

Name: \_\_\_\_\_

Date: \_\_\_\_\_ Core: \_\_\_\_\_

## Water Quality



For aquatic organisms, both plants and animals, a sudden or drastic change in their environment can be life-threatening, so testing the quality of water in terms of temperature, pH, oxygen levels, and nitrates is essential in determining the overall health of a water source. Monthly monitoring and frequent observations are necessary in order to sustain hearty ecosystems and make sure pollution is not becoming a problem or excess nutrients are not disrupting the balance. Described below are some water quality factors that can easily be assessed to find out how a water system is doing.

### Temperature

There are many factors that can affect water temperature causing it to increase or decrease. Shallow water tends to be the temperature of its surroundings...warm if in a sunny area, cooler if shaded. Thermal pollution (the release of hot water from factories) and run-off from hot asphalt can increase water temperatures dramatically. Water temperatures outside the “normal” range can be harmful to aquatic plants and animals by lowering their resistance to pollutants, diseases, and parasites.

Many aquatic organisms prefer cooler water than warmer water. Cooler water is more dense, so it is found in deeper waters. Warmer water is less dense, so it is found closer to the surface. Why do organisms prefer the cooler waters? The temperature of the water plays a key role in the amount of dissolved gases like oxygen or carbon dioxide. As water gets colder, more oxygen can be dissolved in it. Organisms that require more oxygen will be found in deeper parts of the water because it is plentiful down there. Aquatic plants behave a little differently and like to float on top of or be close to the surface of the water. Warmer water and exposure to sunlight will increase the amount of photosynthesis aquatic plants and algae perform. Unfortunately, too much photosynthesis will lead to excessive plant growth and algal blooms.

**Directions:** Based on what you read...identify the effects from the causes of increasing and decreasing temperatures.

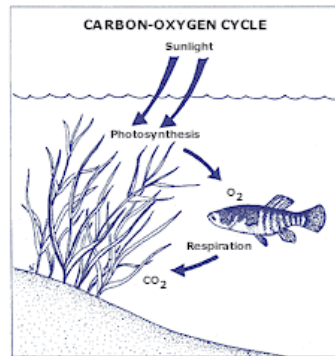
	Possible Causes	Possible Effects
Increasing Temps 	<ul style="list-style-type: none"> <li>• Shallow water</li> <li>• Warmer air temperature</li> <li>• Direct sunlight</li> <li>• Thermal pollution</li> <li>• Warm run-off</li> </ul>	
Decreasing Temps 	<ul style="list-style-type: none"> <li>• Deep water</li> <li>• Cooler air temperature</li> <li>• Shady</li> </ul>	

Name: \_\_\_\_\_

Date: \_\_\_\_\_ Core: \_\_\_\_\_



## Dissolved Oxygen (DO)

As you well know by now, oxygen is a necessity for respiration, and respiration is a life process of all living things. So, how does oxygen get into the water in order to be used by aquatic organisms for their survival? Oxygen gas dissolves in water in a variety of ways. Some oxygen will naturally diffuse into the water directly from the air. Photosynthesis by aquatic plants, algae and phytoplankton will contribute large amounts of oxygen. Of course they do this by removing the carbon dioxide produced primarily by aquatic animals...part of a cycle called the **O<sub>2</sub>/CO<sub>2</sub> cycle**.



