**WABS Stem Fellows 2017-18**

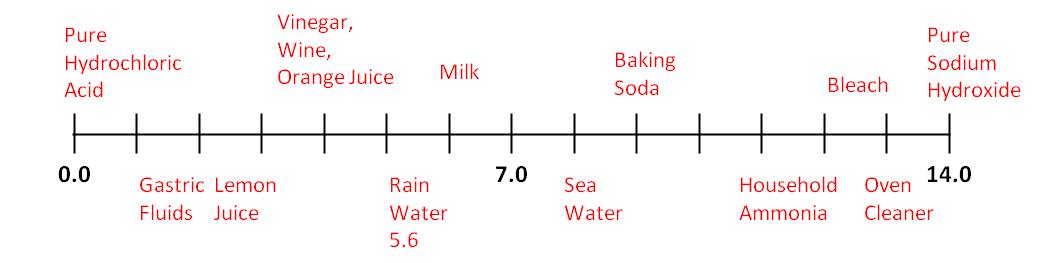
**4th Grade Computer Science, Math and Science**

**Lesson 5 Background Resources: pH Introduction**

**The pH of water is a measurement of how acidic or how basic the water is.** We measure pH on a scale of 0 (pure acid) to 14 (pure alkaline solution or base). Distilled water is neutral and has a pH of 7. Each unit in the pH scale represents a 10 fold change in acidity. For example, a pH of 6 is 10x more acidic than pH of 7, and a pH of 5 is 100x more acidic than a pH of 7. Vice versa, a pH of 8 would be considered 10x more basic than a pH of 7.

Some substances, when dissolved in water, produce charged molecules called ions. Acidic water has extra hydrogen ions (H+) and is given a pH value between 0-7, whereas basic or alkaline water has extra hydroxyl ions (OH-) and is given a pH value between 7-14

< - - - - - - More Acidic More Basic - - - - - - >



### **WHY CARE ABOUT pH?** Aquatic life is adapted to the natural pH levels in their bodies of water, and even slight changes in pH can have negative impacts on the health of the aquatic community. Moderate changes in pH can affect fish egg production, fish and insect gills, and amphibian populations.

### This adverse impacts occur as a change in the pH of water can drastically alter the behavior of other chemicals in the water. For example, ammonia is harmless to fish in water that is slightly acidic. But, as pH increases the ammonia composition (or speciation) changes and the solution becomes toxic. Furthermore, many heavy metals dissolve in acidic water (creating a toxic environment), but may be harmless at other pH levels.

* A typically healthy pH range for wildlife is from 6.5-9.

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### **NATURAL FACTORS INFLUENCING pH :**

**Photosynthesis and Respiration-**during photosynthesis, aquatic plants remove carbon dioxide (CO2) from the water. This can raise the pH in the water as CO2 content in water is acidic. Since plants photosynthesize with sunlight, the pH of the water will be highest during the middle of the afternoon (as CO2 is being removed), and lowest just before sunrise.

**Precipitation-** when precipitation falls through the air, it dissolves gases like carbon dioxide and forms a weak acid. **Natural, unpolluted rain and snow is slightly acidic.**Precipitation usually has a pH between 5 and 6.

**Calcium Carbonate-** the primary component of limestone, this common rock “buffers” the water against changes in pH. Calcium carbonate can exist in water in 3 different forms: ions with 2, 1 or no hydrogen atoms attached. The different molecules form in response to the concentrations of extra hydrogen or hydroxyl ions in the water. Watersheds without limestone lack this buffering ability and are vulnerable to acid rain and/or acid mine drainage.

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### **HUMAN FACTORS INFLUENCING pH**

**Acid rain** - sulfuric acid (produced by coal burning industries) and nitric acid (produced by automobile engines) are major contributors to acid rain. Luckily, in Utah, the buffering soils help to decrease the effects of acid rain.

**Increased concentrations of carbon dioxide -** Carbon dioxide is very soluble in water, forming weak carbonic acid. As our atmosphere’s carbon dioxide concentrations increase, the oceans are becoming more acidic. The effects are devastating to coral reefs, which are stressed or dying throughout the oceans. Animals with calcium carbonate shells are also harmed.

**Point source pollution** - dumping industrial pollutants directly into water can affect its pH.

**Mining** - may expose rocks to rainwater and produce acidic runoff. Mining drainage can introduce acids into a waterway, if it is poorly buffered the pH may reach toxic levels.

Additional Resources/Sources:

<https://extension.usu.edu/waterquality/learnaboutsurfacewater/propertiesofwater/pH>

<https://www.khanacademy.org/science/biology/water-acids-and-bases/acids-bases-and-ph/a/acids-bases-ph-and-bufffers>