

Acid Precipitation



Essential Standard 2.5

Understand the structure of and processes within our atmosphere.

Learning Objective 2.5.5

Explain how human activities affect air quality.

I Can Statements

At the end of this lesson, you should be able to say, with confidence:

- I can explain how acid rain is formed
- I can describe its effects on fish and other aquatic organisms.
- I can describe its effects on forests.
- I can list specific actions humans can take to reduce acid rain.

pH

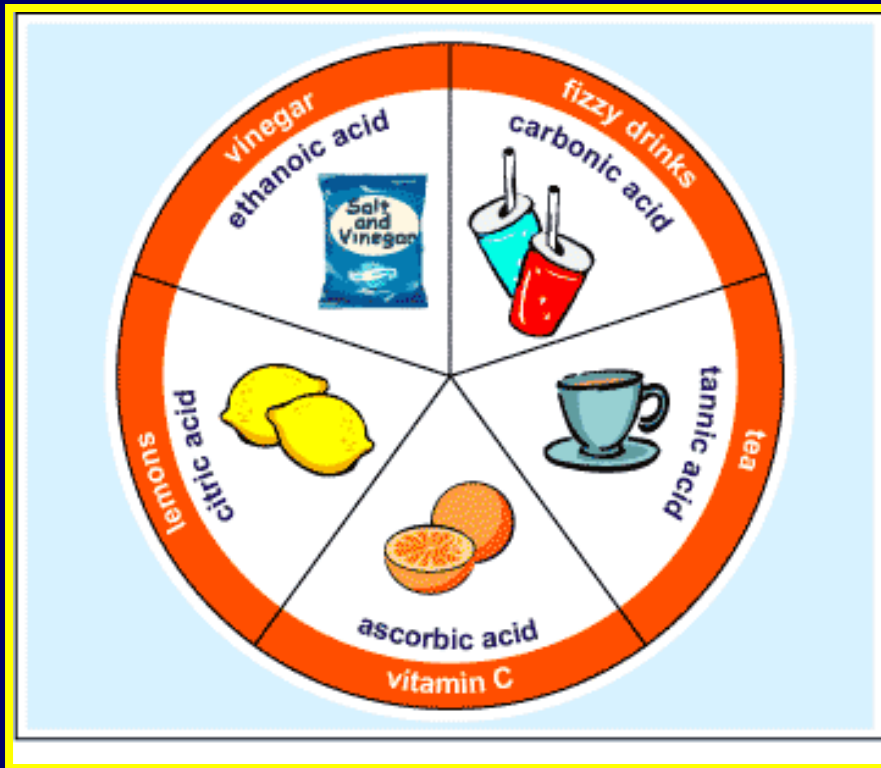
pH is a measurement of how much hydrogen a substance releases when dissolved in water



pH is measured on a scale from 0 - 14

Acids

Acids release hydrogen ions (H^+) when placed in water and have a pH below 7



Acids taste sour and can be found in a lot of our foods

Stomach acid is mostly made up of hydrochloric acids, HCl , with a pH of 3.

Bases

Bases remove H^+ ions by releasing hydroxide ions (OH^-) when placed in water and have a pH above 7.



Bases tend to be slippery and taste bitter.

Our intestines contain a strong base called sodium hydroxide, $NaOH$, with a pH of 14.

Neutral pH

Some substances are not acids or basis and are considered neutral, having a pH of 7.

