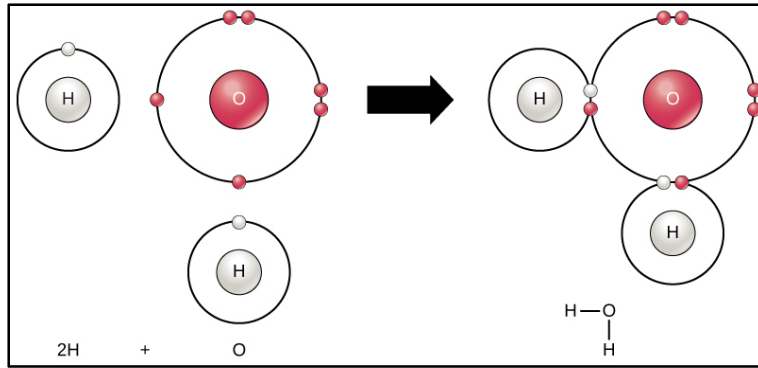


WATER AND WATER POLLUTION

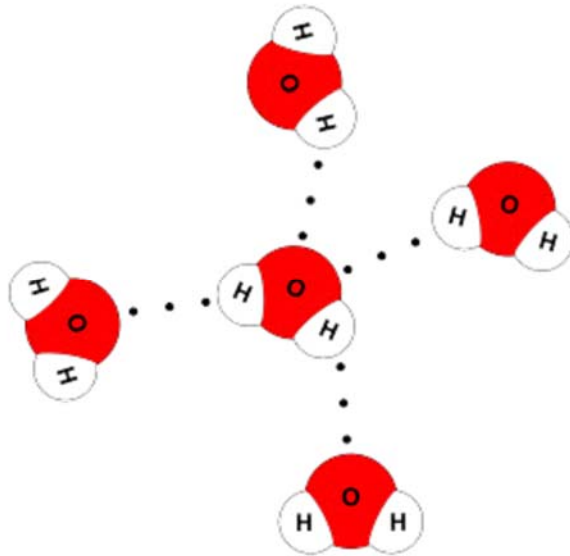


Properties of Water

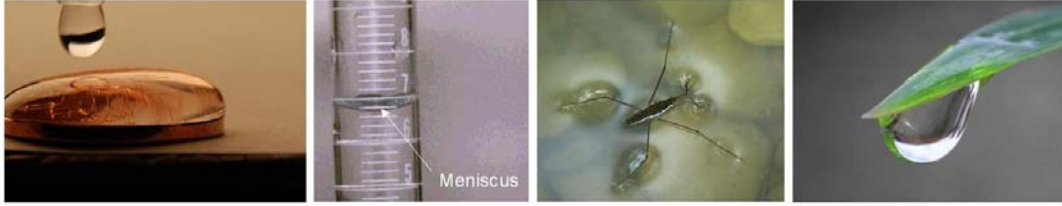
Water, dihydrogen oxide, H_2O , such a small, simple molecule, yet it is vital for life. Let's start by looking at water at the molecular level. Water is made up of two hydrogen atoms and one oxygen atom. These atoms are **COVALENTLY BONDED**, which means electrons are shared between the atoms. Hydrogen has one electron in its outer most shell and oxygen has six. Molecules want to be **STABLE** that means eight electrons total in the outer most shell. **Note:** Now that both hydrogens are bonded with the oxygen there are now eight electrons total.



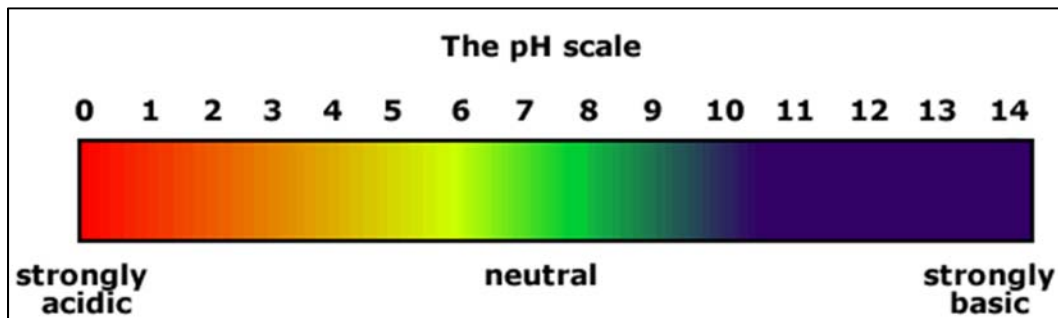
This bond causes the water molecules to be **POLAR**. There is an uneven charge. There is a negative charge near the oxygen atom and a more positive charge near the hydrogen. The polarity is what makes other substances dissolve in water. So when introduced to another atom or molecule that is negatively charged it will be attracted to the hydrogen atoms, a positively charged atom or molecule will be attracted to the oxygen atoms. When more than one molecule of water is involved they are attracted to each other by **HYDROGEN BONDS** (pictured below). The hydrogen atoms are attracted to the oxygen atoms and vice versa.



