Water

Objective:

1. Students will be able to identify and explain the properties and structure of the water cycle as it relates to bodies of water.
2. Students will effectively use inquiry and analysis in the exploration of climate change and the impact on Earth.
3. Students will demonstrate an understanding of water conservation.
4. Students will understand the effects of water pollution and develop ideas to resolve this global concern.
5. Students will effectively analyze data and make predictions related to water consumption and future measures for conservation.

Grades: 6-8

Key Vocabulary:

- **Hydrologic**
- **Transpiration**
- **Point Source Pollution**

Related Literature:

The Water Cycle
Rebecca Harman
A Drop of Water
Walter Wick
Water Runs through this Book
Nancy Bo Flood
One Well: The Story of Water on Earth
Rochelle Strauss

Performance Objectives:

Grade 6: Strand 6: Concept 1 – PO 2-5; Concept 2 – PO 1-6
Grade 7: Strand 1: Concept 1 – PO 1-3
Grade 8: Strand 1: Concept 3 – PO 1-8

NGSS: MS – LS2; MS – ESS3

Background Information:

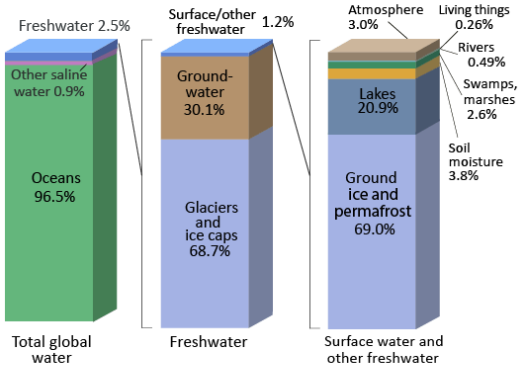
Water can be considered the most valuable resource on Earth. Approximately 70 % of the Earth's surface is covered with water, and life on the planet would not exist without it. While that seems like a large amount of water, only about 1% of that water is fresh. Scientists have found that most of the water on Earth is saltwater and about 2% of Earth's water is frozen in glaciers. Humans and most animal

species need fresh water to survive, and water conservation has become a worldwide concern.

What exactly is water and where do we get it? The composition of water is a chemical formula made of two elements, hydrogen, and oxygen, commonly referred to as H_2O. Water is found in three different forms: liquid, solid and gas. In general, the liquid form is referred to as water, the solid form of water is called ice, and the gas form of water is called steam or vapor. Pure water has no smell or taste.

Water on Earth is constantly in motion. The water cycle demonstrates how water moves from one form to another as it passes through the cycle. The natural cycle of water is known as **hydrologic** cycle, which describes the movement of water on, above, and below the surface of the earth. The Unites States Geological Survey (USGS) has documented the water cycle and the location of where water exists on Earth. For example, the global water distribution chart prepared by the USGS reflects the amount of water located both above and below the surface of the earth at a single point in time. Consider the fact that the greatest percentage of water is saline (saltwater) and is located in the oceans of the world. Freshwater is divided into areas of groundwater, glaciers, lakes, and smaller bodies of water such as streams and swamps. The location of water is significant, but the percentage of usable water is the most important factor to human existence.

Where is Earth's Water?

