Acids and Bases: Properties

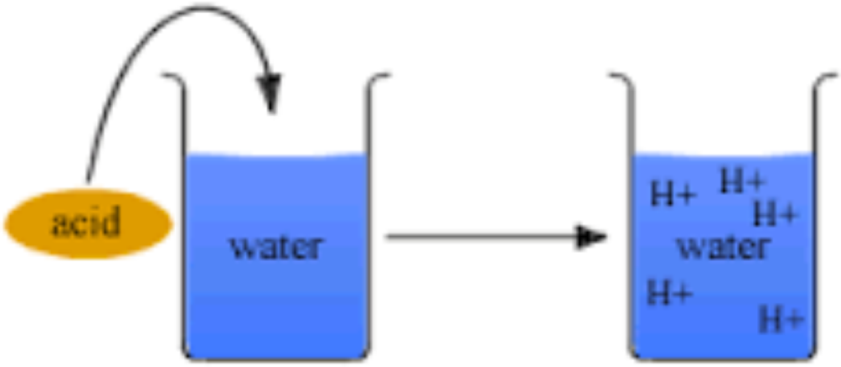
Learning Goals: I will be able to …

- define an *acid*
- identify common properties of acids
- give examples of common acids
- name and write chemical formulas for acids
- define a *base*
- identify common properties of bases
- give examples of common bases
- name and write chemical formulas for bases

Intro Video

Definition of an Acid

- An ***acid*** is defined as a compound that produces hydrogen ions (H^+) when it dissolves in water.



For example: $HCl_{(aq)} \rightarrow H^+_{(aq)} + Cl^-_{(aq)}$

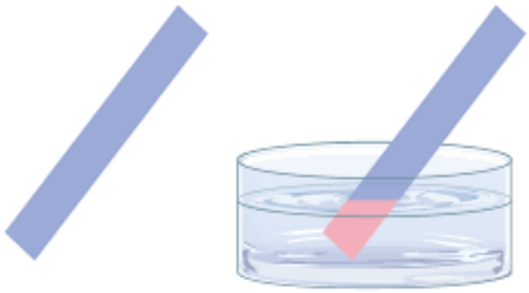
Hydrochloric acid, $HCl_{(aq)}$, forms when hydrogen chloride gas, $HCl_{(g)}$, is added to water.
Water molecules collide with the acid to break the acid molecule apart into cations and anions.

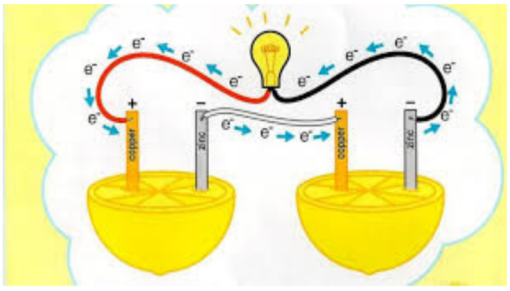
An acid is defined as, a compound that produces hydrogen ions, $H^+_{(aq)}$, when it dissolves in water

Properties of Acids

Properties of acids include:

- are (aq)
- sour tasting
- turn litmus paper red
- react with metals
- good conductors of electricity
- neutralize bases



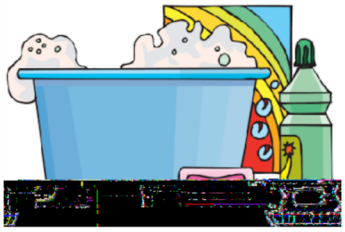


Examples of Acids and Uses

phosphoric acid (H_3PO_4)
- gives soft drinks their tart taste

citric acid ($C_6H_8O_7$)
- found in citrus fruits

acetic acid (CH_3COOH)
- making vinegar



sulfuric acid (H_2SO_4)
- making steel, plastics, and detergents
- found in car batteries

lactic acid ($CH_3CHCOOH$)
- production of yogurt

formic acid (HCOOH)
- produced by black ants and in bee venom

Naming Acids

Binary Acids

→ contain H and a non-metal

→ to name: "**hydro __non-metal__ ic acid**"

→ example: $HCl_{(aq)}$ – hydrochloric acid

Oxyacids

→ contain H and an oxyanion

→ to name: "**__oxyanion__ ic acid**"

→ example: $HNO_{3\,(aq)}$ – nitric acid

There are others, but this is where we will stop in Grade 10.