These hydrogen bonds are responsible for many of water's unique characteristics. Ice floats because the hydrogen bonds are further apart from each other in its solid state. Water does tend to mix well with most substances, however nonpolar substances repel water making them **HYDROPHOBIC**, this is because of the hydrogen bonds. It is also the reason that droplets form and why there is a meniscus in glasses. Water is attracted to water, this is **COHESION**. Try this at home, all you need is a penny and an eye dropper. Count how many drops of water you can fit on the penny before the water spills. As you drop water, you should notice the water stick together and eventually create a "bubble" on the top of the penny. This "bubble" is created by cohesion. Cohesion is responsible for surface tension. This attraction of particles is what keeps water bugs able to stay afloat. **ADHESION** is when water is attracted to other substances. Cohesion is what forms the water droplets; adhesion is what keeps the water droplets on your car or drinking glass.

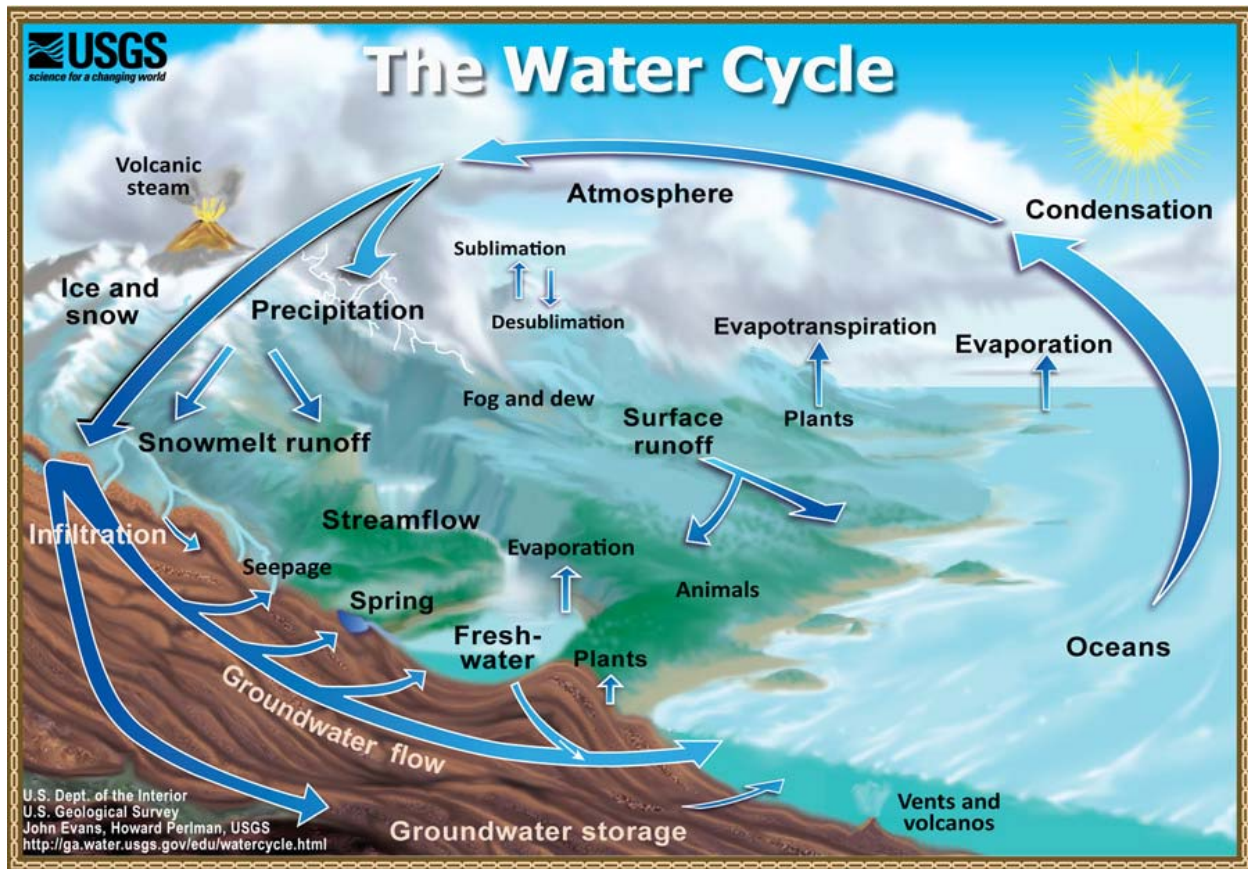


A chemical property of water is its pH. **pH** is the measure of how acidic or basic a solution is. The scale measures from 0-14. Solutions with a measurement of 0-6 are considered acidic and measurements of 8-14 are basic. Water is the magic number 7, neutral, it is neither acidic nor basic. The pH is