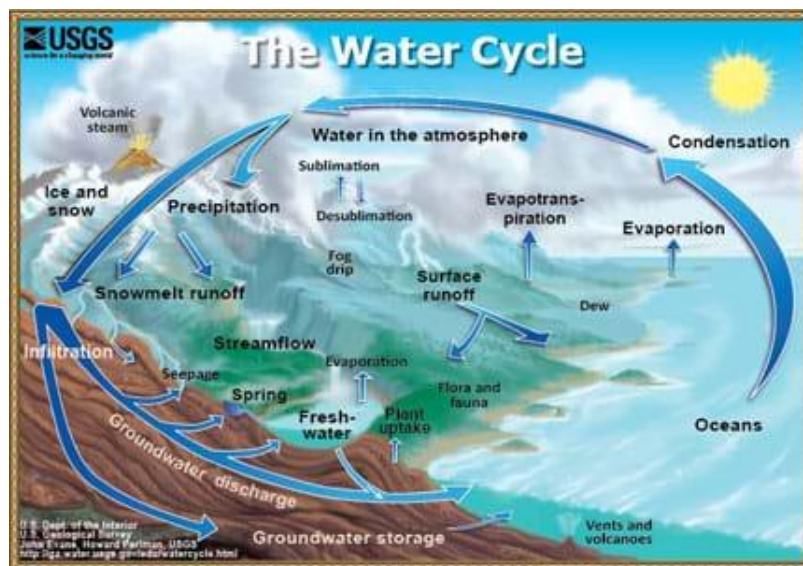


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All About Water!

Introduction :

From where does the water you drink come? Sure, it probably comes out of a sink faucet or drinking fountain, but where was it before that? Today we are going to learn about different water sources, and how that water becomes safe to drink before it ever comes out of a tap. All of these topics are extremely important to environmental engineers, and will help you understand the source of your water. Engineers are in charge of finding good water sources (environmental engineers), treating that water to make it safe (chemical engineers), and then getting that water all the way to you (civil engineers). That means, engineers must think about something called water quality, which is a good indicator of how safe water is to drink. Let's get started!



Water is continuously transformed between different phases.

Many different types of water exist. The two main water types are surface water and groundwater. Streams, rivers and lakes are all commonly found surface water sources with very important and distinctive differences between them. A stream is a body of water with a current. Streams are visibly moving, and have defined banks, so you can see where the stream ends on either side. A river is a natural waterway (usually freshwater) that flows toward an ocean, lake, sea or another river. The main difference between a stream and river is that a river flows somewhere. A stream can start in a mountain and then flow slowly until it just disappears, but it would be impossible for a river to do so. A lake is generally known as a relatively still body of water—not moving or flowing at a visible rate—that is large in size, and surrounded by land.

Water that is brown in color, often resembling the appearance of a cup of tea, is likely filled with dissolved organic matter, known as DOM. DOM is composed of 50% carbon. Carbon is in practically everything—pencils contain lead that is made of carbon, the human body is about 18% carbon, and trees and soil all contain carbon.

DOM has both positive and negative effects on water. One positive is that microorganisms, little tiny things that can only be seen with a microscope, love DOM! They think it is delicious and you always find more microorganisms when you see water with a lot of DOM. The darker the water, the more food available. On the negative side, DOM has the ability to transport metals. Two of the most common and most dangerous of these metals are mercury and arsenic. When mercury comes into contact with microorganisms and water, it can be transformed into a harmful neurotoxin, meaning it becomes dangerous for the brain. Arsenic often occurs naturally in rock formations and it can be released into groundwater when it comes in contact with DOM. This means that if you see water high in DOM, a good chance exists that it is high in metals. So, environmental engineers must keep this information in mind when choosing safe drinking water sources.

Humans play a role in the amount of DOM found in water. Studies have shown that humans cause 10 times more erosion, the wearing away of the earth's surface, than natural processes [U. of Mich, 2004]. By building houses and roads near streams and rivers, humans can increase DOM content in water. However, humans can help reduce erosion! By planting ground cover on hills and stream banks, roots systems help to maintain the natural structure of the soil, and therefore helps limit erosion.