Let's try naming the following acids:

$HBr_{(aq)}$

$H_2SO_{4(aq)}$

$H_3PO_{4(aq)}$

$HF_{(aq)}$

Chemical Formulas for Acids

To write chemical formulas for acids:

→ use crossover method

→ include $_{(aq)}$ after the formula

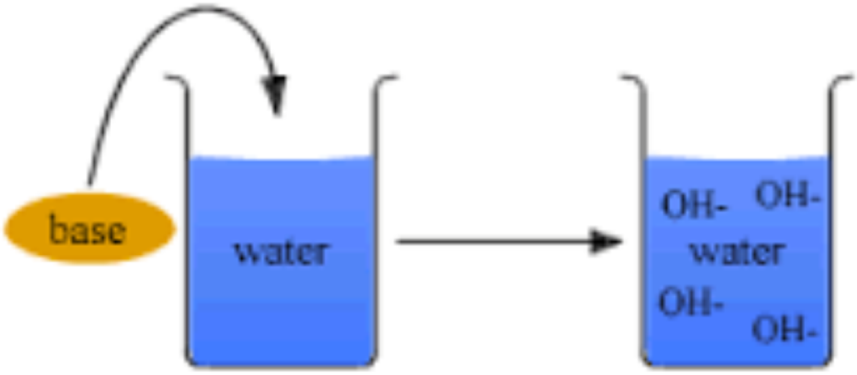
Let's try the following:

bromic acid

hydrosulfuric acid

Definition of a Base

- A ***base*** is defined as a compound that produces hydroxide ions (OH^-) when it dissolves in water.

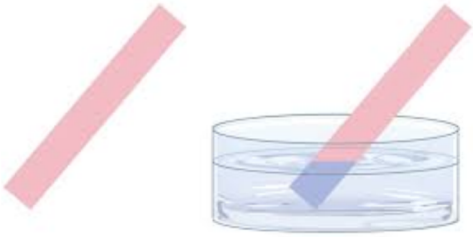


For example: $NaOH_{(aq)} \rightarrow Na^+_{(aq)} + OH^-_{(aq)}$

The anion that always forms when a base dissociates in water is the hydroxide ion, OH^-

A Base is defined as a compound that forms hydroxide ions, $OH^-_{(aq)}$, when dissolved in water.

Properties of Bases



Properties of bases include:

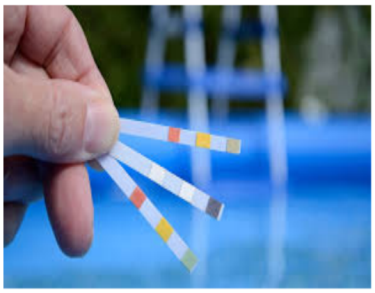
- most are (s)
- bitter tasting
- feels slippery when in solution
- turn litmus paper blue
- good conductors of electricity when in solution
- neutralize acids

Examples of Bases and Uses

magnesium hydroxide ($Mg(OH)_2$)
- used in antacids and deodorants

sodium hydroxide ($NaOH$)
- making soap and removing grease

calcium hydroxide ($Ca(OH)_2$)
- controlling acidity in pool water



Names and Chemical Formulas for Bases

To name bases:

→ "**___metal___ hydroxide"**

→ example: NaOH - sodium hydroxide

To write chemicals formulas for bases:

→ use crossover method

Let's try the following:

alumiunum hydroxide

$Mg(OH)_2$

Hazards of Acids and Bases

Many common acids and bases are corrosive.

- They can cause severe burns if they come in contact with your skin or eyes.
- Example: sulfuric acid → one of the strongest and most corrosive acids
- Example: sodium hydroxide → one of the strongest and most corrosive bases

2. Acids and bases can damage the environment if they are not handled properly.
   - Example: acid spill near lakes or rivers

