

**Aim:** What are the causes and effects of acid deposition?

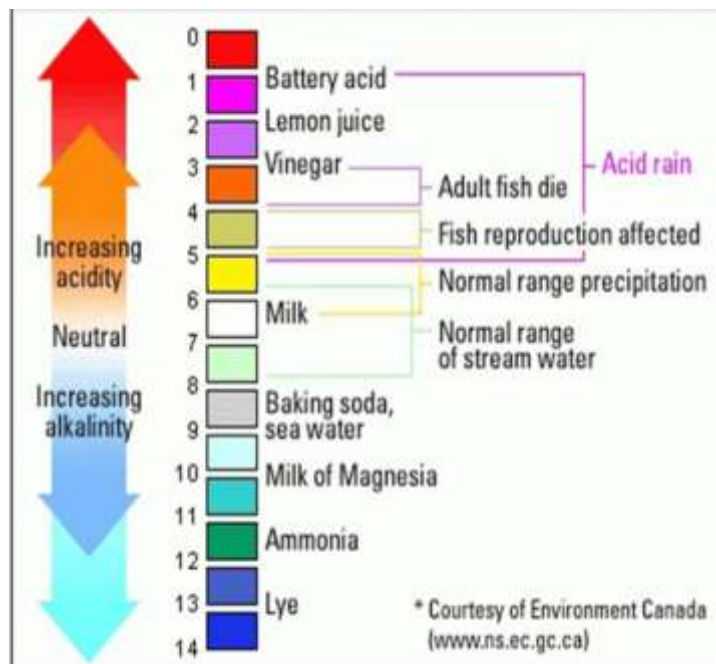
### pH Scale Review – $<7 = \text{ACIDIC}$

each whole pH value below 7 is 10X more acidic than the next higher value

6 is 10X more acidic than 7  
5 is 100X more acidic than 7

### “Clean” Rain –

- pH = ~5.6
- slightly acidic because  $\text{CO}_2$  dissolves to make weak carbonic acid ( $\text{H}_2\text{CO}_3$ )



### Types of Acid Deposition –

Wet Deposition –  $\text{NO}_x$  &  $\text{SO}_2$  react with  $\text{H}_2\text{O}$  to form dilute acids that fall with rain  
nitric acid ( $\text{HNO}_3$ ), nitrous acid ( $\text{HNO}_2$ ), sulfuric acid ( $\text{H}_2\text{SO}_4$ ) - \*pH in the 4 range\*

Dry Deposition – acidic PM (particulate matter) or gas settles out of air or gets absorbed/inhaled

Acid deposition is a secondary pollutant formed when the  $\text{SO}_2$  and  $\text{NO}_x$  directly emitted by the burning of fossil fuels (smokestacks, tailpipes) and other industrial processes (ex. smelting) chemically react in the atmosphere.

### Nature's Natural Buffer and Areas Most Sensitive to Acid Deposition

#### Nature's Buffer

Soils with a natural buffer have basic compounds that neutralize acidic deposition (soils rich in limestone or other carbonates)

Lime (crushed limestone) can always be added to help neutralize the acid in soil or in an acidified lake or pond

#### Soils Sensitive to Acid Deposition

- areas with thin soils that are already acidic (spodosols) – coniferous forests
- areas with soils that have lost their buffering effect
- areas with exposed granite bedrock – no neutralizing effect; acidic rainwater just flows into nearby bodies of water (Adirondack Mountain region)

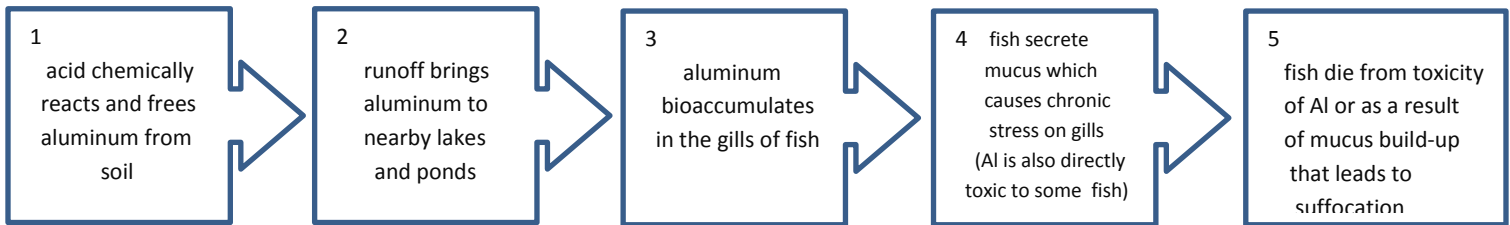
## Problems Associated with Acid Deposition –

### 1. acidification of lakes and streams

pH falls below tolerance level → fish reproduction decreases → fish die off → lake becomes sterile (pH<4.5)

### 2. acidification of soils

- a. negative impact of plants - acid frees aluminum from soil - Al is toxic to trees/plants  
- disrupts root growth which inhibits water and nutrient uptake
- b. negative impact on fish



### 3. forest decline

- a. acids dissolve soil nutrients and carry them away (leaching)
- b. high altitudes – acidic fog/clouds → leaf / needle damage
- c. weakened trees more prone to weather extremes, insects, & disease

### 4. deterioration of structures (buildings and statues)

- a. marble and limestone are more susceptible to chemical action by acidic rain
- b. metals can corrode (mild steel, copper)

damage to building structures, bridges, pipelines, and fencing require maintenance (\$\$)

### 5. circulation of pollutants that cause acid deposition

- a. higher smokestacks → pollutants enter planetary wind belts → more distribution
- b. Northeastern American forests – prevailing westerlies carry pollutants eastward – can be traced back to Ohio River valley coal-burning industrial and power plants and even smelters in Canada
- c. Japan and Korea receive coal-burning emissions from #1 coal-burner: China

"bad neighbor effect"