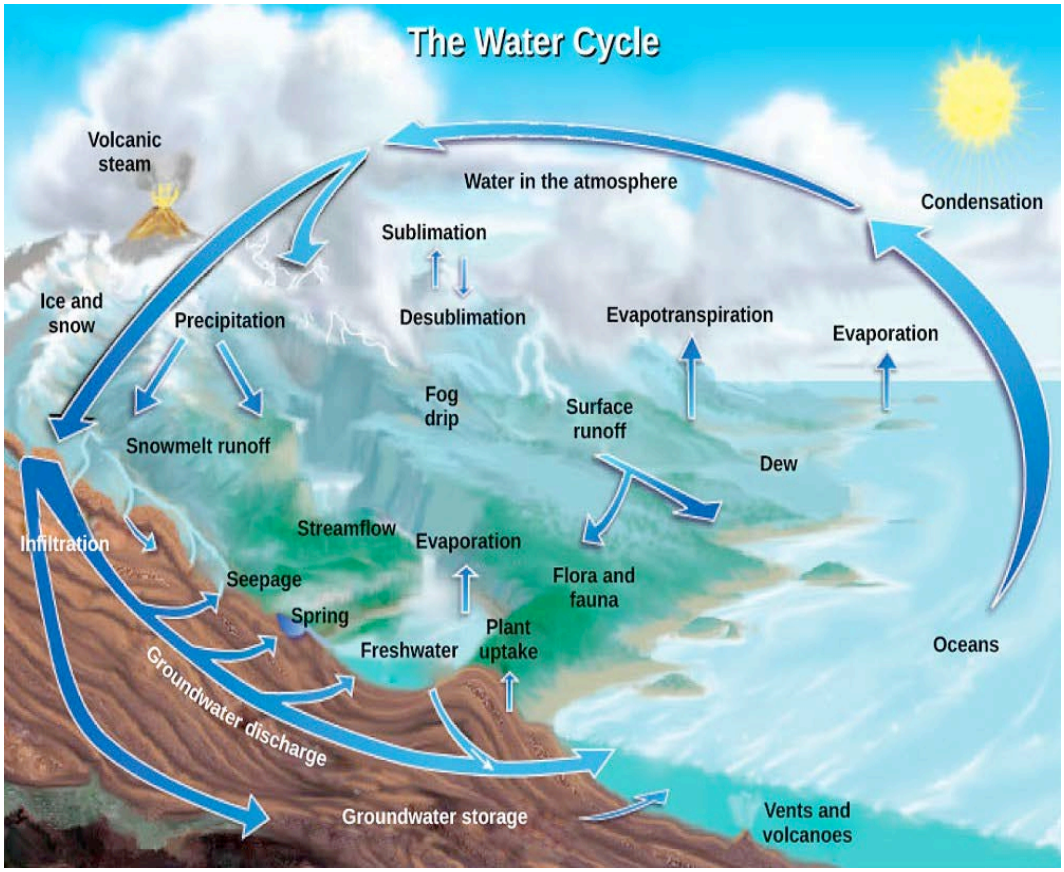


Source: Igor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (editor), 1993, Water in Crisis: A Guide to the World's Fresh Water Resources.
NOTE: Numbers are rounded, so percent summations may not add to 100.

Freshwater resources are both above ground and underground. Water located in rivers and lakes is easy to observe, but much more water is stored underground. Groundwater replenishes many rivers and lakes, and is part of water that has seeped into the ground to refill aquifers. Groundwater is critical to providing water to locations such as desert towns and places where water is scarce.

The water cycle is the path water takes as it moves around the earth. A single drop of water is an essential part of the accumulation of water on the planet and how water is replenished. Constantly changing from liquid to vapor to ice, water tells a

story of life on earth. Beginning with the largest percentage of water, the ocean, a drop of water can be followed in the water cycle. Imagine a sunny day on the beach as you look over the ocean. You can't see it, but the water cycle is in full motion. A single drop of water at the ocean's surface is heated by the sun and the process of **evaporation** begins. The drop becomes water vapor and rises up into the air. Winds carry the vapor higher into the sky where the air is cool. As the vapor droplet gets cooler, it changes back into a liquid, which is called **condensation**. The vapor can condense and get cool enough that it joins other droplets and becomes part of a cloud. Soon that single drop of water from the ocean, joining others in the same way, will become bigger droplets and fall to the earth as rain. The process is called **precipitation**, which is helped out by gravity, and the rain drops may fall in various places. For example, rain falls back to the ocean, or it may fall on dry parts of land and soak into the ground. Rain may fall in rivers or lakes to refill them, or streams to allow them to flow faster. Rain may make a puddle in the street or fill a canal. Just think of all the places rain can fall and how it can change the landscape. The **collection** or storage of water is also a part of the water cycle. From areas of collection such as lakes or groundwater, the water cycle begins again. Plants are a part of the water cycle as moisture is carried through the plant from its roots to small pores on the underside of leaves where it changes to vapor and is released into the atmosphere. The process is called **transpiration**, which is essentially evaporation of water from plant leaves.
The USGS water cycle diagram reflects various landforms, bodies of water and ways in which water flows. Each phase of the cycle demonstrates the constant movement of water and the impact water has on the Earth.



The USGS water cycle.

While water is considered a renewable resource, environmental and human factors can contaminate the water supply and pose a global concern regarding usable water for the future. The USGS asks these questions: “What is in the water? Is it safe for drinking? Can fish and other aquatic life thrive in streams and lakes that are affected by human activities? What is the water quality?” To answer these questions, it is helpful to understand what "water quality" means, how it is determined, and the natural processes and human activities that affect water quality.

What do we mean by "water quality"?

“Water quality can be thought of as a measure of the suitability of water for a particular use based on selected physical, chemical, and biological characteristics. To determine water quality, scientists’ first measure and analyze characteristics of the water such as temperature, dissolved mineral content, and number of bacteria. Selected characteristics are then compared to numeric standards and guidelines to decide if the water is suitable for a particular use.” (USGS)

How is water quality measured?