Video Link - TedEd - Acids and Bases

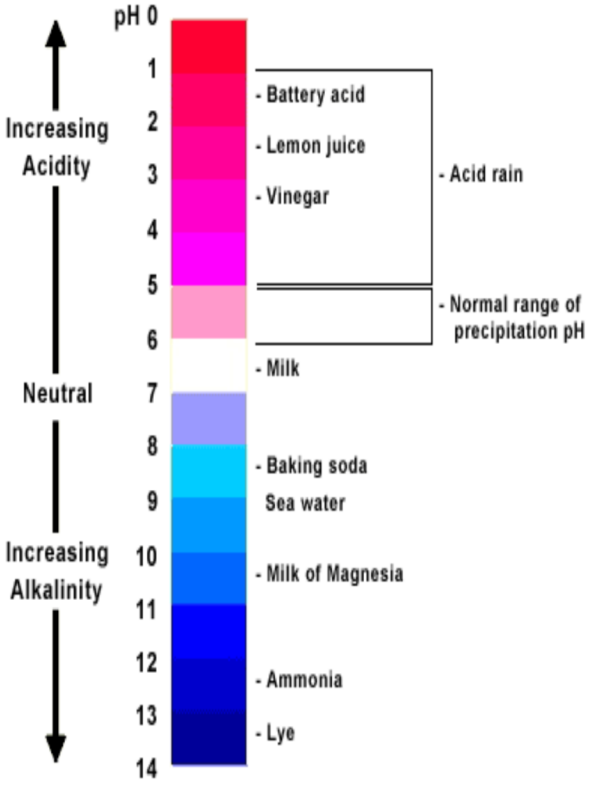
Acids and Bases: The pH Scale

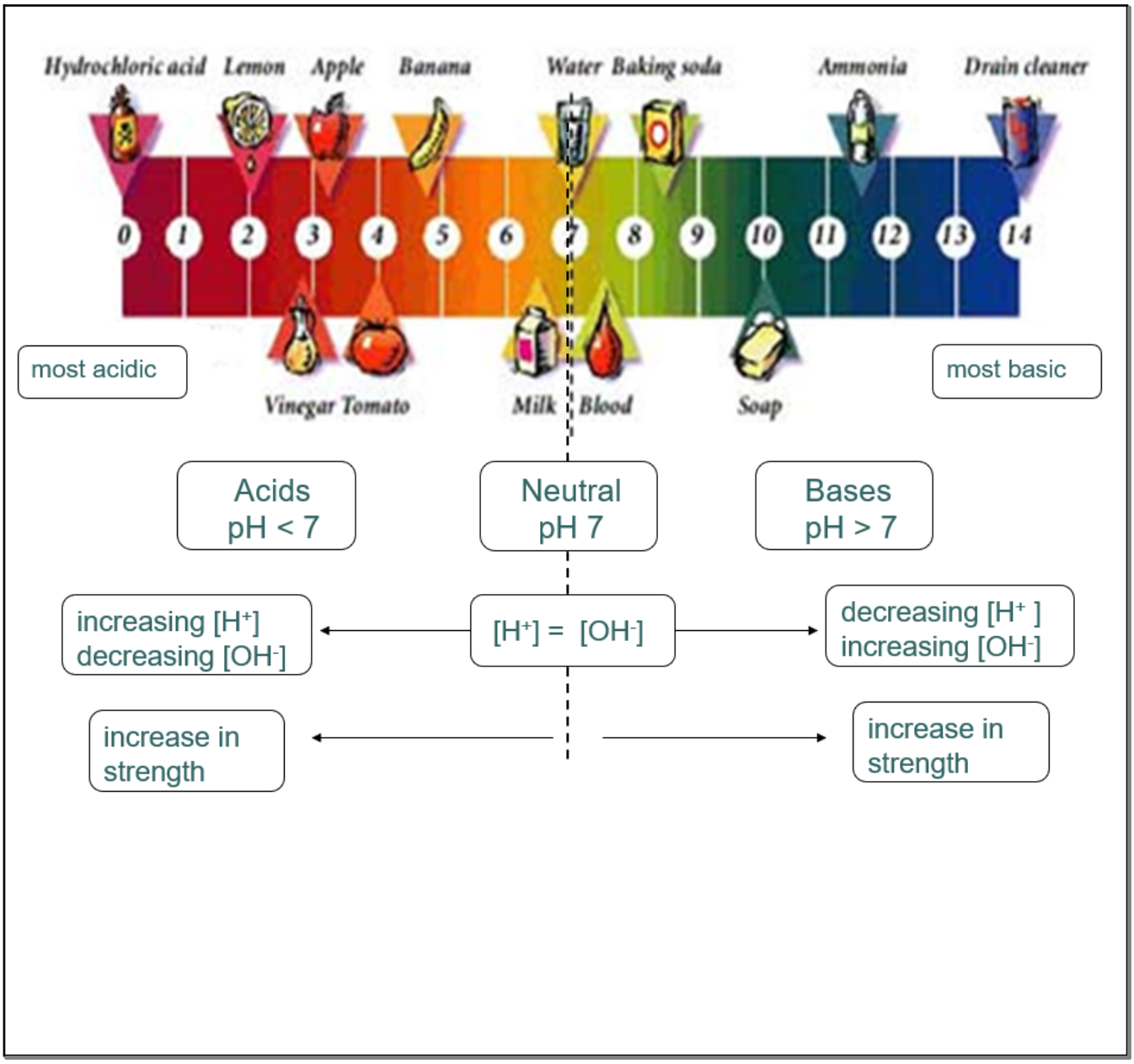
Learning Goals: I will be able to …

- define the *pH scale*
- describe acidic solutions, basic solutions, and neutral solutions
- use pH to identify a substance as a weak/strong acid or a weak/strong base
- define *pH indicator*
- identify and describe various types of pH indicators

What is the pH Scale?