an easy ways to measure the quality of water. Another special property of water is that it is the only natural substance that is found in all three states of matter at the temperatures normally found on Earth. Water freezes at 32°F and boils at 212°F.



The Hydrologic Cycle

Now that we know how water works at a molecular level, let's look deeper on how it interacts with the environment. The **HYDROLOGIC CYCLE**, also known as the water cycle, is the process of how water travels as it goes from water vapor, to precipitation, then collects on lands and bodies of water, and begins again.



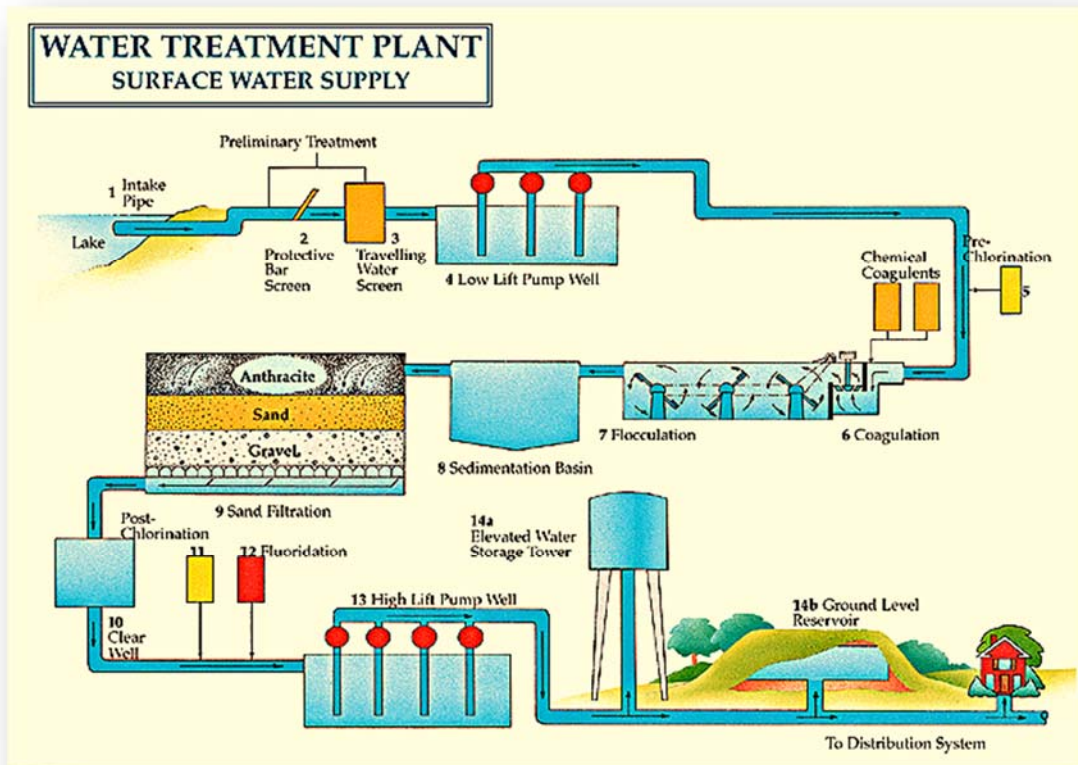
EVAPORATION is when water changes from a liquid state to a gas state, mostly from bodies of waters such as lakes, rivers, and oceans. Heat energy is needed to break the hydrogen bonds in order to separate the water molecules. Water evaporation does not just happen in bodies of water, it also comes from plants, and this is called **TRANSPIRATION**. Once the water vapor rises, it starts to cool. The cooling makes the vapor turn back into a liquid; this process is known as **CONDENSATION**. Condensation is what forms fog and clouds. The water has to come back down to Earth. **PRECIPITATION** can be in the form of rain, sleet, hail, or snow. From there the water is **COLLECTED** by soaking into the ground or running into bodies of water and the cycle continues.