Some aspects of water quality can be determined right in the stream or at the well. These include temperature, acidity (pH), dissolved oxygen, and electrical conductance (an indirect indicator of dissolved minerals in the water). Analyses of individual chemicals generally are done at a laboratory.

Source: USGS

There is no question that water is a natural resource that must be conserved and protected. Pollutants in the water, salt or fresh, create health concerns for all life on the planet. Scientists have found that water, as demonstrated in the water cycle, has been on earth for millions of years. Water has changed from liquid to gas over and over as is replenishes its source. Imagine that a dinosaur once drank the same water that you have in your drinking glass!

As far back as the ancient Egyptians, people have been concerned with clean drinking water. The first known filtering of pollutants, dirt, and sand was likely done by boiling water over a fire. Today, the task is much greater. Since only about 1% of the water on Earth is fresh, pollutants making their way into the water are a critical factor in preserving life as we know it.

Pollution in water has a negative effect on plants, animals, and humans. Both marine animals and those living on the land are dependent on clean water. The ocean ecosystem, for example, is directly affected by pollution. There are two types of pollutants, non-point source pollution and source point pollution. Non-point source pollution comes from various places and cannot be traced back to one specific source (oil spill on road, or car exhaust since it's not just one source).

Point source pollution would be coming from a source than be easily traced back (factory with smoke coming out of it) Oil spills, sewage, chemicals, industrial waste and more have proven to be detrimental to the health of existing marine life and their future. Pollutants are not part of the natural ocean ecosystem and upset the balance in the environment. Many marine species live in the water, find their food in it, and raise their young in it. Pollution in the water causes enormous health-related problems for these animal species. Plant species are also at risk when pollutants invade their living spaces. Large amounts of harmful bacteria cause diseases and mutated cellular structures that alter the natural functions of both plants and animals.

Oil spills alone have created serious concerns in and around the areas of impact. Oil does not dissolve in water, but floats on the surface, causing the oil to become a thickened sludge. Ocean currents carry the oil sludge to distant locations, which becomes a deadly hazard to marine life. Industrial waste pollutants carry contaminants that are harmful to marine life. These pollutants are also carried to the fresh water supplies used by humans as well as animals. High levels of lead, asbestos, and pesticides have been found in freshwater sources, resulting in the contamination of streams, rivers, and groundwater. Chemicals seeping down into the groundwater leave a lasting impact within the wildlife ecosystems. In addition, industrial pollutants can rise into the air contaminating the water particles as they are carried through the water cycle.

"Water, water everywhere and not a drop to drink." Conservation, education, and human ingenuity can change that statement from a dire prediction to a state of hope for the future: "Water, water everywhere, and plenty for all to drink!"

Sources: United States Environmental Protection Agency (EPA); Unites States Geological Society (USGS); U. S. Department of Agriculture, Natural Resources Conservation Services.

Procedures and Activities:

1. State the learning objectives. Review previous instruction as it relates to the topic and objectives.
2. Review vocabulary.
3. Read related literature; follow up with discussion and open-ended questioning. Ask students what they know about water and how they use it each day. Ask questions related to conserving water each day. Discuss water resources in the local community and around the world. Discuss water as a natural resource and how it may be contaminated. Ask students what they know about water-related diseases and how they affect communities around the world.
4. Discuss the concern of global climate changes and the impact on water. Relate the discussion to glaciers and the ice caps. Review the sources of fresh water and how potential climate changes may alter the resource.
5. Discuss water-generated power systems across the U.S. and the globe. Make comparisons with the use of fresh water and filtered water from alternate sources.
6. Read and discuss water pollution and ask students to give examples. Ask students to identify ways in which water pollution can be monitored, controlled, and stopped.

Activity: After closely studying the water cycle, students complete the water cycle diagram by labeling and explaining the process.

Activity: To check for understanding of water as a natural resource, students complete the "Natural Resource" worksheet.

Activity: With the discussion of how water is used in daily life, students complete the worksheet, "How do I use Water." This offers an opportunity for students to see how much water the use and where they may be able to conserve. This is an activity that may be done in small groups and shared with the class.

Activity: "Poetry in Motion" is an opportunity for student to be creative in writing a poem about water inside a picture of a water drop.

Activity: To emphasize the effects of pollution, students use the "Clean Water, please" activity to analyze the impact on the surroundings and think of ways to resolve the problem.