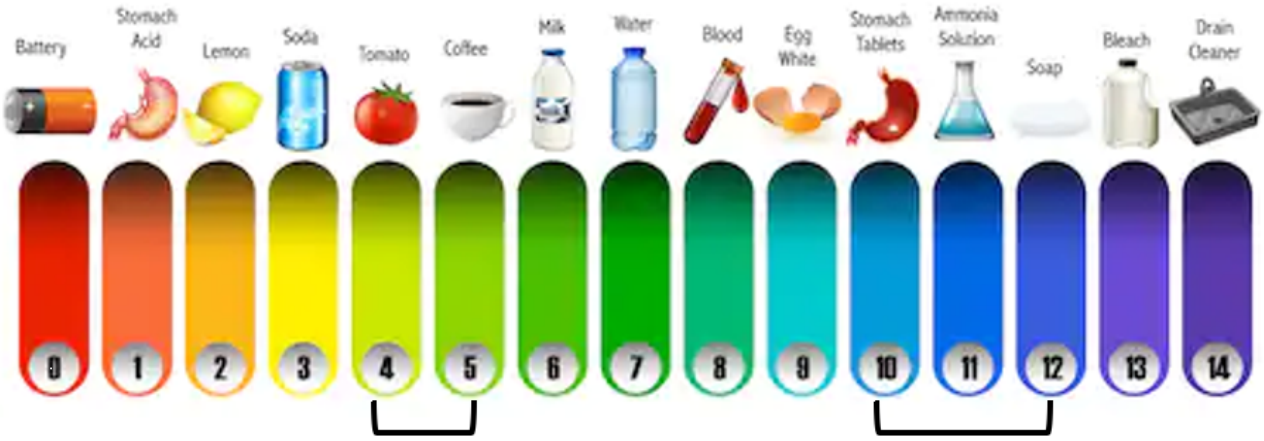
- The ***pH scale*** is a numerical scale, ranging from 0 to 14, used to classify aqueous solutions as acidic, basic, or neutral.
- Also indicates the strength of the acid or base (weak/strong)




Hydrochloric acid
Lemon
Apple
Banana
Water
Baking soda
Ammonia
Drain cleaner
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
most acidic
most basic
Vinegar
Tomato
Milk
Blood
Soap
Acids
pH < 7
Neutral
pH 7
Bases
pH > 7
increasing [H+]
decreasing [OH-]
[H+] = [OH-]
decreasing [H+]
increasing [OH-]
increase in strength
increase in strength

- A value on the pH scale differs from the value above it or below it by a power of 10.

Examples:



At pH 4, $[H^+]$ is 10x greater than at pH 5. pH 4 is 10x more acidic than pH 5.

At pH 10, $[H^+]$ is 100x greater than at pH 12. pH 10 is 100x more acidic than pH 12.

Determining the pH of a Solution

pH Meter

→ uses the electrical properties of a solution to determine pH

pH Indicators

→ a chemical that is added to a solution

→ shows the acidity or basicity of the solution by changing colour at a particular pH or range of pH values

