

## Water Testing

According to the United States Geological Society (USGS), water quality is a term used to describe the chemical, physical, and biological characteristics of water. Water quality can be measured scientifically; however, it depends on the user to define what “good” water quality is.

For example, the water quality may be good enough to wash a car but not good enough to drink. The water quality of natural bodies of water determines if they are suitable habitats for aquatic plants and animals.

Water quality is measured by studying the chemistry or assessing the life in the water. Standards are established to protect water for uses such as drinking, recreation, agricultural irrigation, and maintenance of aquatic life. Natural water quality will vary based on the geology, seasons, and climate. Humans can alter water quality by participating in activities such as development, farming, mining, combustion of fossil fuels, stream channel alteration, and animal-feeding operations.

In coal mines, miners used to take canaries down into mine shafts

Environmental Effects	pH Value	Examples
<b>ACIDIC</b>	pH=0	Battery acid
	pH=1	Sulfuric acid
	pH=2	Lemon juice, Vinegar
	pH=3	Orange juice, Soda
	pH=4	Acid rain (4.2–4.4) Acidic lake (4.5)
All fish die (4.2)	pH=5	Bananas (4.5) Clean rain (5.6)
Frog eggs, tadpoles, crayfish, and mayflies die (5.5)	<b>NEUTRAL</b>	Healthy lake (6.5)
Rainbow trout begin to die (6.0)		Milk (6.5–6.8)
	pH=7	Pure water
	pH=8	Sea water, Eggs
	pH=9	Baking soda
	pH=10	Milk of Magnesia
	pH=11	Ammonia
	pH=12	Soapy water
	pH=13	Bleach
<b>BASIC</b>	pH=14	Liquid drain cleaner

with them to alert them when the air quality was particularly dangerous. If the air quality was bad, the canary would stop singing or die, which was a sign for the miners to get out as fast as possible. Seagrass functions as a sign of a healthy ecosystem, much like the canary in the coal mine.

If the health of the seagrasses is suffering, it is a sign that other wetlands life forms—plants and

animals—are in danger, often as a result of human pollution activities. Steps should be taken right away to intervene!

To create a profile of the health of a body of water, a variety of tests are performed, each an important piece of the puzzle. As you perform each test, you are not only a scientist, you are a detective and a doctor, working to piece together



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the clues of what the water is trying to say to you about how well it is able to support the organisms that call it home.

Imagine that you are babysitting a baby brother or sister who has not yet learned how to talk. All of a sudden the baby starts crying and simply won't stop. How do you figure out what's wrong? You might take him or her to the doctor and the doctor will check the baby's eyes, ears, nose, or throat, listen to his or her chest, pinch fingers, etc., and eventually pronounce what illness the baby has and what treatments you should follow.

In a way, water quality testing allows you to take on the role of the doctor or nurturing babysitter. Earth's waters are crying out to you! But before we can propose a solution, we have to figure out what's wrong. We have to know what the symptoms are before we can prescribe a treatment.

### Temperature

#### Why does it matter how warm or cold the water is?

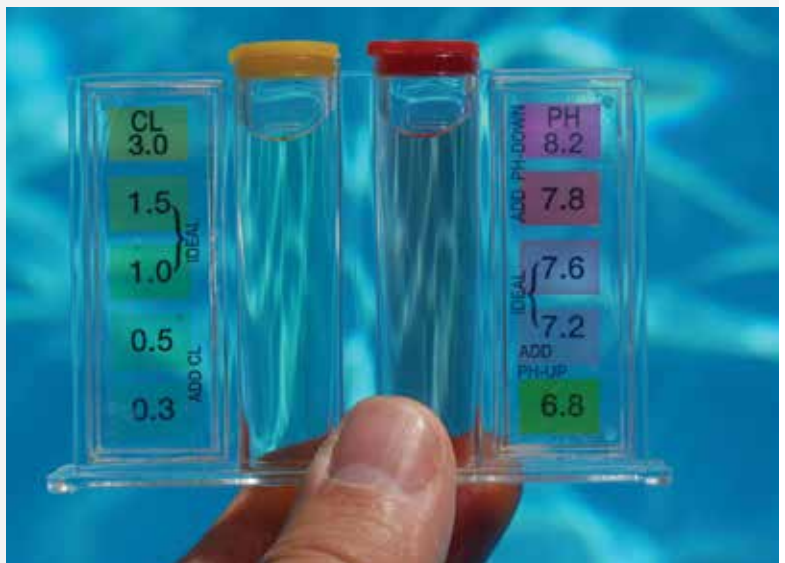
Water temperatures outside of the “normal range” can harm the aquatic organisms that live there. Water that is colder allows more oxygen to flow and helps aquatic organisms like fish to

breathe more easily. Warmer water temperatures can cause an increase in plant and algae growth which may harm the ecosystem by choking out necessary nutrients. In general, when the water temperature becomes too hot, organisms become stressed, which in turn lowers their resistance to pollutants and diseases.

