of this fresh water is found in lakes, rivers, streams, and underground. We even store water in our bodies! Keep reading to learn splashing new facts about where water is found and how we use it!

ILLINOIS WATER

The Great Lakes Basin includes forests, wetlands, and dunes, all of which serve as a home for more than **3,500** species of plants and animals.

There are around **900** miles of large rivers that form our western, eastern, and southern borders.

There are more than **91,000** freshwater lakes and ponds in Illinois.

Our watersheds, groundwater, and surface water are interdependent with the waters of other states.

Illinois has jurisdiction over more than **1,500** square miles of open water in Lake Michigan.

There are over **119,000** miles of streams within Illinois' borders.

The Great Lakes contain nearly **20% OF EARTH'S FRESH WATER**, making it the largest freshwater system in the world!

HOW MUCH FRESH WATER?

About 97% of Earth's water is salt water and the remaining 3% is fresh water for us to use! But what do those numbers *look* like? Try out this activity to get a better perspective!

- Start with a gallon of water. This represents all the water on the earth.
- Pour 1/2 cup of water from the jug into a clear cup. This 1/2 cup represents all fresh water on Earth. The water left in the jug represents the salt water found in the oceans.
- From the 1/2 cup of water, use an eye dropper and squeeze one drop out. This one single drop represents all the fresh water available for our use which is found in rivers and lakes. The remainder of the 1/2 cup represents polar ice caps, groundwater, water bound up as soil moisture, biomass water, or water in the atmosphere.



Locks & Dams

The Mississippi River has been an important route for trade and travel for centuries, allowing people to transport goods easily from the northern to the southern parts of North America. In 1930, U.S. Congress decided to make the Mississippi River wider and deeper so boats could move at all times. First, dams were built. Dams hold water back to make sure every part of the river is at least nine feet deep. That is deep enough to float heavy barges up and down the river. But how do the barges get through the dams? Each dam has a lock. A lock is like an elevator, only slower. A tugboat pushes a barge into the lock.

The doors close and water is put in or taken out of the lock. This raises or lowers the barge until it is at the same height as the water on the other side of the dam. The doors then open up and the barge goes on its way. The whole process can take up to two hours!

The Mississippi River is divided into two sections: the Upper Mississippi and the Lower Mississippi. There are 29 locks and dams on the Upper Mississippi. These are located between St. Louis, Missouri, and Minneapolis, Minnesota. There are no locks and dams south of St. Louis. Instead, there are wing dams to control the flow of water and levees to contain the river during flooding.

The Illinois River is approximately 273 miles long and is an important tributary of the Mississippi River. It makes up a large portion of the 336-mile-long water system called the Illinois Waterway. The Illinois Waterway holds a series of eight locks and dams and is an important water system because it connects the Great Lakes with the Mississippi River and the Gulf of Mexico. The Illinois River itself has long been an important transportation route for civilizations and continues as an important route for modern industrial shipping of goods such as grain and oil. Another important tributary of the Mississippi River is the Kaskaskia River which holds one lock and dam system and is 325 miles long. Starting in East Central Illinois to the west of Champaign, the Kaskaskia River plays an important role in agriculture, offering the ability to transport goods from the central part of the state to the Mississippi. Today these three rivers continue to be vital trade routes for many crops and other products.



Kaskaskia River Lock and Dam

The Mighty Mississippi



Few rivers have played such an integral role in shaping our nation's historical, cultural, and economic heritage as the Mississippi River. The Native Americans that once lived on the banks of the Mississippi River called it "Messipi," meaning "Big River," and "Mee-zee-see-bee," meaning "Father of Waters." It is one of the world's greatest river systems. This major river originates as a tiny outlet stream from Lake Itasca in northern Minnesota and flows 2,350 miles to the Gulf of Mexico. It drains all or parts of 31 states as well as two Canadian provinces. The drainage basin is 1.15 million square miles, which is roughly 1/8 of North America, and extends from the Appalachian Mountains in the east to the Rocky Mountains in the west. The river discharges 612,000 cubic feet per second into the Gulf, which is equal to 166 semi-trailers per second. Roughly 12 million people live

in the 125 counties or parishes that border the river. It also provides habitat for at least 260 fish species and 40% of the nation's migratory birds, as well as 38 mussel species, 50 mammal species, and 145 amphibian and reptile species on the Upper Mississippi alone.