Types of pH Indicators

Litmus Paper

→ blue litmus paper turns red in acidic solutions

→ red litmus paper turns blue in basic solutions

→ neither blue nor red change colour in neutral solutions

pH Paper

→ strip of paper that changes colour depending on pH

→ colour is compared against a colour chart to determine the pH of the solution

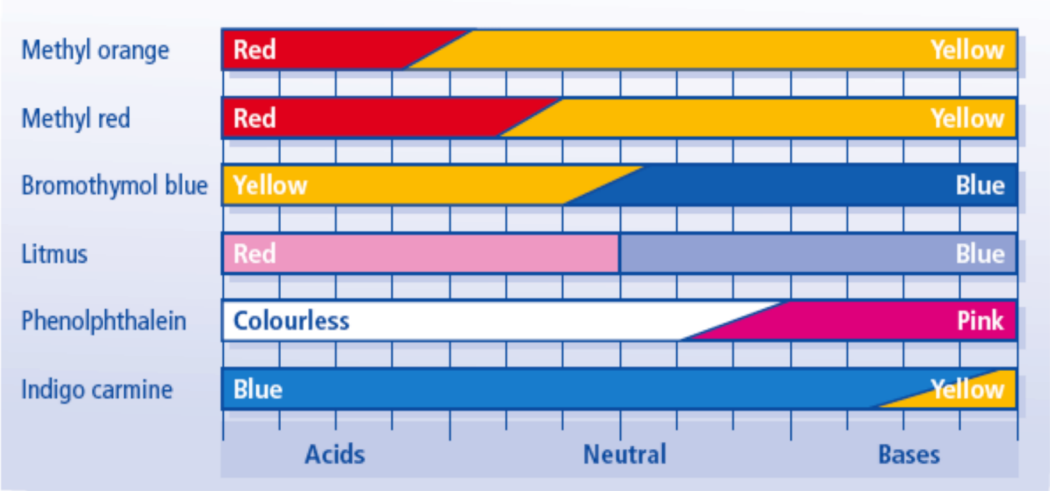
Universal Indicator

→ a chemical that is made up of several indicators

→ changes different colours at different pH values

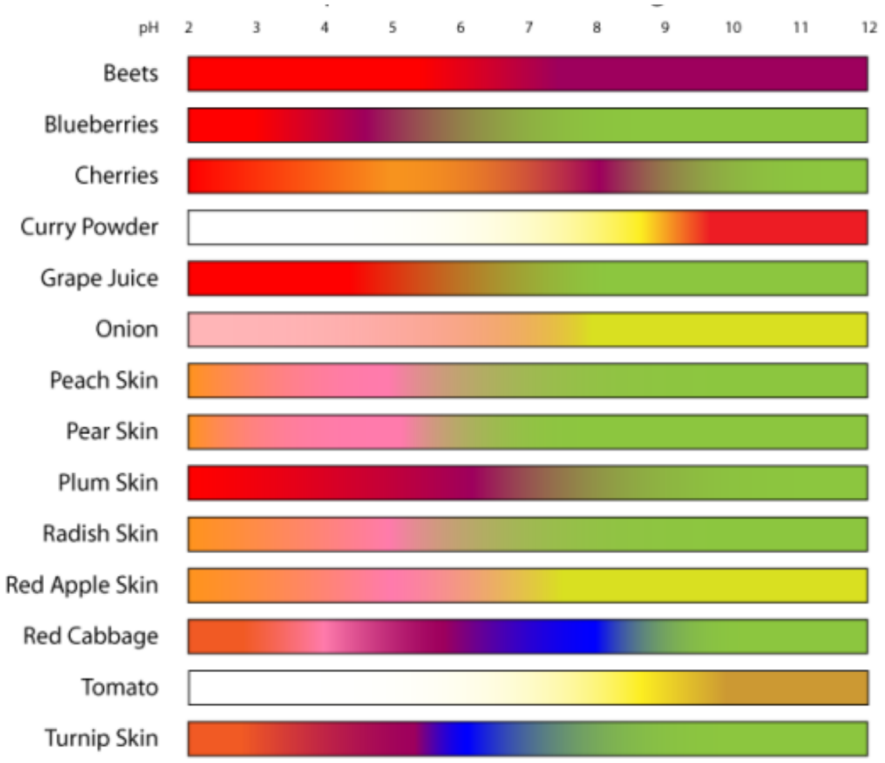
Other pH Indicators

- Specific indicators can also be used, which change colour within a small range of pH values.
- A few common indicators and their colour changes include:



Natural Acid-Base Indicators

Natural acid-base indicators include:



pH in Everyday Life

Your health depends on controlling your body's pH

Example: Sweat and oils make your skin mildly acidic (pH ~5.5). This is toxic enough to skin organisms to prevent them from growing out of control.

Most skin creams and shampoos are slightly acidic, so they maintain the natural acidity of the skin.

Soaps can be slightly basic (pH 7 or 8). Washing too much can raise skin pH and encourage the growth of skin bacteria.

The acidity of skin can also react with some metals. This is why you may get a rash from some jewellery or your cellphone.

Reactions of Acids and Bases

Learning Goals: I will be able to …

- write balanced chemical equations for *neutralization* reactions

- A ***neutralization*** reaction occurs when an acid reacts with a base

acid + base → water + a salt

Example

$$2HCl_{(aq)} + Mg(OH)_{2\,(aq)} \rightarrow 2H_2O_{(l)} + MgCl_{2(aq)}$$