#### What causes temperature changes?

The biggest threat is water that is too warm. Though Florida's waters are warmer than others because of its proximity to the equator, its water can still become warmer in several ways:

- **Thermal pollution**—Many industries use river water in their processes. Though the water is usually cleaned and treated before it is returned back to the river, it is often warmer than it was before. Additionally, runoff from paved parking lots and rooftops is warmer from sitting in the sun and will increase water temperature as it seeps through the ground back toward the stream, pond, or marsh.
- **Lack of shade**—Shade from trees prevents sunlight from warming a body of water directly and too quickly. Human activity that removes



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trees from the waterside allows sunlight to reach the water more easily and warm it.

- **Water depth**—The air around a body of water can also affect the water's temperature. Shallow bodies of water warm and cool more quickly than deeper ones. When humans fill in ponds or lakes to get rid of excess dirt or trash, the depth of the water can change, increasing the temperature of the water.

### pH

#### **What is pH and why is it important?**

Water contains tiny particles of hydrogen and hydroxide ions. The amount of each ion present in the water determines the pH value, reported on a scale of 0-14. Aquatic organisms are extremely sensitive to the pH of their environment. Even the smallest changes in pH can endanger plants and animals. If the pH of the water is outside of their desired range, the organisms may not survive or reproduce, threatening the biodiversity of the ecosystem.

#### **What causes pH to change?**

The pH of a body of water changes as different chemicals

enter the water, such as acid rain, increased algae, hard-water minerals from runoff, chemicals released from industrial processes, and decomposing matter.

### Turbidity

#### **What is turbidity and why is it important?**

Turbidity refers to how clear or cloudy the water appears; the cloudier the water, the higher the turbidity. Water becomes cloudy when there are a lot of extra particles floating around, off of which light bounces. When water is very cloudy, sunlight is able to warm the water more quickly, which can lead to problems with warmer water temperatures as discussed in the temperature section.

#### **What causes changes in turbidity?**

There are many factors that increase water's turbidity:

- Soil erosion
- Runoff from urban areas like parking lots and roads
- Sewage
- Decomposing plant/animal matter
- Gasoline or oil from roads

### Dissolved Oxygen

#### **What is dissolved oxygen and why is it important?**

We all need oxygen to breathe. Organisms that live in the water rely on oxygen that has dissolved into the water in order to breathe. Dissolved oxygen (DO) refers to the amount of oxygen gas that has successfully incorporated into aquatic environments.

#### **What causes changes in dissolved oxygen levels?**

Dissolved oxygen increases when water flows over rocks, when water churns because of waves and wind, and when aquatic plants perform photosynthesis—the conversion of carbon dioxide into oxygen gas with the help of the sun. DO levels are also influenced by the time of day. At sundown, photosynthesis stops, but animals continue to breathe, causing a decrease in DO levels. For this reason, you can expect DO levels to be lower in the morning than in the afternoon.

### Nitrates

#### **What are nitrates and why are they important?**

Nitrogen is an element that occurs naturally on Earth. All living organisms need nitrogen to survive. Nitrates can also be manufactured by humans when they produce fertilizers. Elevated



## Water Testing *continued*

levels of nitrates in water used for drinking can contribute to Blue-Baby Syndrome, a disease in which nitrates prevent oxygen from circulating through the blood, often causing death. High levels of nitrates can also contribute to excessive growth of aquatic plants and algae, resulting in foul-tasting water, bad odors, and increased turbidity.

### **What causes changes in nitrate levels?**

The major source of nitrate pollution comes from agricultural areas where the manure from

livestock kept in feedlots seeps into the ground and back into the water. Man-made fertilizers also run off from crops into the water.

### **Salinity**

#### **What is salinity and why is it important?**

Salinity is the measure of how much salt is in the water. It is particularly important to evaluate the salinity of bodies of water where freshwater mixes with seawater because aquatic organisms have varying abilities to survive depending on the salinity level.