Activity: As a class or in groups, students investigate how differing amounts of water affect plants. Students plant the same type of plant (outdoor starter plants are best) in the same size containers using potting soil. Plastic drinking cups work well. Be sure to put two small holes in the bottom of each cup for drainage. Label each plant with a number or letter. Each group of students has 3 plants. Plant # 1 gets 1/4 cup of water each day. Plant # 2 gets ½ cup of water each day and plant # 3 gets ¾ cup of water each day. Students observe and take notes over a two-week period. Notes should include the growth of the plants, condition of the plant and its leaves, condition of the soil, smell of the soil, and longevity of the plants. Data from the observations can be charted and analyzed for the final presentation to the class. Materials: Starter plants, potting soil, containers for plants, measuring cups, tray for under plant containers, and sunny location for plants

Activity: Research the causes and effects of water pollution and write an expository essay on topics such as: Ocean and sea dumping; Underground storage pollution; Death of aquatic animals; Disruption of the food chain; Diseases.

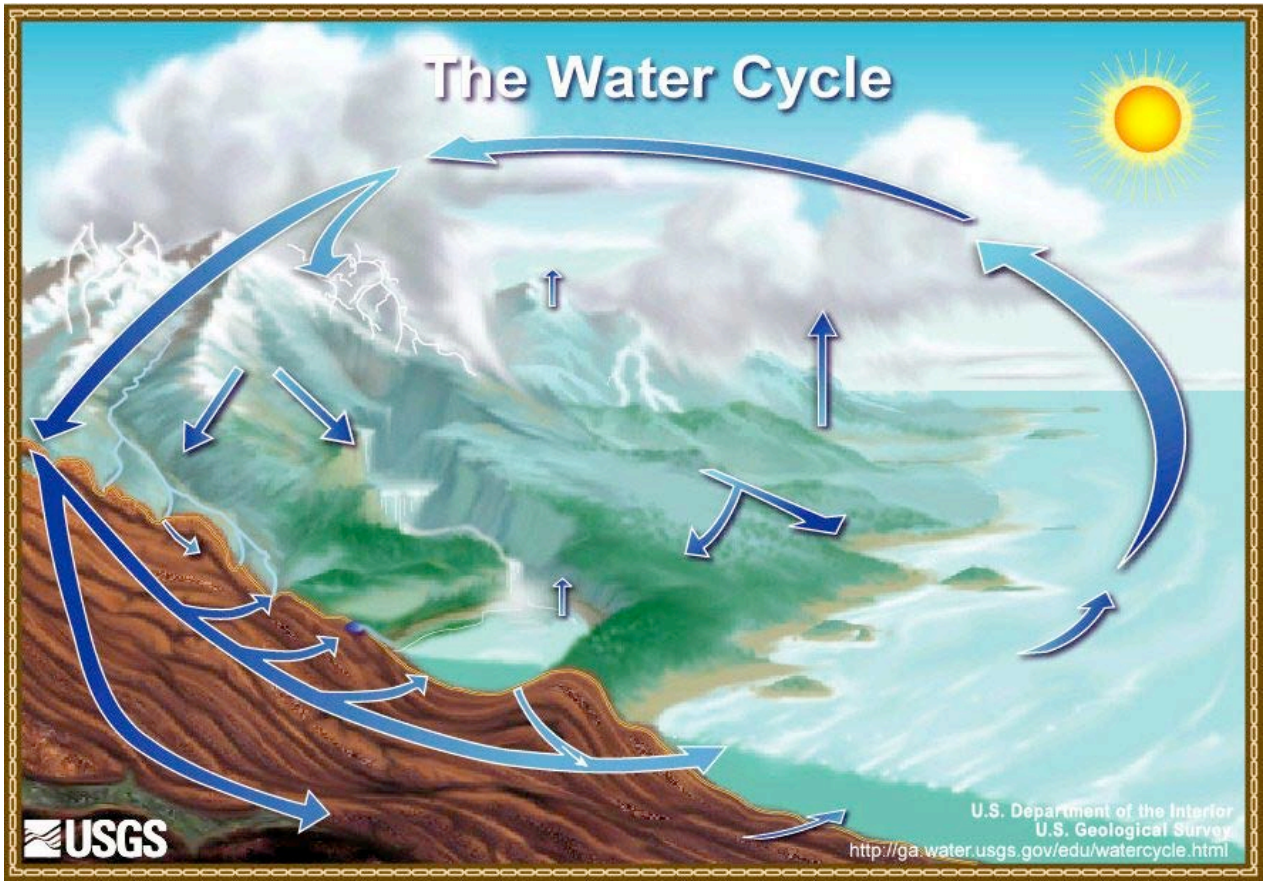
Activity: Using the pictures in "The Power of Water," divide the students into six groups. Each group is given a picture. The group analyzes the picture with a focus on: Description and location; Source of the water; Impact of possible climate change; How the location can best be protected from pollution; and predictions for the future.

Activity: Students use the information on "Water: How do we use it?" to better understand the daily use of water and how water can be conserved. This activity involves research, calculations, analysis of data, charting data and predictions.