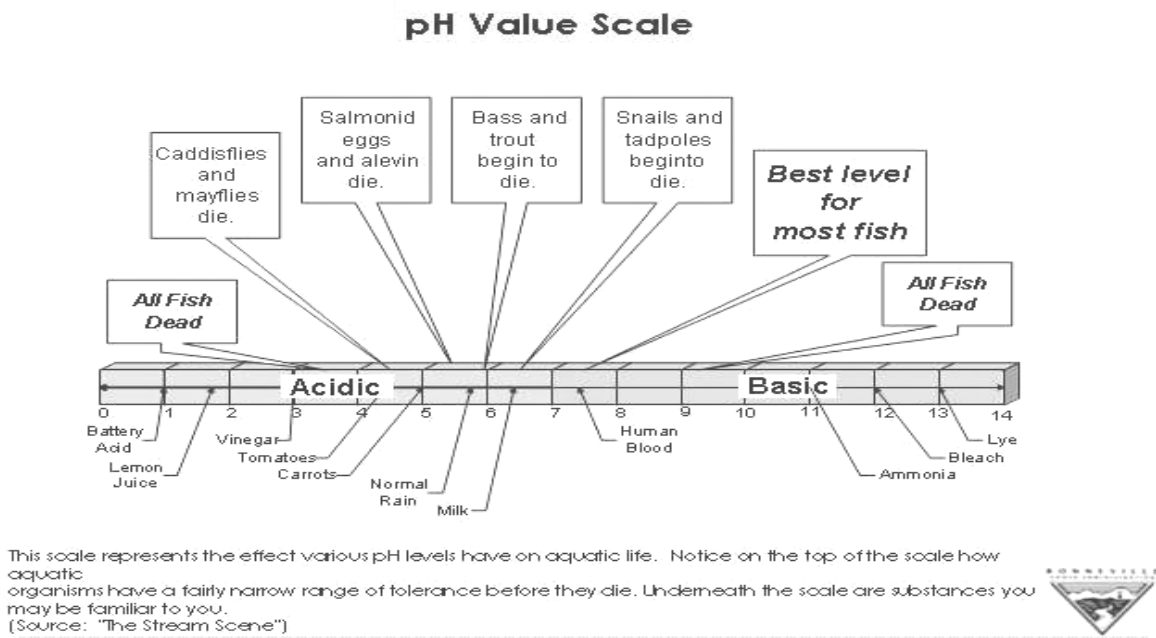
Dissolved oxygen will also change as a result of an algal bloom. While the algae are growing at a fast rate, the DO levels will increase. As the resources get used up, space, light, and CO<sub>2</sub> become limited, the algae will start to die off. As a result, bacteria will begin to rapidly decompose the dying/dead algae, a process requiring lots of oxygen. Thus the before mentioned abundance of DO, suddenly becomes depleted. This phenomenon is known as **eutrophication** and is usually caused by an excess of nutrients from fertilizer runoff to begin with. DO levels can become so low after this that many other aquatic organisms begin to die off as well because they don't have enough oxygen for survival. Ultimately, oxygen gas is vital to the existence of most aquatic organisms and contributes to a greater diversity of living things when abundant and plentiful.

**Directions:** Based on what you read...identify the effects from the causes of increasing and decreasing oxygen levels.

	Possible Causes	Possible Effects
Increasing DO 	<ul style="list-style-type: none"> <li>• Cooler water</li> <li>• Photosynthesis is occurring</li> <li>• Algal bloom (initial)</li> </ul>	
Decreasing DO 	<ul style="list-style-type: none"> <li>• Warmer water</li> <li>• Night time (no photosynthesis)</li> <li>• Excess decomposition</li> </ul>	

## pH

When water mixes with certain substances, the bonds between the oxygen and hydrogen atoms can be broken into hydrogen ( $H^+$ ) or a hydroxide ( $OH^-$ ) ions. When this happens, water can become more alkaline (basic) or acidic. The concentration of hydrogen or hydroxide ions determines water's pH value and is assessed using a scale of 1—14. When the concentration of these two ions is equal, water has a pH of 7...what we call neutral. More  $H^+$  ions decrease the pH, making the water more acidic. More  $OH^-$  ions increase the pH, making the water more alkaline or basic.



The pH of water may be affected by rainfall, which is slightly acidic because it carries with it dissolved carbon dioxide (carbonic acid) and other pollutants. However, run-off that travels over certain minerals such as limestone on its way to a stream or river can cause the pH to become more alkaline. Other things that can affect pH are photosynthesis (uses up  $CO_2$ ), decomposition (creates  $CO_2$ ), respiration (creates  $CO_2$ ) and excretion (creates ammonia). As you can see in the graphic above, aquatic organisms can be greatly affected by sudden changes in the water's pH.