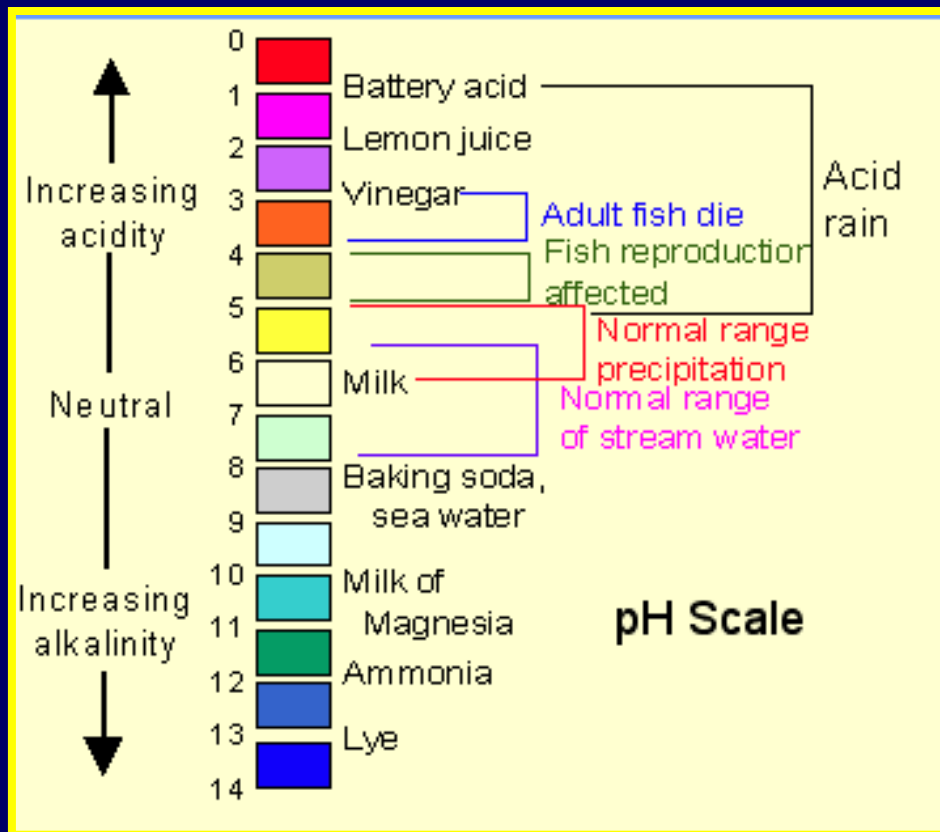


Pure distilled water has a pH of 7.

Tap water, lake water, river water, and ocean water tend to be slightly acid due to carbonic acid (carbon dioxide and water)

pH Strength

On the pH scale, the further you move away from 7, the stronger the solution becomes as an acid or as a base.

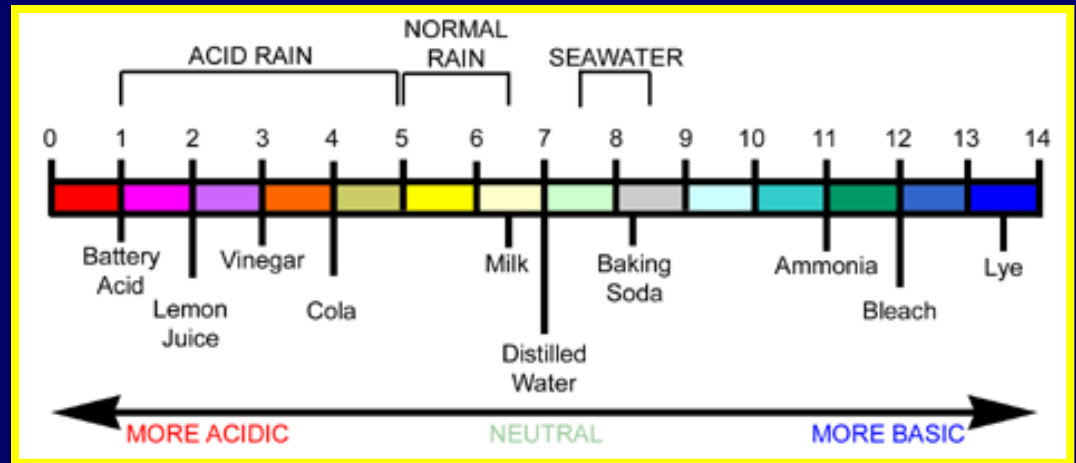


Each change in pH represents a change by a factor of 10

pH 3 is ten times more acidic than pH 4 and 1,000 times more acidic than pH 5.

Acid Precipitation

Acid precipitation refers to rain, snow, sleet, mist, and fog that has a pH lower than 5.



Normal rain has a pH between 6.5 and 5 due to carbon dioxide mixing with water to form carbonic acid.

