

5.1 Acids and Bases

- Many familiar compounds
 - Classification based on chemical composition
- can be very dangerous
 - corrosive
 - NEVER try to identify an acid or base by taste or touch!



Understanding pH

- The **strength** of acids and bases is **measured** on the **pH scale**.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Acids

<7

Neutral

$=7$

Bases

>7

Understanding pH

- Each decrease of 1 on the pH scale indicates 10 × more acidic
 - For example, pH 4 is 10 times more acidic than pH 5.
 - pH 3 is 1000 times more acidic than pH 6

Determining pH



Litmus paper

- pH cannot be determined by sight.
 - pH is measured by chemicals called indicators or by a pH meter that measures the electrical conductivity of the solution.
- pH indicators change colour
 - Litmus paper.
 - Blue = basic (pH above 7)
 - Red = acidic (pH below 7)
 - Universal indicators contain many indicators that turn different colours at different pH values (liquid or paper)

Determining pH continued

- A pH meter uses electrical probes to measure how solutions conduct electricity.
- Indicators change colour at different pH values
 - Bromothymol blue for pH 6 – 7.6
 - phenolphthalein for pH 8.2 – 10.
 - natural indicators include beets and cabbage

NaCl

NaOH

**THE BASE IS
UNDER A SALT**

Acids

- Acids often are written with symbol (aq) = aqueous = dissolved in water.
- The chemical formula of an acid usually starts with hydrogen (H) sometimes with carbon (C).
 - $\text{HCl}_{(aq)}$ = hydrochloric acid
 - $\text{HNO}_{3(aq)}$ = nitric acid
 - $\text{CH}_3\text{COOH}_{(aq)}$ = acetic acid



Sulfuric acid is used in batteries.

Naming Acids

– Hydrogen + **...-ide** = hydro**...ic** acid

• $\text{HF}_{(\text{aq})}$ = hydrogen fluoride = hydrofluoric acid

– Hydrogen + **...-ate** = **...ic** acid

• $\text{H}_2\text{CO}_{3(\text{aq})}$ = hydrogen carbonate = carbonic acid

– Hydrogen + **...-ite** = **...ous** acid

• $\text{H}_2\text{SO}_{3(\text{aq})}$ = hydrogen sulphite = sulphurous acid

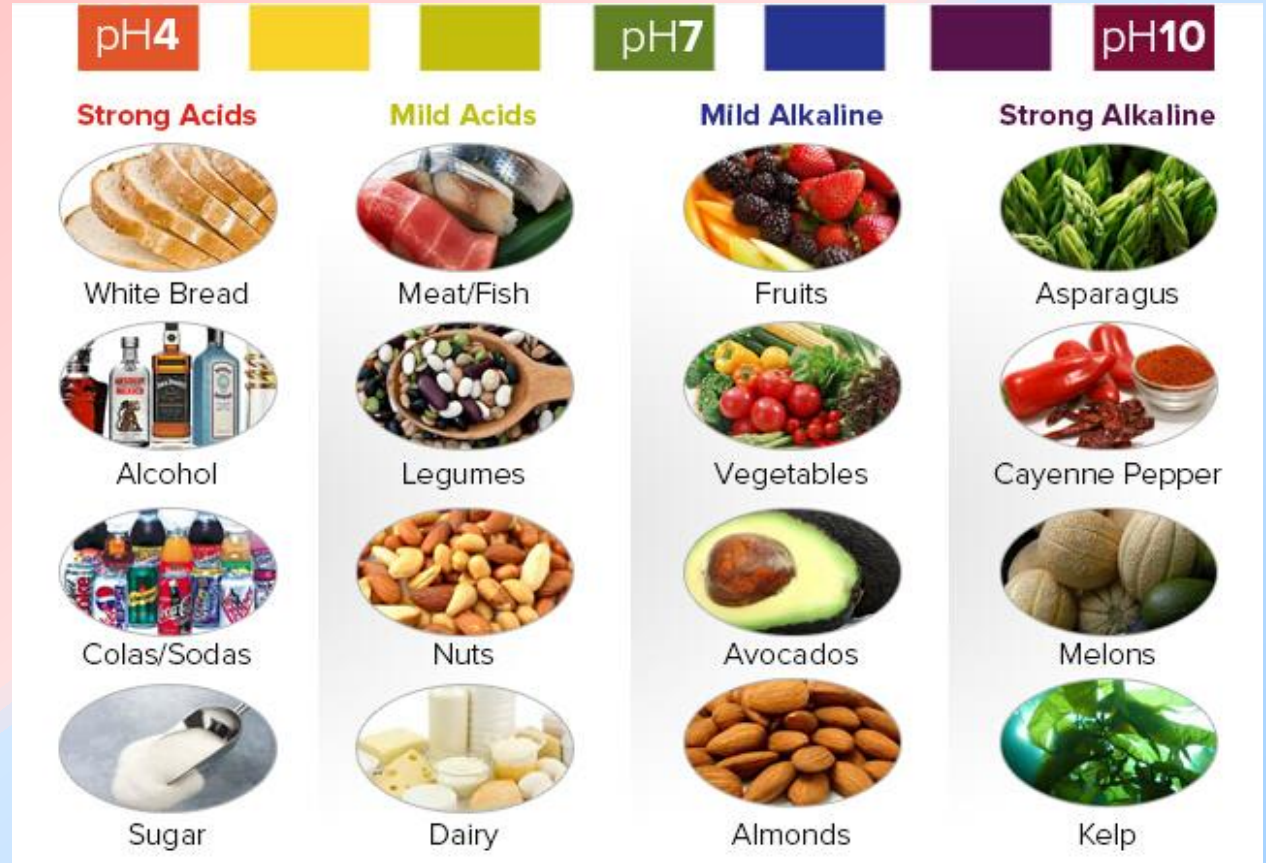
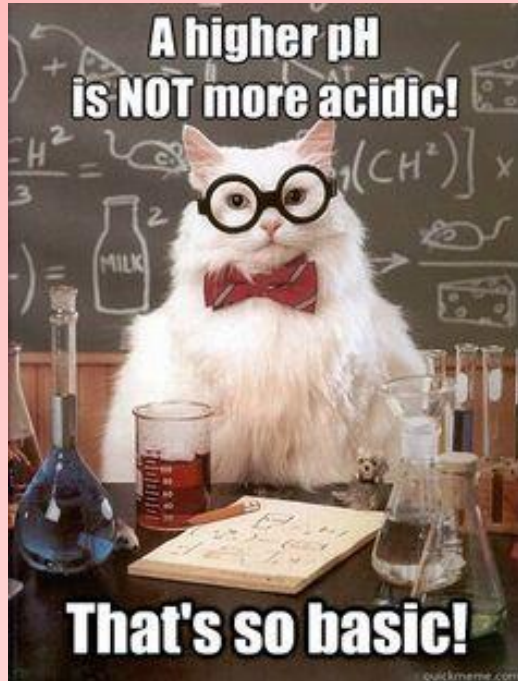
Bases