The Mississippi is also one of Illinois' greatest agricultural assets. Corn and soybeans, as well as other crops, travel down the Mississippi River to New Orleans where they are loaded onto larger ships and transported around the world. The river allows us to transport large amounts of grain at very little cost. Barges, or flat-bottomed boats, can move one ton of cargo 576 miles per gallon of fuel. A rail car would move the same ton of cargo 413 miles, and a truck only 155 miles. Using the river for transportation also generates fewer emissions than rail or truck.

As a MATTER of Fact

Water matters! Actually, water IS matter. Water is a molecule made up of three atoms that are bonded together. These atoms are hydrogen, hydrogen, and oxygen, which is why we call it H₂O. One droplet of water contains billions of H₂O molecules! Although water may seem simple because it has no taste, smell, or color, it is more than it appears to be.

Water is known as the "universal solvent" because more substances dissolve in water than any other liquid. This means that wherever water flows, whether that is in the ground or through our bodies, it picks up nutrients, chemicals, and minerals and carries them along.

The amazing thing about water is that it is the only natural substance on Earth that can be found in all three physical states of matter: solid (ice or snow), liquid (water), and gas (vapor or steam). Liquid water is found in rivers, lakes, streams, and swimming pools. Water vapor, in its gaseous state, forms the clouds, rises from the boiling water on the stove, and is even in the air – this is what makes us feel sticky on humid days. The solid form of water is known as ice. Ice can be found in our freezers or in the Arctic and Antarctic Oceans as icebergs. These three states are incredibly important because they allow water to go through a process called the Water Cycle.



SOLID



LIQUID



GAS

ATOM: the basic building block for all matter and is made up of protons, electrons, and neutrons.

MATTER: everything around you (air, water, people, rocks, etc.) and is made up of atoms.

MOLECULE: a substance made up of two or more atoms bonded together.

THE WATER CYCLE

There is nothing like taking a drink from a cold glass of water on a hot summer day! Staying hydrated is very important for our health. But did you know that the water you drink today is the same water that the dinosaurs drank? That is because Earth has been recycling water for over 4 billion years!

All the water on Earth moves between oceans, rivers, lakes, the land, and the atmosphere in an ongoing cycle called the water cycle, which is powered by the sun. As the water flows through the cycle, it can change between the three states of matter: solid, liquid, and gas.

SUBLIMATION

Water can change from a solid to a gas without becoming a liquid first! This means that Earth's ice, like glaciers and icebergs, can evaporate directly into the atmosphere without even melting. This process is called sublimation.

TRANSPIRATION

Flowers, trees, and many other plants also lose water to the atmosphere through their leaves. This process is known as transpiration.

EVAPORATION

Energy from the sun heats up the surface of the earth, which causes the temperature of bodies of water to increase. When the temperature of the water rises, some of the water turns into a gas called "vapor" and rises into the air! This process is called evaporation.

CONDENSATION

As water vapor rises into the atmosphere, it begins to cool, changing the vapor back into a liquid. Because the temperatures are much colder way up in the sky, the droplets condense – meaning they get really close together – and form clouds. This process is called condensation. Currents in the atmosphere cause the clouds to move all around the earth.