Activity: Students study water microscopically and learn the differences between phytoplankton and zooplankton. They collect a sample of water and try to identify these organisms.

Reflections and Assessments: Students are assessed on various levels depending on the activity. Participation, grade standards, and percentages may be applied to each activity. Activities are designed for flexibility and use before or after fieldtrips. Most activities meet the **STEM** guidelines.

Water Cycle Diagram



Label the diagram with the following parts of the cycle and define each term:

1. Evaporation _____
2. Condensation _____
3. Precipitation _____
4. Water run-off _____
5. Groundwater _____

Extra: Steam, Fresh water, Water in the atmosphere, Source of heat.

Natural Resources

What is a renewable resource? (Give 2 examples)

1._____

2. _____

What is a nonrenewable resource? (Give 2 examples)

1. _____

2. _____

What is conservation of natural resources?

_____

_____

_____

_____

How can **you** conserve natural resources?

_____

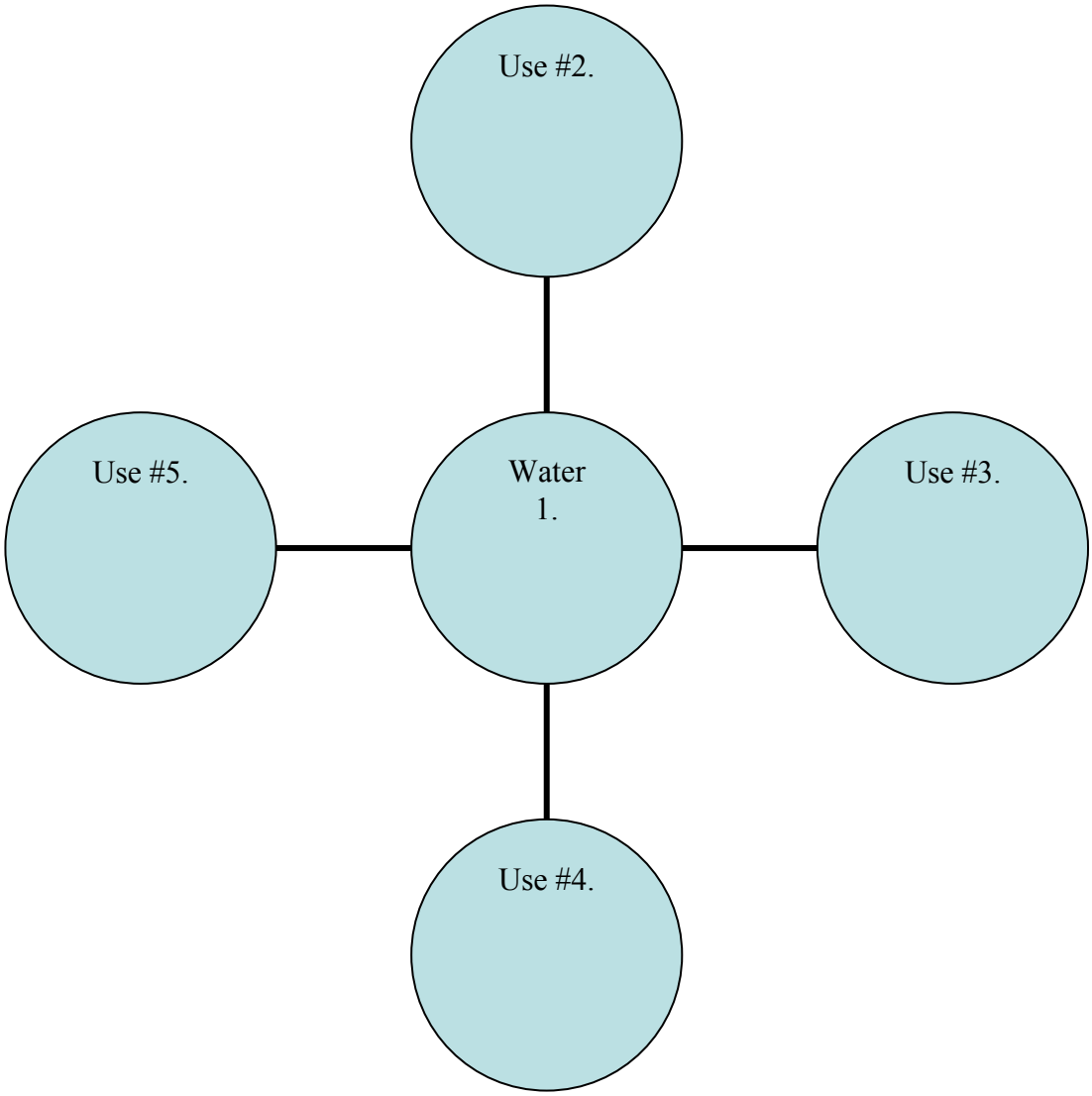
_____

_____

_____

How do I use water?