Drinking Water and Water Quality

Many people take for granted that water is always available. Many countries are not so fortunate. Even though the Earth is mostly water only 3% is fresh water, and the majority of that water is frozen in the cryosphere. The **CRYOSPHERE** is the part of Earth's water that is frozen, this includes, glaciers, ice caps, and permafrost. In Ohio, there are two main sources of drinking water; **GROUND WATER** and **SURFACE WATER**. After it rains the water either percolates into the ground (ground water) or flows into lakes, rivers, streams, or reservoirs (surface water).

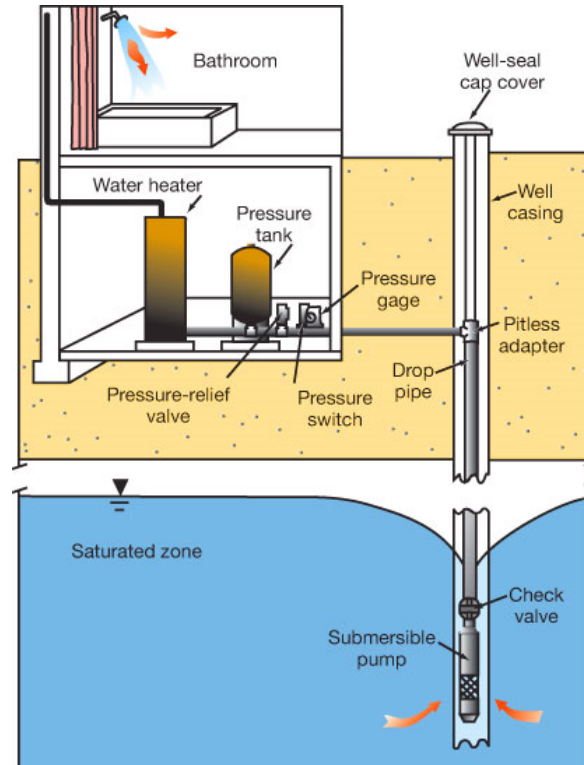
Here is the process, if you get your water through surface water. First pumps are placed in lakes, rivers, and reservoirs to collect water. Through a pumping station and pipes, water travels to the water treatment plant. The first step to start cleaning the water is the use of coagulates. **COAGULATES** cause particles to "clump" together. These "clumps" are called **FLOC**. The process of getting rid of the floc is called **CLARIFICATION**. By now most of the floc has been removed. Water is then filtered through layers of active carbon, sand, and gravel. The water is still not ready to be sent to your house, there could still be microorganisms in it, so the last step is for the water to be disinfected. **DISINFECTION** is when chemicals like chlorine or ozone are added to kill off the microorganisms. The water is finally clean enough to be considered drinking water and is sent through pipes and a pumping station to your house. Throughout the trip, water is continually tested. There are thousands of tests that are done; some of the major ones include pH, E.coli, lead, fluorine, nitrate, and sulfide levels. Watch the video below to see the process for yourself.

Water and You: The Water Treatment Process



Not all people use county or city water, some houses use a **WELL SYSTEM**. A well taps into a ground water storage area called an **AQUIFER**. Wells can be shallow and may only have to go twenty five feet down. However some many need to be deeper in order to reach water. A pipe is drilled down into the source of the water. At the end of piping there is a pump that pulls in the water. The pump does not continuously bring it water. The pressure tank and pressure switch, control the water pressure in your house. This means that water is not just trickling out of the facet when you wash your hands. When the tank holding water inside your house starts to lose water the pressure tank pushes the water through the pipes to get to the facet. As it is doing that it is also pulling water from the reservoir. A benefit to having a well is that you do not have to pay a monthly water bill. However, you are responsible for any problems that may happen with the system. In order to do maintenance on a well, not all of it is located underground. There is about a foot of pipe left above ground that allows for easy access if necessary.

Some disadvantages to having a well is that if it does not rain for a while there may be less water to pull from.



