pH

"There was, at this time, a small alkaline water hole at the desert's edge . . . .
No one but crows would drink there."
— Barry Holstun Lopez

The concentration of hydrogen ions in a solution is called **pH** and determines whether a solution is acid or alkaline. A pH value shows the intensity of acid or alkaline conditions. In general, acidity is a measure of a substance's ability to neutralize bases, and alkalinity is a measure of a substance's ability to neutralize acids.

The pH scale ranges from 1 (acid) to 14 (alkaline or basic) with 7 as neutral. The scale is logarithmic so a change of one pH unit means a tenfold change in acid or alkaline concentration. A change from 7 to 6 represents 10 times the concentration, 7 to 5, 100 times, and so on.

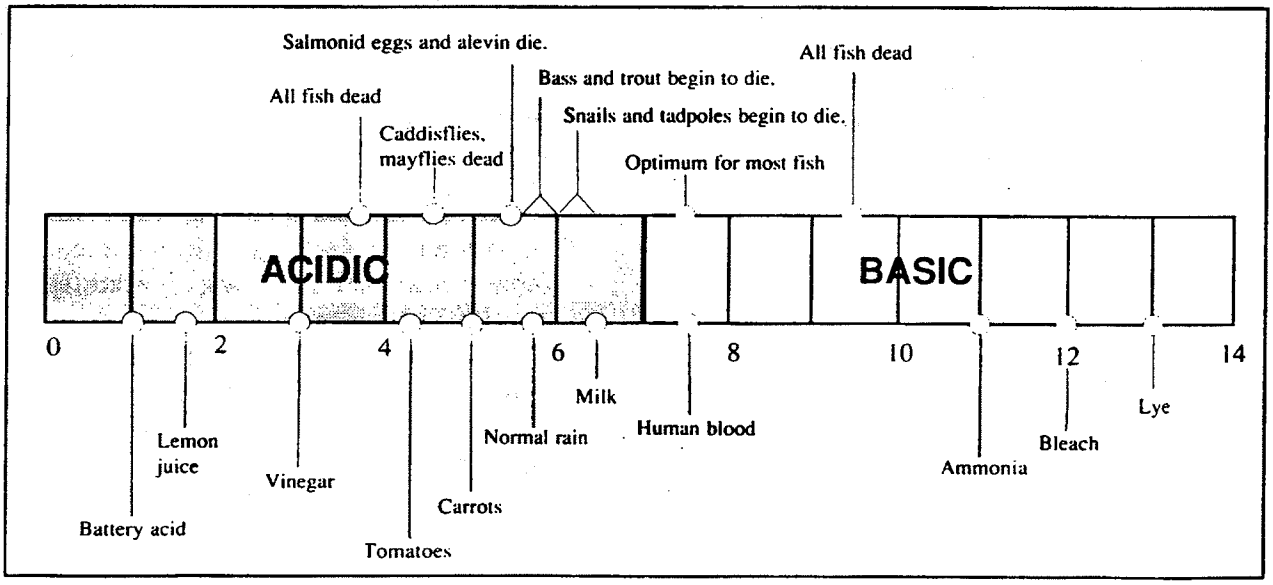
Most organisms have a narrow pH range in which they can live (figure 12). While some fish can tolerate a range of 5 to 9, others cannot tolerate a change of even one pH unit. Because of this narrow range of tolerance, pH limits where many organisms can live and the composition of a community.

While pure distilled water has a pH of about 7, any minerals dissolved in water can change the pH. These minerals can be dissolved from a streambed, the soil in a watershed, sediments washed into a stream, or the atmosphere.

In eastern Oregon, where many soils have a high alkaline content, pH levels of some water bodies can rise above 10. Forest soils tend to be slightly acid and many lakes or streams in forested regions of Oregon can approach a pH of 6.

The age of a lake can also influence pH. Young lakes are often basic. As organic materials build up, decomposition forms organic acids

Figure 12. pH Scale



and releases carbon dioxide. Carbon dioxide mixed with water forms carbonic acid, making the lake more acidic.

When rain falls through the atmosphere, the gases it contacts come into solution. As rain absorbs carbon dioxide it becomes slightly acidic, but reaches a natural lower limit of pH 5.6.

Rainfall measuring just under 2.0 fell on Wheeling, WV, in 1978.