Fill in the most important ways you use water each day.

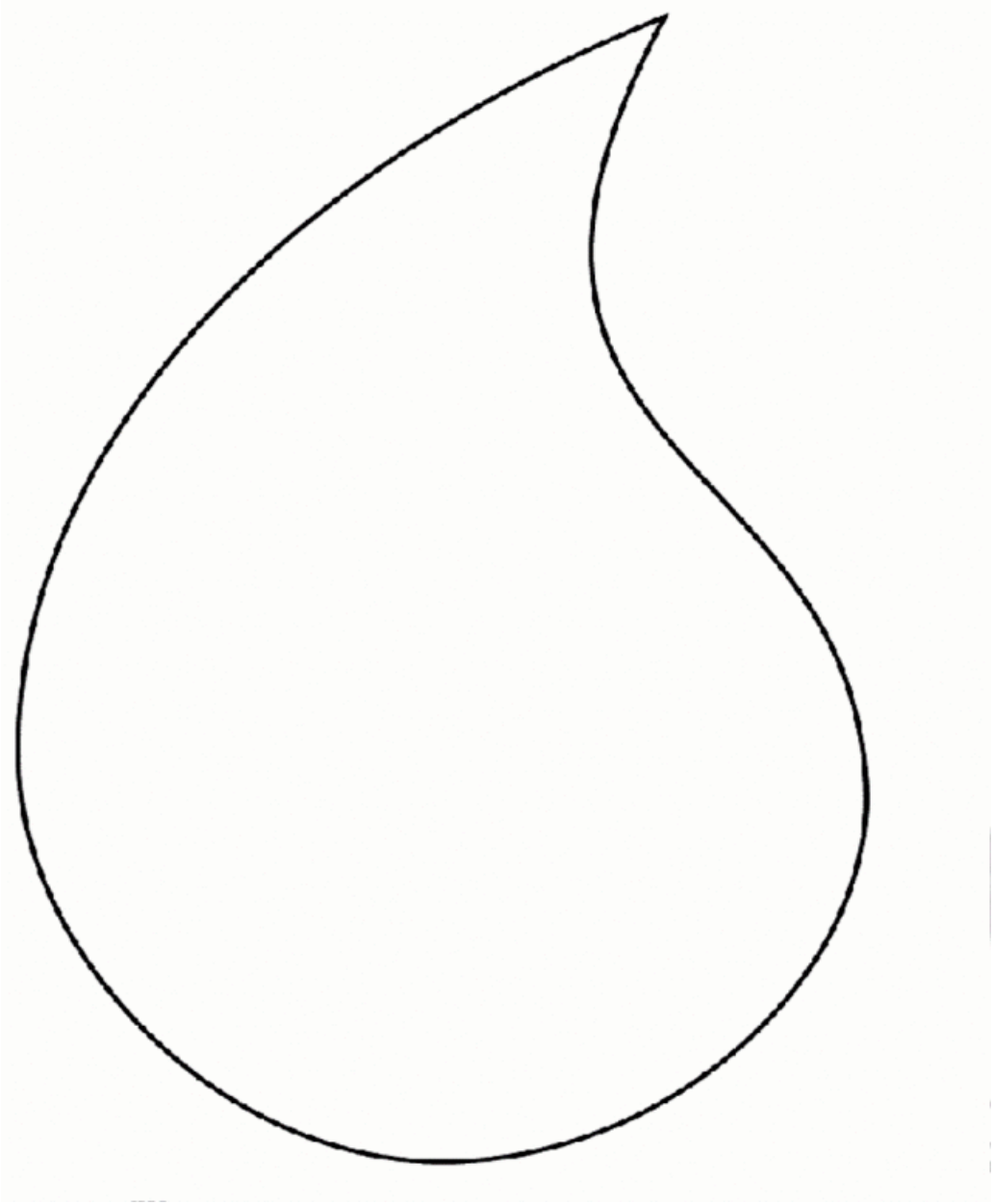


How many gallons of water do you think you use in one day? _____

How could you use less water? _____

_____

Poetry in Motion



Write your poem inside the water drop.

Clean Water, Please!

Study the picture of polluted water. Notice the details in the picture.
List three things you see as immediate concerns:

1. _____
2. _____
3. _____

Think about how that water impacts the environment. Write an article about the causes of water pollution, the impact on the community, and ways to resolve the problem.
Include information about the contamination of the surrounding area, the wildlife ecosystem, and human uses of water.

