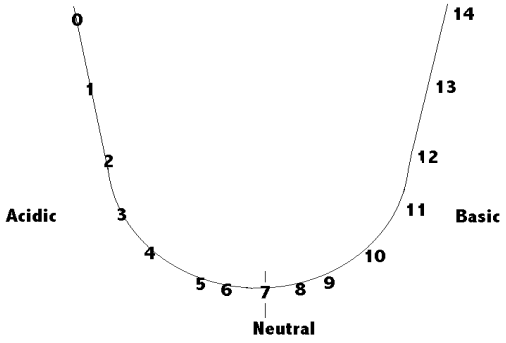
pH FACT SHEET

Definition: A measurement of hydrogen ion concentration (H+) in liquids and other substances. The amount of H+ can determine whether the substance is acidic or basic, (alkaline).

Background:

- Water contains both H^+ (hydrogen) and OH^- (hydroxyl) ions.
- Pure distilled water has an equal number of hydrogen and hydroxyl ions…making the water neutral (pH of 7).
- More hydrogen than hydroxyl ions results in an acidic solution, (pH <7).
- More hydroxyl than hydrogen ions results in a basic solution, (pH >7).
- pH is expressed on a Log10 scale from 1-14, thus a pH of 6 is *10 times* more acidic than pH of 7.
- Natural rain has pH of about 5.6, ($CO_2 + H_2O$ forms carbonic acid, which breaks off a H+ and makes rain acidic).
- Organic acids in upper soil layer can lower pH by producing extra H+.
- Calcium carbonate rocks and soils ($CaCO_3$), can buffer changes in pH.
- Photosynthesis removes CO_2, (and eventually carbonic acid) making water more basic.
- Respiration/decomposition adds CO_2 (and eventually carbonic acid) making water more acidic.



carbon dioxide + water + **solar energy** ⇒ glucose + oxygen

$6\ CO_2 + 6\ H_2O$ + **solar energy** ⇒ $C_6H_{12}O_6 + 6\ O_2$

glucose + oxygen ⇒ carbon dioxide + water + e**nergy**

$C_6H_{12}O_6 + 6\ O_2 \Rightarrow 6\ CO_2 + 6\ H_2O$ + e**nergy**

- *High pH* prevails in summer when waterways are heavily influenced by groundwater flow and buffered by limestone soils and more photosynthesis occurs.
- *Low pH* prevails in late winter and spring when snow melts and precipitation rapidly enters waterways (without contact with calcium carbonate rocks), there is less buffered groundwater influence, and photosynthesis is not occurring.

Environmental Impacts

- Effects of acid rain are worse in those regions that:
  - Are downwind of industrial areas
  - Do not contain calcium carbonate in rocks and soils to reduce acidity.
- Primary cause of acid rain is from nitrogen oxides (NO_x) and sulfur dioxide (SO_2), from automobile and coal-fired power plant emissions, which transform into nitric & sulfuric acid.
- Northeast USA typically receives acidic rain of pH 4.5 or lower.
- Resulting acidic rain precipitates to the ground, rendering waterways too acidic to support aquatic life.
- Average pH of natural creek water in Pennsylvania is between 6.5 and 8.5, except in acid mine drainage streams.
- Most organisms are adapted to live within a specific range of pH, thus, even a slight change may be fatal.

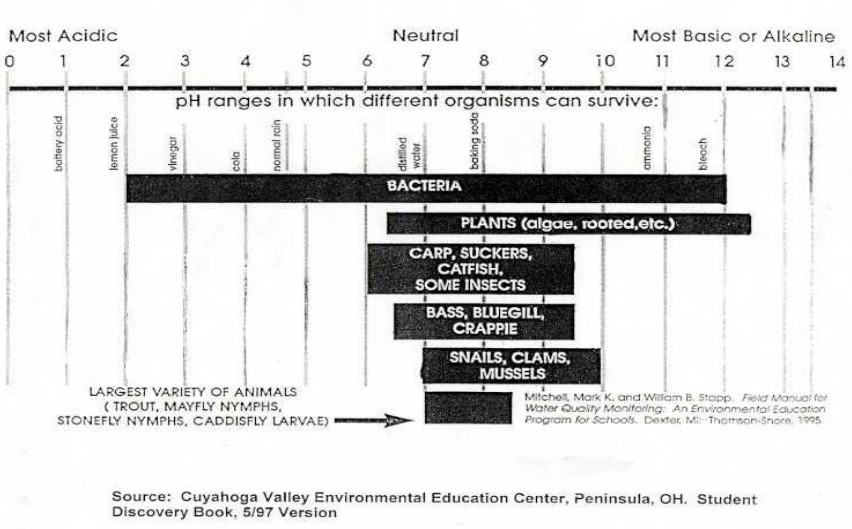


Fig. 4: pH ranges in which different organisms can survive
Source: Cuyahoga Valley Environmental Education Center, Student of Pennsylvania Discovery Book 5/97 version. Peninsula, OH.

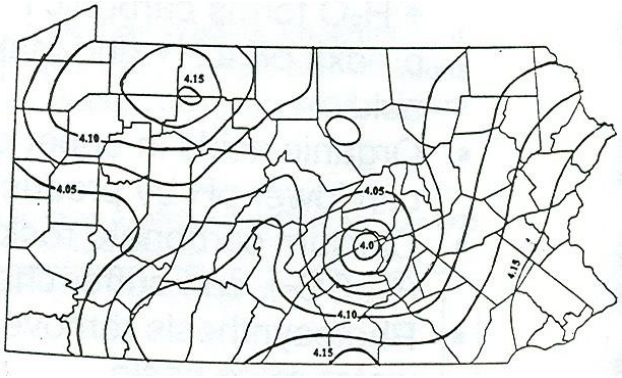


Fig. 5: pH of rain in Pennsylvania
Based on: Cuff, 1989. Atlas 1997.

- Acid mine drainage, from coal mining and other resource extraction, contains sulfuric acid (H_2SO_4) which can break off an extra H+.
- Acidic water (low pH) releases metals, which can harm aquatic life.

Water Quality:

- Natural waters should have a pH between 5-8.5.
- EPA's required pH levels for drinking water is 6.5-8.5.