PRECIPITATION

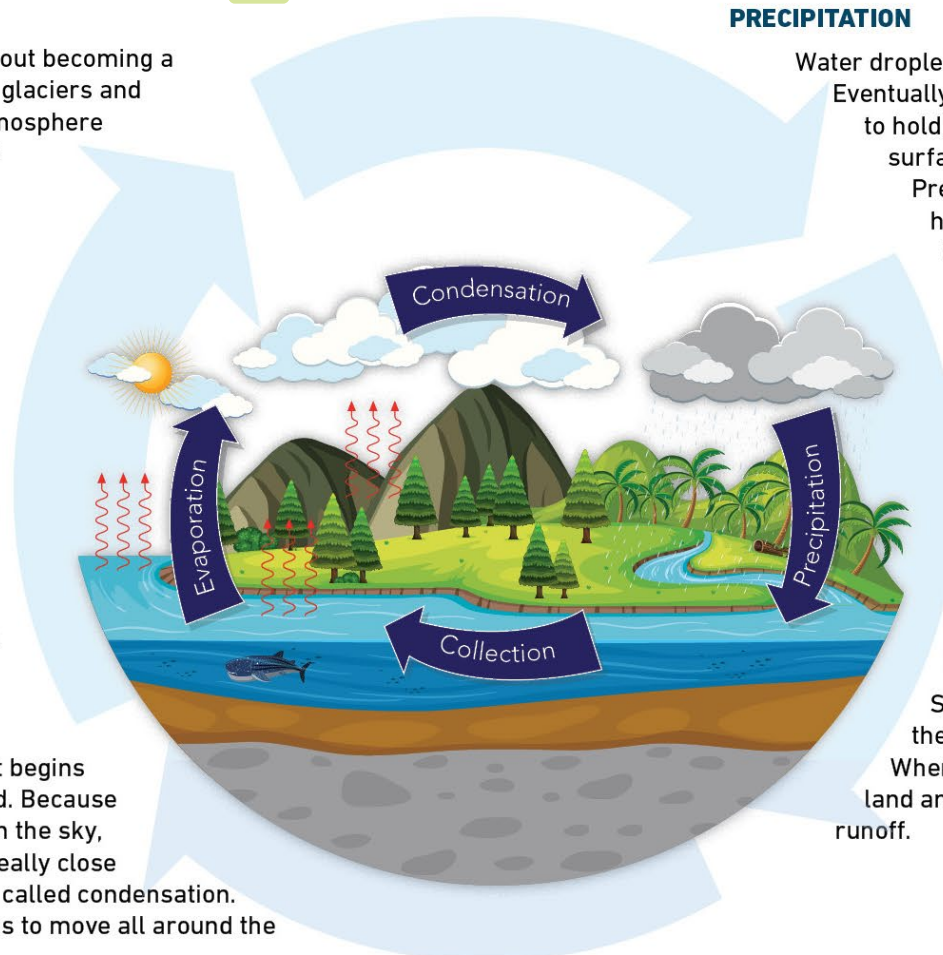
Water droplets that form the clouds continue to condense. Eventually they become too big and heavy for the atmosphere to hold them and so they fall back down to the earth's surface. This process is known as precipitation. Precipitation can be in the form of rain, sleet, snow, or hail, depending on the temperature of the atmosphere in which it is falling through.

COLLECTION

The fallen precipitation is then "collected" in bodies of water like rivers, streams, oceans, glaciers, aquifers, watersheds, and reservoirs! Eventually, the water will evaporate back into the atmosphere, beginning the cycle all over again. How the water is "collected" depends on where on Earth it lands! Remember, there are many different climates and temperatures that will affect the state of matter that is precipitated!

RUNOFF

Sometimes areas can experience flooding in which there is too much water for the soil below to soak up. When that happens, the excess water will flow over the land and down to low areas due to gravity. This is called runoff.



BIOMASS: organic matter that comes from living or recently living things and can be turned into a renewable energy.

BUFFER STRIP: a grassed strip in areas of cropland that are subject to erosion.

CROP ROTATION: growing a sequence of different crops on the same ground to maintain or increase its fertility.

CONSERVATION: the protection of things found in nature.

COVER CROP: a crop planted to prevent soil erosion and to keep nutrients in the soil.

EROSION: the process in which the surface of the earth is worn away by the action of winds, waters, glaciers, and waves.

FERTILIZER: a chemical or natural product used to nourish plants and help them grow.

INSECTICIDE: products used to kill insects to protect plants from damage.

LIMITED RESOURCE: a fixed amount of a natural resource on Earth.

LIVESTOCK: domestic animals that are raised for food, milk, or fiber.

MODERATION: the avoidance of excess or extreme.

NITROGEN: a chemical element that makes up a large percent of the air in Earth's atmosphere and is a part of all living things.

PASTURE: land on which animals graze.

PESTICIDE: products used to control the damage caused by harmful diseases, insects, or weeds in a growing crop.

PRESERVATION: the effort to keep something from loss, decay, or injury.

STEWARDSHIP: the responsible and careful management of something.

SUSTAINABILITY: using natural resources responsibly so that we have those resources for the future.

UNLIMITED RESOURCE: an abundant amount of a natural resource on earth.

WATER QUALITY: the measurement of the healthiness and cleanliness of water.