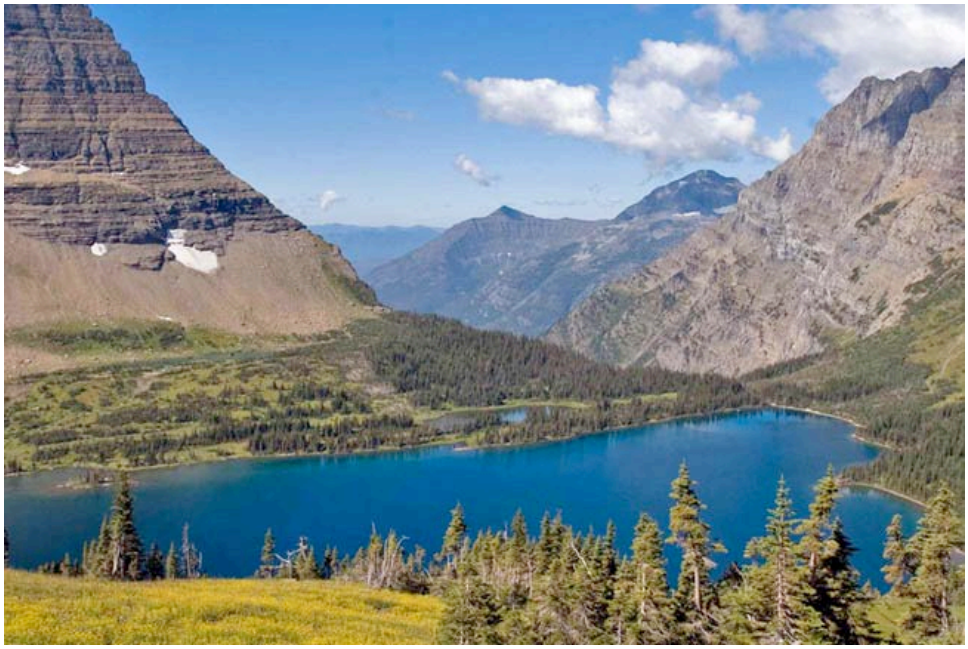
The Power of Water

1 Bow River Falls in Canada

2 Stephens Glacier in Alaska

3 Silver Glen Springs in Florida

4 Plum Island Estuary



5 Hidden Lake, Montana

6 A Saline Lake in California

Photo credits: # 1 USGS; # 2 Bruce F. Molina, USGS; # 3 Galina & Georgi Stanev, USGS; # 4 Matthew Kirwan, USGS; # 5 Lisa McKeon, USGS; # 6 C. D. Miller, USGS.

Water – How do we use it?

Activity	Normal Use	Conservation Use
Flushing	Depending on tank size 5-7 gallons	Displacement bottles in tank 4 gallons
Showering	Water running 25 gallons	Wet down; soap down 4 gallons
Bathing	Tub full 40 gallons	Minimal water level 10-12 gallons
Brushing teeth	Water running 5 gallon	Wet brush; rinse ½ gallon
Washing hands	Water running 2 gallons	Fill sink 1 gallon
Drinking	Run water to cold 1 gallon	Keep water in refrigerator 8 ounces
Dishwasher	Full cycle 16 gallons	Short cycle 7 gallons
Dishes by hand	Water running 30 gallons	Wash and rinse 5 gallons
Washing clothes	Full cycle 60 gallons	Short cycle 27 gallons

The U. S. Department of Agriculture, Natural Resources Conservation Service reports that the daily use of water in the home looks much like what is listed above. It is estimated that in the United States, we use 25 trillion gallons of fresh water each year. Each person uses approximately 168 gallons of water each day. How can we replenish the fresh water we are using to maintain water for the future?

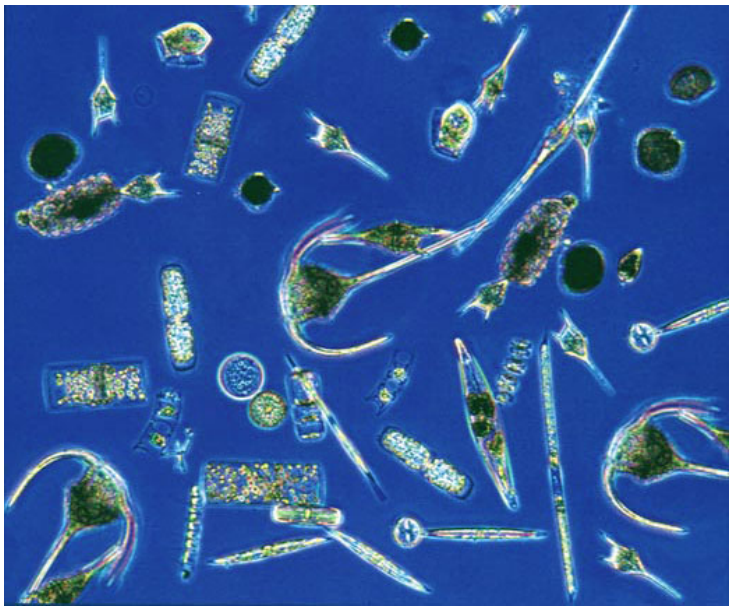
You are the engineer for a project to conserve, purify, and replenish fresh water. Select one or two of the areas of water use from the list above. Using technology, gather data on your choice, chart the data, and create a process for conserving, purifying and replenishing the fresh water. Predict how the long-term impact of your findings and resolution will be beneficial to everyone.