Burning of Fossil Fuels

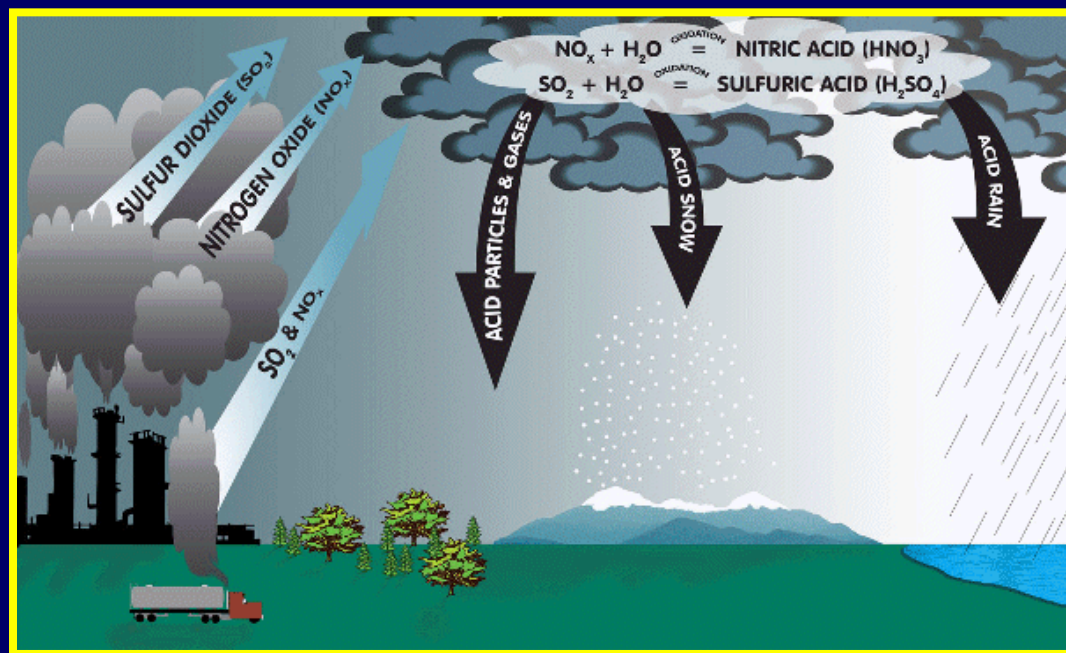
The number one cause of acid precipitation are coal burning power plants that generate 25% of the electricity North Carolina.



The second highest contributor to the formation of acid precipitation is exhaust from automobiles.

Formation of Acid Precipitation

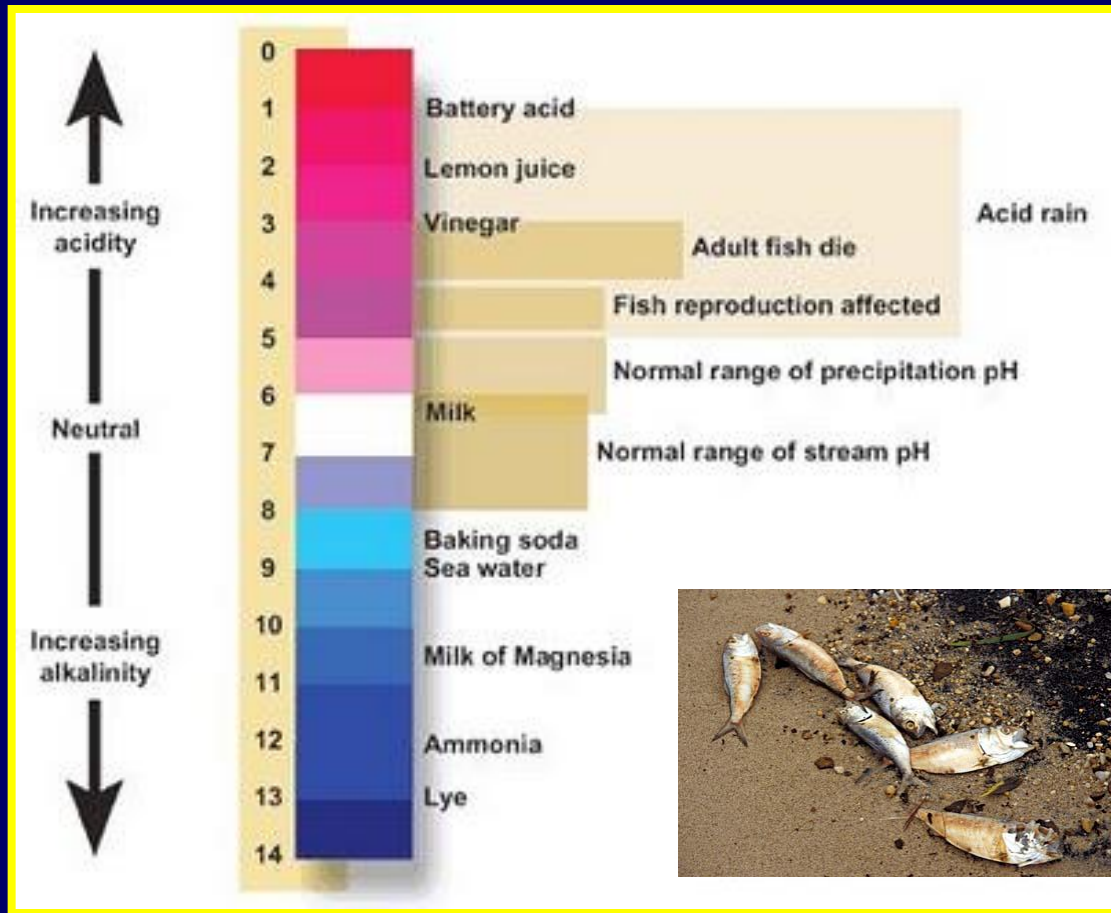
When coal and other fossil fuels are burned sulfur dioxides, SO_2 , and nitrogen dioxides, NO_2 , are released into the atmosphere.