AG VOCAB

Water & Agriculture

Water is a very important natural resource for farmers who are raising crops and livestock for the foods we eat and for the fuels and fibers we use on a daily basis! Farmers' livelihood and way of life depend on their ability to use the land. Therefore, it is in the farmers' best interest to protect the land and water they rely on.

You learned that all living things need fresh water. Water is a limited resource, meaning there is only a certain amount of it available. Because there is a limited supply of water, it is everyone's responsibility to practice conservation, preservation, and moderation to protect the water we have. Farmers use both common sense and technology to help conserve water and to preserve water quality. Here are some ways that farmers are practicing their stewardship skills:

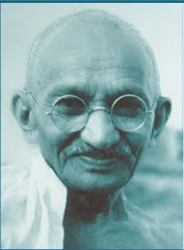
- Farmers use a wide variety of technologies to collect data about their fields! This can help them figure out where and how often to apply fertilizer. Instead of spraying their entire field with the same amount of product at the same rate and same times, they know the specific places and specific times to apply products to their crops. This will help plants grow, minimize nutrient loss, and protect our water supply—all while saving farmers time and money.
- Many farmers use precision irrigation systems to reduce the amount of water needed to water their crop.
- Some farmers use buffer strips, cover crops, and/or practice no-till or reduced tillage farming practices to reduce erosion and water runoff that could impact water quality.



- Livestock farmers and ranchers put fences up around streams, rivers, and ponds to keep livestock out of the water and reduce erosion.
- Farmers partner with organizations to learn more about nutrient loss reduction strategies, stream bank stabilization and restoration programs, woodchip bioreactor buffers for nitrogen runoff, and much more!



"When the well is dry, we will know the worth of water."
-Benjamin Franklin 1706-1790



"There is enough water for human need, but not for human greed."
-Mahatma Gandhi 1869-1948

"Water is the driving force of all nature."
-Leonardo De Vinci 1452-1519



"A lake is the landscape's most beautiful and expressive feature. It is Earth's eye; looking into which the beholder measures the depth of his own nature."
-Henry David Thoreau 1817-1862

CONSERVING WATER

We all must work together to conserve our water and to make sure it is clean and healthy! Staying hydrated, showering, cooking, doing the dishes and laundry, swimming, watering plants and crops on farms, creating

art, mixing concrete—we use fresh water for pretty much everything! The amount of water available for human use is limited. We need to make sure we do our part to conserve water. Drought, flood, pollution,

population growth, industrial needs, climate change, and other factors may lead to a shortage of fresh water. So how can you practice water conservation and preservation at home? It's easy!



Turn off water faucets when they are not in use. Do not leave the water running when brushing teeth or rinsing dishes.



Take shorter showers. Install low-flow or more economical showerheads.



Use water conserving toilets or put a capped bottle of marbles/rocks in the tank to decrease water use.



Use less water in the bathtub.



Use a broom to sweep off sidewalks instead of hosing them down.



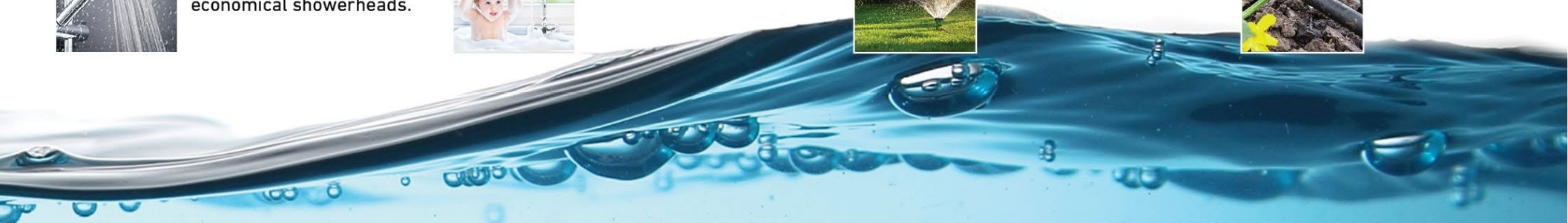
Water lawns less often.



Water gardens in the early morning when evaporation is lower.



Use drip irrigation systems to water plants.