Air pollution, primarily from automobile exhaust and fossil fuel burning, has increased concentrations of sulfur and nitrogen oxides in the air. These fall with rain as weak sulfuric and nitric acids causing an "acid rain." Currently in portions of the eastern United States, the mean pH for rainfall is 4.3, approximately ten times more acidic than normal. Rainfall measuring just under pH 2.0 fell on Wheeling, West Virginia, in 1978. This was approximately 5,000 times the acidity of normal rainfall and is the most acidic rainfall on record.

Increased acidity has caused pH to exceed lethal levels for fish in many lakes. A U.S. government study estimated that 55 percent of the lakes and 42 percent of stream miles in the eastern United States are currently being subjected to acidic deposition, which will eventually lead to their deterioration. In addition, acid build-up in soils can have detrimental effects on forests and crops, and hinders natural nutrient recycling processes.

Because rain can fall a considerable distance from a pollution source, acid rain is a regional and global problem.

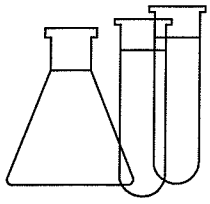
Factors that determine the pH of a body of water can be far removed from a particular site, making it difficult to directly manage the pH. Because pH is a limiting factor, it is important to have a measurement to determine which organisms can survive and prosper. This measurement also serves as a baseline measurement and can assist in the monitoring of future changes.

Extensions

1. "Deadly Skies," *Aquatic Project WILD*, pp. 133-136.
2. "Water Canaries," *Aquatic Project WILD*, pp. 35-39.
3. "Deadly Waters," *Aquatic Project WILD*, pp. 137-141.
4. "How the Soil Affects Acid Rain," *Earth: The Water Planet*, pp. 73-78.
5. "Acid Rain—How Acid Is It?" *Groundwater: A Vital Resource*, pp. 31-34.
6. "Does Acid Rain Affect Groundwater?" *Groundwater: A Vital Resource*, pp. 39.
7. "Making Acid Rain," *Groundwater: A Vital Resource*, pp. 40-41.
8. Take comparably aged leaves from several different tree species. Set up separate containers for each species with 16 oz. of water each. Measure the pH.

   Strip the leaves from the stems and soak 1 oz. of the leaf material in the water overnight. Test the pH the next day. Note the differences in pH from naturally occurring materials in the leaves.

   Discuss how plant materials falling into a stream can change the water quality for stream organisms. A good choice of species might include Douglas-fir, alder, willow and oak. (Contributed by Mary Roberts, 1989.)



pH Level Testing

The pH value is the concentration of hydrogen ions in water. It is how acidic or basic the water is.

Method:

1. Follow instructions on pH strip test box.

1. Once testing is complete, record your findings in the pH data record.

2. Students can compare their findings to the state standards on page *55* and come up with factors that may have influenced the pH level. Also have them look at the pH value scale attached to see how different ranges affect aquatic life.

Background:

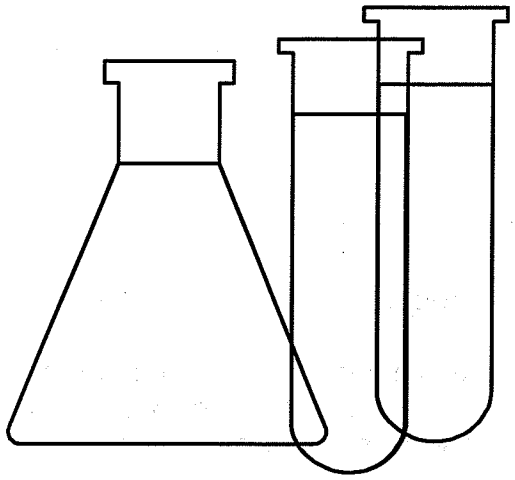
- pH levels can greatly affect stream life as most organisms have a narrow range of tolerance.

- pH is affected by rainfall, pollution, and soil composition.

- Most organisms can live in the 5-9 range, others perish if the value changes by just one pH unit.

Kits available from Hach Company World Headquarters P.O. Box 389
Loveland, CO 80539. 1-800-227-4224.

pH Testing



Testing for pH Levels

Method:

1. Follow instruction on pH strip test box.

2. Once test is complete, record your findings in the pH data record.

3. Then compare your findings to the standards to develop a conclusion about the health of health of the stream.

pH FACT SHEET

State Standards

Class AA (Extraordinary)	6.5 - 8.5
Class A (Excellent)	6.5 - 8.5
Class D (Good)	6.5 - 8.5
Class C (Fair)	6.5 - 9.0

Source: WAC 173-201A-030)