Sulfur dioxide and nitrogen dioxides mix with water to form sulfuric acid and nitric acid.

Surface Water

When acid precipitation enters waterways, the pH of the water is lowered.



Most fish eggs cannot hatch with a pH less than 5.

Adult fish die when the pH falls below 4.

Forests

Acid precipitation can also damage forests, especially those at higher elevations.



Effect of acid precipitation at Mount Mitchell in NC

Soils at high elevations tend to be thin so they have less buffering effect.

Forests

Acid precipitation causes soils to release aluminum which then blocks a tree's ability to take up water.



Acid precipitation also dissolves minerals and nutrients in the soil, washing them away before plants can use them.

Forest trees undergoing stress from acid precipitation are less able to withstand cold temperatures, insects, and disease.

Reducing Acid Precipitation

In the 1990's, the Acid Rain Program was added to the Clean Air Act that suggests various methods to reduce acid rain from coal burning plants.



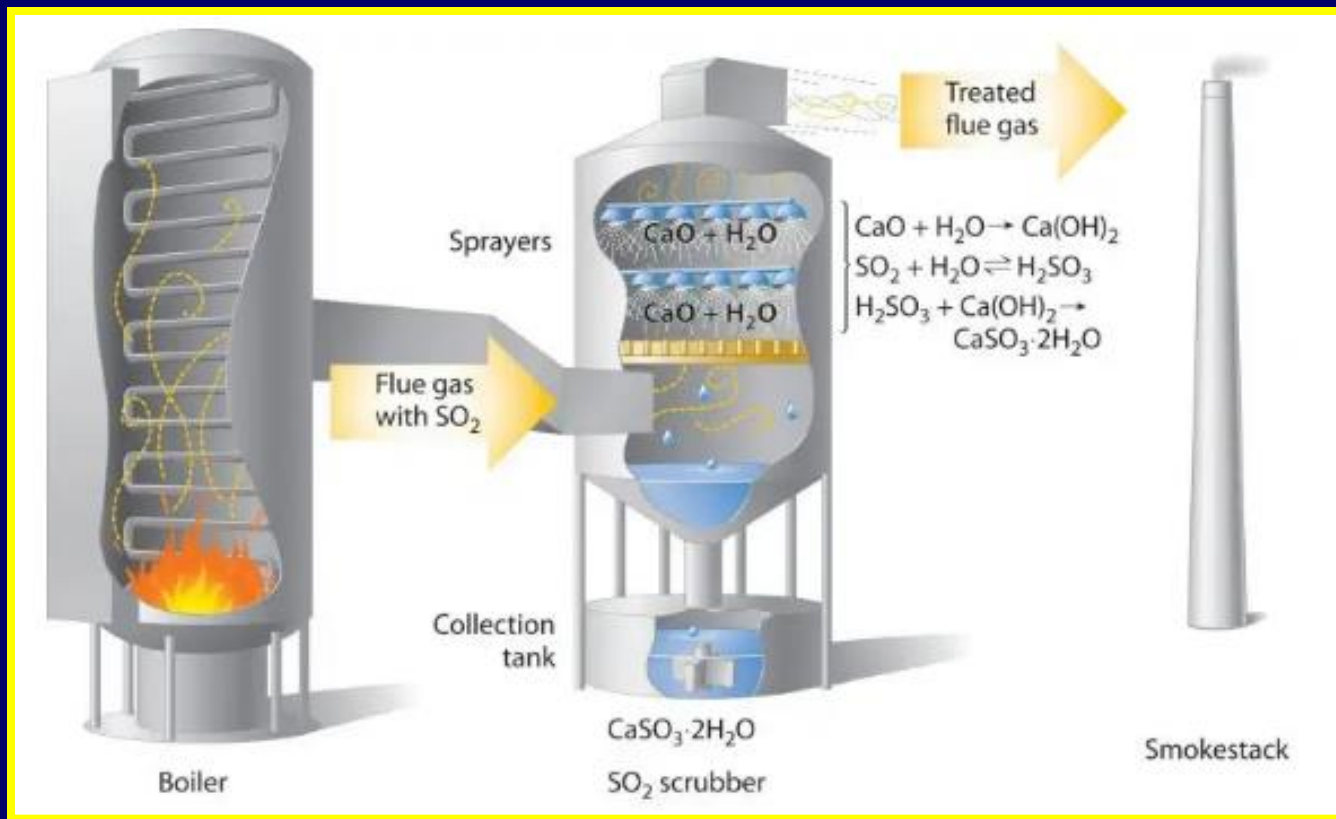
One method to reduce acid rain is to use coal with less sulfur.

Another method is to wash the coal to reduce the amount of sulfur in the coal.



Reducing Acid Precipitation

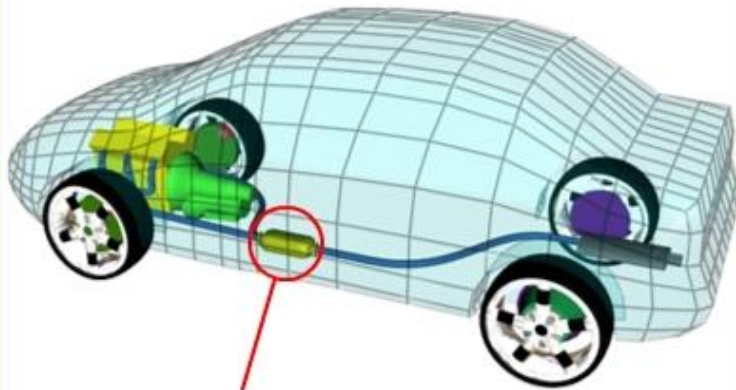
Coal plants can also use limestone scrubbers (filter) on their smokestacks that collect sulfur dioxides before they can be released into the atmosphere.



Reducing Acid Precipitation

Catalytic converters are used on cars to help reduce nitrogen oxide emissions, as well as VOCs.

How Catalytic Converters Work

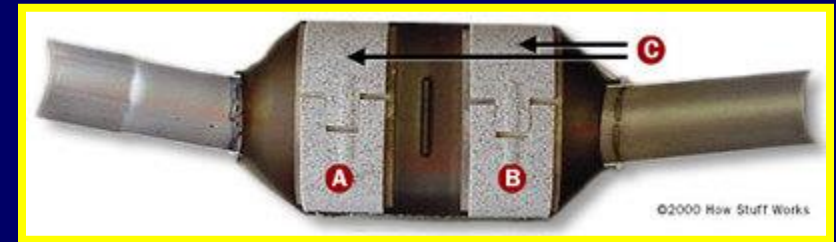


Catalytic Converter

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- 1st Stage – Removes nitrogen from NO
- 2nd Stage – Reduces the unburned hydrocarbons and carbon monoxides molecules

Reducing Acid Precipitation

Alternative energy sources to generate electricity, such as nuclear power, hydropower, geothermal power, wind power, and solar power, do not use fossil fuels and so also reduce acid rain.



The End