CAREERS



Megan Dwyer
Illinois Corn Marketing Board &
Illinois Corn Growers Association
Nutrient Loss Reduction Manager
Geneseo, IL

Tell us about your job and how you became interested in the agriculture industry.

As a 4th generation farmer, raising the 5th, agriculture has always been something I've been passionate about. Serving as the Nutrient Loss Reduction Manager for IL Corn has also given me an opportunity to serve Illinois corn farmers on issues concerning soil health, stewardship, and water quality. I work on educational campaigns to help farmers understand best management practices and how their decisions impact the quality of water leaving their farm fields. I also get to help develop programs and work on policy issues that drive the decisions they make and the resources they have available to try new conservation practices. Helping farmers see what is happening on their own fields is vital to ensuring everyone does their part to ensure water quality is a priority.

What are some challenges that you come across in a job like this?

Water is probably the biggest factor impacting agriculture. There is only so much fresh water available and we must make sure we do everything we can to ensure it is available for generations to come. Every farmer and every field are also different, so adopting the same practice on all fields doesn't always make the most sense. It takes time to figure out what system works best for each situation. Finding sources of funding and technical resources for farmers to try new practices that positively impact water quality can be challenging, but they are worth the time and financial investment in the long run!

What changes do you see for the future in this industry?

Technology is a huge part of agriculture and using it for not only research, but also implementation of practices, will continue to grow. As we get better information, we can make smarter and more timely decisions using the most precise technology available. I also think the concern over preserving water quality will continue to grow, and hopefully that will provide more government and public/private funding to become available to help ensure we meet those demands.

What is your favorite part of your job?

My favorite part about my job is that I get to not only work with farmers, but also people creating the policies and regulations farmers must follow. It's challenging to find solutions that work for both groups and being able to be a part of that is really rewarding. Knowing that the projects I work on today could help shape the opportunities my children have in agriculture in the future is also something I enjoy. Water quality and soil health are parts of agriculture that are always going to be important, so working to preserve those finite resources is something we all need to support to be successful.



Ray Bennett
Hines Furlong Line
Towboat Vessel Captain
Eddyville, IL

Tell us about your job. How far do you travel? Do you go through the locks and dams to deliver products and return home?

My current position with Hines Furlong Line is Vessel Captain on the Motor Vessel Danny L Whitford, a 4000-horsepower towboat, which typically pushes a 15-barge tow. As Captain, I oversee the daily operation of a nine-member crew and the navigation of the vessel. The boat operates 24 hours a day, seven days a week. I stand two, six hours watches, six hours apart in a 24-hour period. I pilot the vessel during each watch, navigating the river, making locks, picking up and dropping barges at fleets along the way. I am currently running the Cumberland River between Cairo, Illinois and Nashville, Tennessee, but I have also worked on the Illinois, Ohio, and Upper Mississippi Rivers. My job requires me to be away from home four weeks at a time which is the hardest part of my job. You must be able to adjust to missing family and special life events when you are working.

How is your job important in regards to the agriculture industry?

We transport fertilizer, steel, and ethanol products to Nashville. The ethanol barges originate from Peoria, Illinois. On the return trip from Nashville we transport corn and soybeans from Clarksville, Illinois to Cairo, Illinois. We also carry sand and gravel to support the construction industry in Nashville, Tennessee. The ability of the inland waterways to import and export products related to the agriculture industry provides a cost-effective way to ship and receive supplies and products. A 15-barge tow can transport the same bulk tonnage as 900 semi-tractor trailers.

What changes do you see for the future of this industry?