*What did you learn about the health of Florida's waters? What differences did you notice in the waters at Fort De Soto, Crystal Springs, or Clearwater Beach?*

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# Florida: Habitat H<sub>2</sub>O Discovery Journal

## Water Testing *continued*

There are several characteristics we can test to assess water quality. Using the water samples or locations you are given, complete the chart below to help you record the values for each of the following measures.

What?	Why?	Value				
		Test 1	Test 2	Test 3	Test 4	Test 5
Water Temperature	Species tolerate temperatures differently					
pH	The acidity of the water must be between 5.6-8.5 for aquatic organisms to survive					
Nitrates	Decomposing animals produce nitrates, which are nutrients needed by plants					
Dissolved Oxygen (DO)	Amount of oxygen in the water from aquatic plants undergoing photosynthesis during the daylight					
Salinity	Concentration of salt in the water					
Turbidity	The clarity of the water determines the amount of light that can penetrate to the aquatic plants beneath the surface					



## Water Quality 101

Water quality affects people all over the world. How does human activity affect water quality?

### Citarum river pollution

Shown below is one of the dirtiest rivers in the world—the Citarum River, located in Indonesia, a series of islands in southeast Asia. Just a few years ago, the waters were clean and the local villagers used the river for fishing and rice paddies. In the 1980s, as industry boomed, the 500 factories lining the river began leaking toxic chemical waste into the river. Further, there is no curbside trash pick-up service like you might have at home. This means that families and businesses dump their trash and waste directly into the river, claiming they don't have anywhere else to put it. Unfortunately, for most of the population, the

Citarum is the only source of water nearby, so people continue to collect the water to drink, cook with, and wash their clothes. And what about the trash? Because fishing is no longer an option, the people shift through the trash looking for objects they might salvage and sell.

### And by the way...

...we're actually running out of water! Or are we? Though 70 percent of the Earth's surface is covered with water, 97 percent of that is salt water. Of the remaining 3 percent freshwater, only 1 percent is available for human use (by human use, we mean water that is drinkable). That's like removing 1 tablespoon of water from a filled gallon jug of water. If you and five friends tried to share that 1 tablespoon of water for all



### What does the Citarum have to do with me?

Wealthier countries often pay poorer countries to take away the wealthy country's trash on large boats. Electronics are a major culprit. As the technology that we use every day such as cell phones, computers, and tablets becomes outdated, we toss them in favor of newer models. Outdated electronic equipment takes up a lot of space in our country's trash load. So the next time you throw something away, think about where it might end up, and instead of contributing to the problem, recycle or reuse as much as possible.





## Beef with burgers

- Between feeding cattle, watering plants, and producing bread, it takes 634 gallons of water to make a hamburger.
- The average North American uses 105.7 gallons of water each day for domestic uses alone. The average citizen of a developing country, like Mozambique, uses 1.3 gallons of water each day.
- One-sixth of the world's population does not have access to safe water. Two-fifths of the world's population does not have access to adequate sanitation of their water.
- In 2019, the World Resources Institute, identified 17 countries that face “extremely high” levels of water stress. Twelve of the countries are in Middle East and North Africa.

## Water Quality 101 *continued*

of your daily needs, that would represent the drinkable water on Earth.

Technically speaking, water is not disappearing from the Earth. In fact, thanks to the closed nature of the water cycle, the water that is on the Earth today is the same water that was around when dinosaurs roamed! (Refer to the diagram on page 18 for a refresher on the water cycle.) The problem is that more and more humans are polluting the water that is usable, forcing us to find alternative ways to treat our water so that it is drinkable.

### What are the uses of water?

Of course we need water to drink, but we use water for a lot of other things as well. Rank the three major water use areas from 1-3, with 1 using the most amount of

water and 3 using the least amount of water:

- \_\_\_ Industry
- \_\_\_ Domestic (showering, cooking, etc.)
- \_\_\_ Agriculture

### Water is essential

Have you ever thought about what's really in water? We need it to survive, and fish and other creatures live in it, but have you ever thought of it as anything besides a clear, brownish, or bluish liquid?

In fact, there are millions upon millions of particles in our water. The presence or absence of certain organisms and chemicals can tell us how “healthy” the water is and whether it is good for animals and humans to live in or drink.



### DID YOU KNOW?

Nephelometric Turbidity Units, or NTUs, are the units we use when we measure turbidity. The term *Nephelometric* refers to the way the instrument estimates how light is scattered by suspended particulate material in the water. Fish become injured when exposed to water with a turbidity of 25 NTU or more. During a flood, turbidities can jump to well over 100 NTU but will usually settle down after a day or two. The EPA requires turbidity in drinking water not to exceed 5 NTU.