- The **chemical formula** of a **base** usually **ends** with **hydroxide (OH)**.
- Bases are often **written** with the **symbol** (aq) = aqueous = **dissolved in water**.
- Bases can be **gentle** or very **caustic**.
- Examples of common bases:
 - $\text{NaOH}_{(aq)}$
 - $\text{Mg}(\text{OH})_{2(aq)}$
 - $\text{Ca}(\text{OH})_{2(aq)}$
 - $\text{NH}_4\text{OH}_{(aq)}$



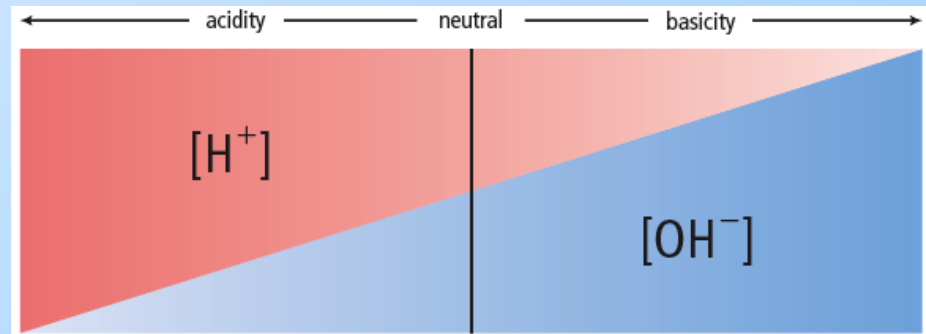
Production of Ions

- Acids and bases can conduct electricity because they release ions in solution.
 - Acids release hydrogen ions, H^+ .
 - Bases release hydroxide ions OH^- .



Production of Ions

- The **pH** of a solution refers to the **concentration** of **ions** it has.
 - **Square brackets** are used to signify **concentration**, $[H^+]$, $[OH^-]$
 - **High $[H^+]$ = low pH, very acidic**
 - **High $[OH^-]$ = high pH, very basic**
 - A solution **cannot** have **BOTH high $[H^+]$ and $[OH^-]$** ; they **cancel** each other out and form water. This process is called **neutralization**.
 - **$H^+ + OH^- \rightarrow H_2O$**



Properties of Acids and Bases

Table 5.6 Properties of Acids and Bases

Property	Acid	Base
Taste CAUTION: Never taste chemicals in the laboratory.	<ul style="list-style-type: none">• Acids taste sour. Lemons, limes, and vinegar are common examples.	<ul style="list-style-type: none">• Bases taste bitter. The quinine in tonic water is one example.
Touch CAUTION: Never touch chemicals in the laboratory with your bare skin.	<ul style="list-style-type: none">• Many acids will burn your skin. Sulfuric acid (battery acid) is one example.	<ul style="list-style-type: none">• Bases feel slippery.• Many bases will burn your skin. Sodium hydroxide (lye) is one example.
Indicator tests	<ul style="list-style-type: none">• Acids turn blue litmus paper red.• Phenolphthalein is colourless in an acidic solution.	<ul style="list-style-type: none">• Bases turn red litmus blue.• Phenolphthalein is colourless in slightly basic solutions and pink in moderate to strongly basic solutions.
Reaction with some metals, such as magnesium or zinc	<ul style="list-style-type: none">• Acids corrode metals.	<ul style="list-style-type: none">• No reaction
Electrical conductivity	<ul style="list-style-type: none">• Conductive	<ul style="list-style-type: none">• Conductive
pH	<ul style="list-style-type: none">• Less than 7	<ul style="list-style-type: none">• More than 7
Production of ions	<ul style="list-style-type: none">• Acids form hydrogen (H^+) ions when dissolved in solution.	<ul style="list-style-type: none">• Bases form hydroxide (OH^-) ions when dissolved in solution.