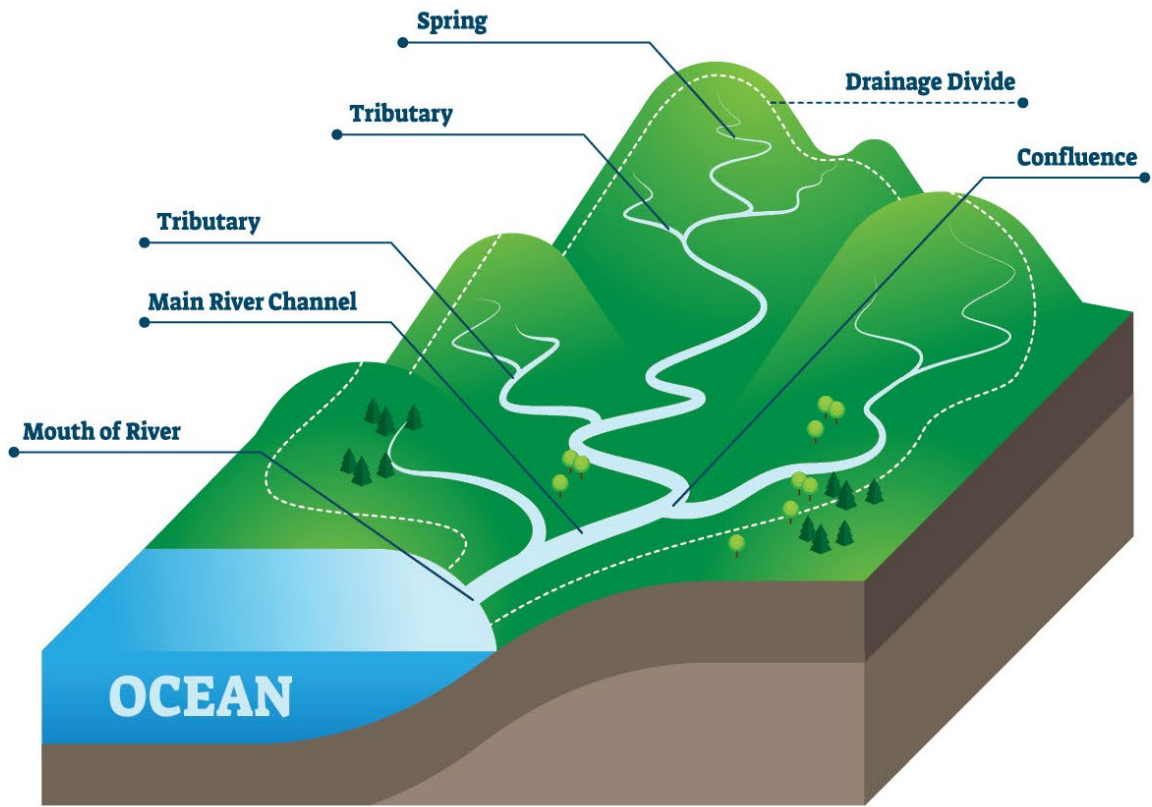
The towboat industry will continue to play a vital role in providing a cost-efficient way to transport products and supplies. It continues to be an environmentally safe mode of transportation. The need to improve and repair locks and dams to cut down on delay times will help all industries.

What is your favorite part of your job?

I really enjoy just driving the boat up and down the river. It's a challenge to safely navigate each situation with the constant changes in water levels and weather conditions. It is also an instant gratification to safely manage narrow channels and bridges or to navigate a 1150-foot-long by 105-foot-wide, 15-barge tow into a 110-foot-wide lock chamber. The best part of my job is getting to go home for my four weeks off to spend time with my family!

Watershed

A watershed is a geographic area in which water, sediments, and dissolved minerals all drain into a common body of water like a stream, creek, reservoir, or bay. A watershed includes all plants, animals, and people who live in it, as well as the non-living components like rocks and soil. We are all part of a watershed, and everything we do can affect the surface and ground water that runs through its systems.



CREATE A WATERSHED

Our "Wad-O-Watershed" lesson will show students the basic geography of a watershed, how water flows through the system, and how people can impact the quality of our water!

MATERIALS NEEDED:

· Large, clear plastic tub

· Wax paper (at least two feet per person)

· Spray bottle filled with colored water

First, take your piece of wax paper and crumple it up into a ball. Then, partially unfold the wax paper to form a 3D topography, complete with hills and valleys. This is your "wad-o-watershed." Experiment with the water to see how your watershed functions.

Take your spray bottle and spray colored water on the high points or "divides" of the watershed. Notice the flow of the water and where the water pools and collects. Experiment with different quantities of water as you spray.

Make a list of water use activities that happen in your local watershed. These may also include natural events, such as flooding, drought, mudslides, and fire. Finally, let's see what happens when we have pollutants in our environment. Find some items to serve as your "pollutants." For instance, Orange Kool-Aid powder could be excess fertilizer on a golf course. Purple Kool-Aid could be a dump site. Mini chocolate chips could be dog poop at the local park.