Data Record

Date: _____ Observers: _____

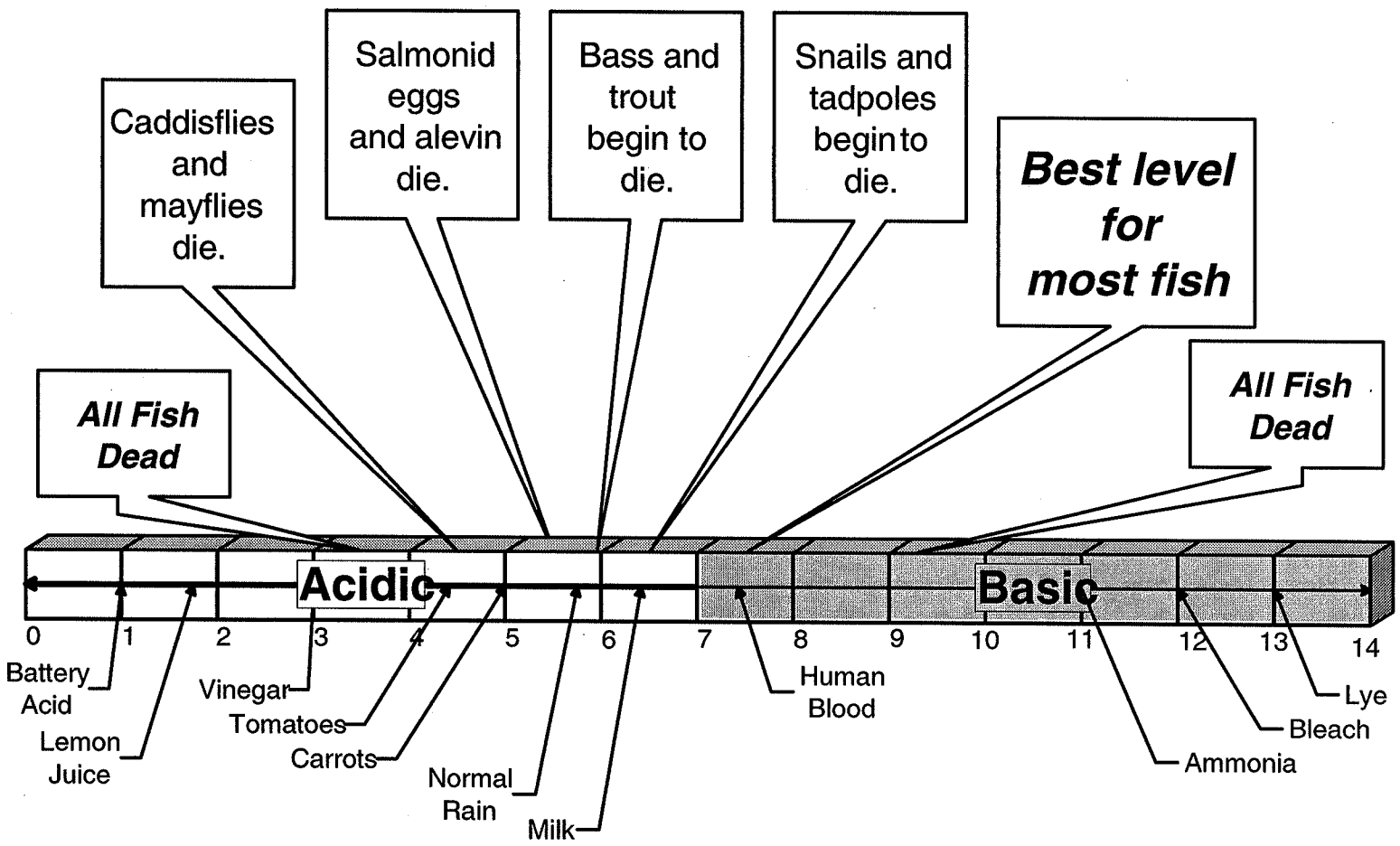
sample 1	sample 2	sample 2	average

FACTORS THAT AFFECT PH LEVEL VALUES

- Air pollution, primarily from automobile exhaust and fossil fuel burning increase concentrate of sulfur and nitrogen oxides in the air. Therefore, when it rains these particles or components turn it to "acid rain" and increase the acidity of lakes and streams.

- Runoff that contains waste water from farms, logging or mining sites, and other commercial and residential developments send chemicals and other constituents that alter pH levels.

pH Value Scale



This scale represents the effect various pH levels have on aquatic life. Notice on the top of the scale how aquatic organisms have a fairly narrow range of tolerance before they die. Underneath the scale are substances you may be familiar with and where these fit on the scale as well. (Source: "The Stream Scene")