Many people are unaware of the many steps that water goes through before it comes out of the tap. Figure 1 shows the conventional U.S. drinking water treatment process.

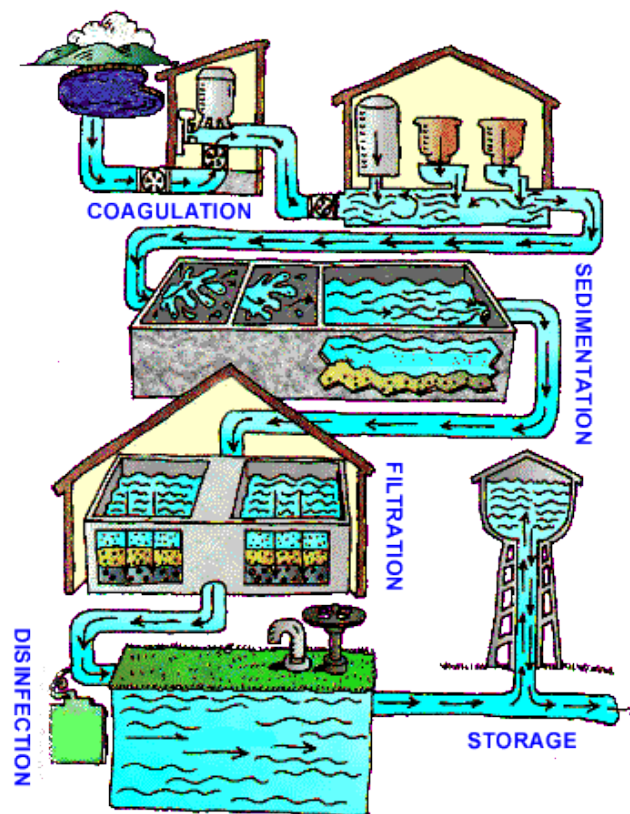


Figure 1: Conventional drinking water treatment process.

With few exceptions, all public water in the U.S. must go through this conventional drinking water process before it comes out of the tap. The first step, of course, is the smart selection of drinking water sources. The first step in the treatment process is called **coagulation**. During coagulation, chemicals are added to the water that make dirt and some dissolved particles stick together, resulting in clumps that are referred to as flocs. During the next process, **sedimentation**, the flocs start get really heavy and sink to the bottom of the tank where they can be removed. After coagulation and sedimentation comes **filtration**. During this step in the water treatment process, all of the water being treated flows slowly through filters made up of layers of sand, gravel and charcoal. Following filtration is the final step in the treatment process: **disinfection**. During disinfection, chlorine is added. Chlorine is the same thing that is used to disinfect swimming pools, but when it is used for drinking water disinfection, much less is added. The law states that a certain amount of chlorine must be present in your water every time you turn your tap on. This requirement exists because some dangerous microorganisms that are able to get through all of the other treatment processes are killed by chlorine.

High DOM concentrations are very difficult to remove from water. Because DOM is dissolved in water, it requires a chemical reaction (or reactions) to remove it. Problems during the disinfection process can result if high amounts of DOM are in the water. They can form what are called disinfection byproducts (DBPs), which are harmful if ingested. One common DPB is chloroform (you may have seen a movie or television show in which a cloth is put over someone's mouth or nose and then the person passes out—which is due to breathing in chloroform!).

Water is an essential resource on earth. There are many different types of water sources and they all have different characteristics, which can affect their ability to become drinking water sources. One of the most important characteristics to consider when choosing a drinking water source is dissolved organic matter content. We learned that water with a high DOM content can have lots of other things in the water, such as microorganisms and metals, which would make the water much harder to treat! We also talked about the drinking water treatment process and learned about all the phases that your water goes through before it comes out of your tap. In order, those processes were: coagulation, sedimentation, filtration, disinfection, and storage. It's important to realize that if any of these steps were skipped, our water would not be clean enough to drink and could make people very sick.

Activity : Define the following words :

Coagulation ; disinfection ; dissolved organic matter (DOM) ; erosion ; floc ; sedimentation .