Water Pollution and Commination

You probably noticed surface water is treated a lot. That is because of all the pollutants and toxins that get into it. Ground water can also be polluted and filters are placed in the pumps to reduce toxins. **WATER POLLUTION** is defined as the buildup of a substance so much that it causes harm to plant and animal life. The type of substances that enter our water systems is usually not the problem. The problem occurs when so much of a substance that the water cannot dilute it. It is obvious that the overwhelming majority of water pollution comes from humans and there are two major ways pollution can happen. When the location of the pollution can be pinpointed to a location, it is called **POINT-SOURCE POLLUTION**. Most of the pollution is caused by many different sources; this is called **NONPOINT-SOURCE POLLUTION**. Usually the effects of pollution

are most felt near the source, however sometimes (seen with nuclear pollution) the effects can be seen hundreds or thousands of miles away. Then it is can **TRANSBOUNDARY POLLUTION**. Sometimes pollution can be physically seen, like after an oil spill. Other times the chemicals and bacteria cannot be seen. So how can we tell if water is contaminated? When remember when drinking water was discussed? Water going through the pipes was constantly collected and samples were sent away to get testes. Polluted water is chemically tested the same way. There are also **BIOLOGICAL INDICATORS**. If fish are not surviving in a lake or river, there is a good chance that it has to do with poor water quality.

There are thousands of ways our water sources can get polluted. Exhaust from a car can end up affecting the ocean. Remember the water cycle. The fumes of a car enter the atmosphere. These fumes combine with the cooling water vapor. This will fall back to the Earth. If the concentration of the pollutant is high enough it can be considered acid rain. This rain can fall back into an ocean, therefore containing it. So what you do in Ohio may affect the water quality in a country across the world! Another way our waters are polluted is through fertilizers. Farmers spray their crops with nitrogen and phosphorus rich fertilizers that help plants grow. The fertilizers runoff into streams and eventually make it into the bigger bodies of water. This excess of nutrients can cause **ALGAL BLOOMS**, more commonly known as **RED TIDE**. Algae and plankton as grow better in the presence of nitrogen and phosphorus. The over growth of these can cause the water to turn red. Red tide can lead to a **DEAD ZONE**. The algae and plankton consume all the oxygen in the water. Therefore nothing else has a chance to survive there.



About half of the ocean pollution is caused by sewage and waste water. **WASTE WATER** is considered to be chemicals dumped down drains, and untreated liquid waste from factories. A lot of pollution and waste enters water from highway **RUNOFF**. Oil, brake fluid, and other debris runs into streams and makes its way to the oceans, just like the farmer's chemical fertilizers. Waste coming from the factories include polychlorinated biphenyls (PCBs), lead, cadmium, and mercury. Fish that live in mercury polluted water ingest the toxin then they contain the toxin as well. People eating these fish can get mercury poisoning. Factories and industries will also produce thermal pollution. Thermal pollution is when water is returned to where it came from either warmer or colder than the normal temperature. Aquatic life cannot adapt fast enough to survive in the new temperature of water.



Chemical and oil spills are not the only culprit to polluting the water. Shore lines can be lined with trash, plastic being the most common. Most plastics are not biodegradable, so they do not break up naturally in the environment. Plastic can present a choking hazard. Marine life many also get tangled in plastic bags, drink holding rings, and netting.



The link below is a video that shows all the major types of water pollution.

What is Water Pollution?

Water Conservation and Clean up

With so many ways to contaminate the water, it is hard to find a solution. Here are some things that have and continue to help. Make people aware. Many take for granted the clean water and do not notice the effects they may be contributing to. Laws that make factories limit their waste water disposal, and the amount of

chemical that can be released. Industries are usually fined for not obeying these laws. We must also remember while water covers 70% of the Earth, we must use it wisely, we use it faster than it being replaced. The chart below shows your some ways you can conserve water.

Play your part, be water smart!

Wise Water Use



Get an Energy Star labeled washing mashine. Wash only full loads.



Use low flow shoerhead.



Use a shut-off nozzle on your hose.



Put faucet aertors on sink faucets.



Turn off the water while soaping hands and brushing teeth.



Mulch around plants to hold water in the soil.



Water your yard and outdoor plants early or late in the day to reduce evaporation



Install new toilettes that use less than 1.6 gallons per flush.



Turn off sink faucet whle scrubbing dishes and pots.



Use plants that require less water.



Take shorter showers - five minutes or less is best.



Use a broom, not a hose, to clean driveways and walkways.



Save it, or do without it!



Now answer question 1 through 22.