Plankton Lab

In a drop of water, there are countless microorganisms called plankton! Plankton is microscopic plants or animals. Plankton that is similar to animals is called zooplankton and plankton that is similar to plants is called phytoplankton. Collect water from a local lake or other source and use a microscope at school to identify your plankton.

Zooplankton

Phytoplankton

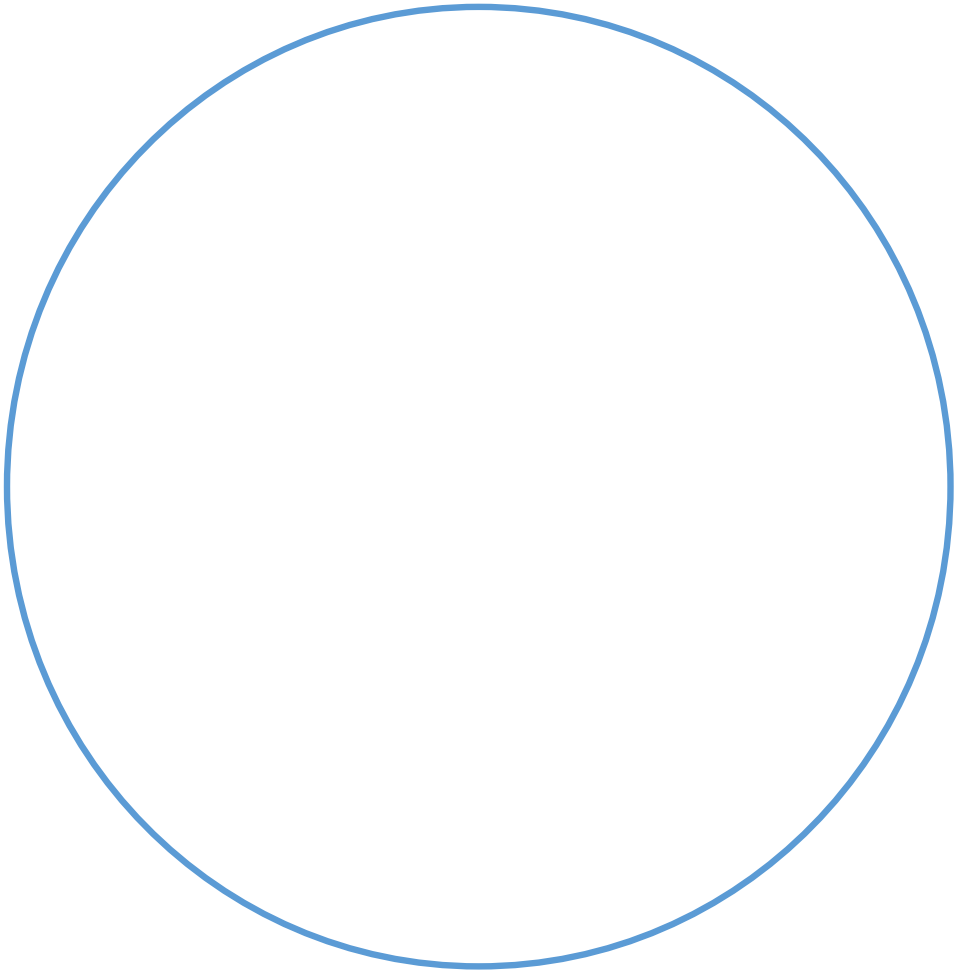


Zooplankton typically has many feather-like appendages to help with movement and a mouth to eat phytoplankton.

Phytoplankton is usually shaped simply and is slightly green due to the photosynthetic properties it has- it uses the sun to make its own food like a plant.

Plankton Lab

View your sample of water and draw the plankton you see. Circle your favorite plankton and write if it is zooplankton or phytoplankton and why.



My Plankton:

_____

Is it Phytoplankton or Zooplankton and why?

_____

The special characteristics:

_____

_____