**Directions:** Based on what you read...identify the causes of increasing and decreasing pH levels.

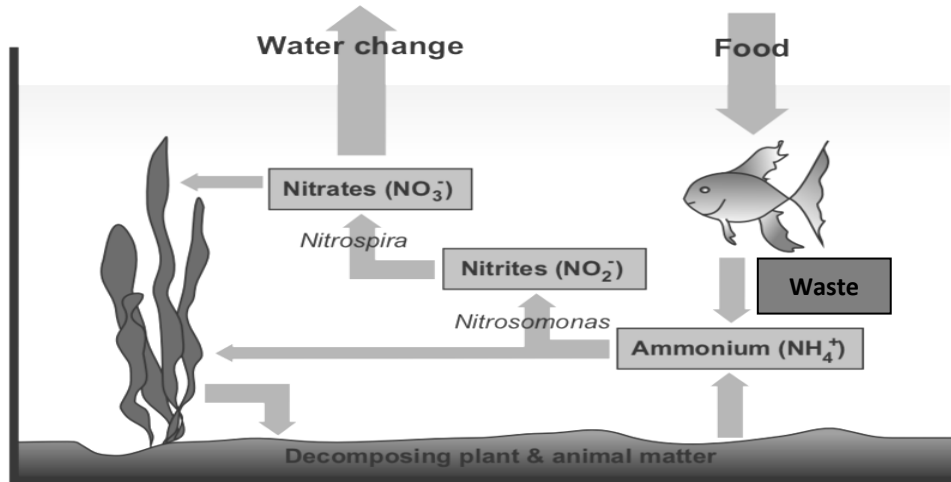
	Possible Causes	Possible Effects
Increasing pH (alkaline) 	<ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Plants will not grow</li> <li>• Harmful or lethal to fish if too basic</li> </ul>
Decreasing pH (acidic) 	<ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Fish eggs will not hatch</li> <li>• Harmful or lethal to fish, frogs, and insects if too acidic</li> </ul>

Name: \_\_\_\_\_

Date: \_\_\_\_\_ Core: \_\_\_\_\_

## Nitrates and Nitrites

Nitrogen is a necessity of life used to build proteins. Even though most of the air in the atmosphere is made up of nitrogen gas, plants and animals have no way to use it or convert it into the usable form of nitrogen...nitrites and nitrates. Fortunately, bacteria, through decomposition of waste and dead or decaying matter, “fix” the nitrogen for other living things through a process called the **nitrogen cycle**.



\*Nitrosomonas and Nitrospira are types of bacteria

Certain bacteria in the water and gravel change nitrogen in the ammonia of waste products into nitrites and nitrates. Plants diffuse nitrates into their roots/leaves so they can be used by the plants to build proteins. Then animals will eat plants to get their needed nitrogen for protein production. Animals create waste and/or organisms die which will be decomposed and the cycle starts all over. This of course is grossly simplified, but it highlights the basic principles of the nitrogen cycle.

One other way nitrates enter an aquatic environment is from agricultural run-off containing fertilizers or excess nutrients. Nitrates are relatively harmless to freshwater fish, but they will also act as a fertilizer for plant growth. An excess of nitrates will allow more photosynthesis to take place in plants and algae, thus leading to **eutrophication**. Algae will blanket the entire surface of the water and the plants that grow underneath the water will not get enough light and die. Decomposition ensues and all the oxygen is used up causing other organisms to die too. So, although the nitrates themselves are harmless, their presence can have devastating effects.

**Reflection:** Answer the following questions in complete sentences and use information from above to support your answer.

1) Suppose the nitrate level rose significantly for several weeks. How would the plants and animals be affected? How might water quality change?

2) Sally was very excited about her new fish tank. In one evening, she filled it with water, treated the water to remove harsh chemicals, added a couple plants and several fish. Within 2 weeks, everything in her tank died. Based on what you read above...what might be the cause of Sally's tank of death?