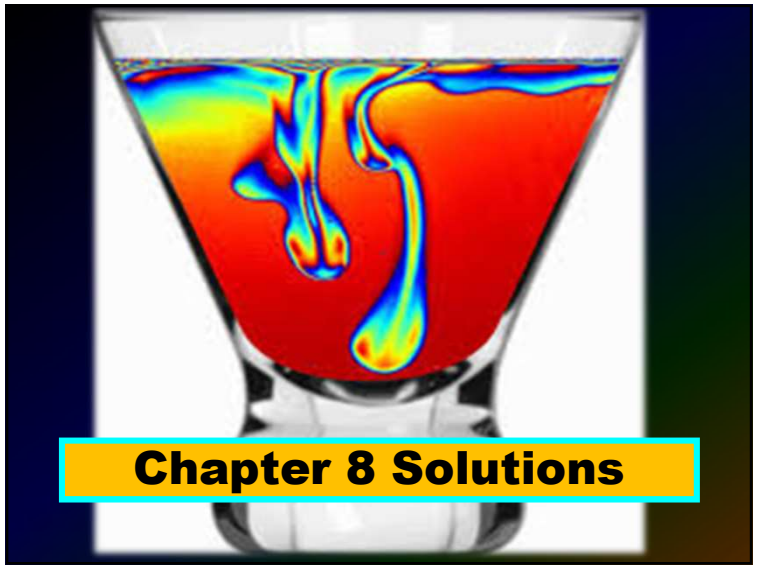
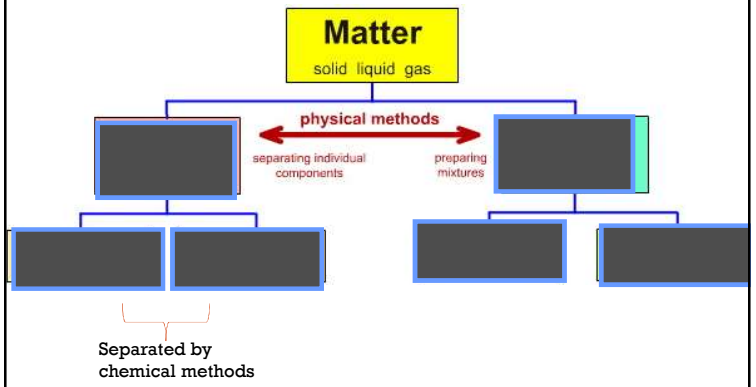
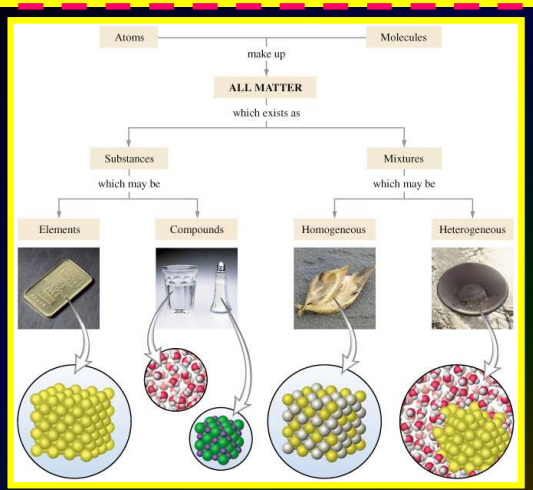


FILL IN THE CONCEPT MAP FOR MATTER



All Matter



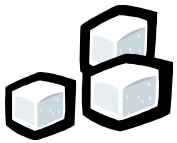
TWO TYPES OF SUBSTANCES

PURE SUBSTANCES

- A sample of matter that has definite chemical and physical properties.
- Elements and compounds are pure substances.

Examples: table salt and sugar

ELEMENT, COMPOUND, OR ATOM?



- Carbon — Element
- Proton — Atom
- Aluminum — Element
- Water — Compound
- Neutron — Atom
- Sugar — Compound

- Electron — Atom
- Salt — Compound
- Iron — Element
- Glass — Compound
- Copper — Element

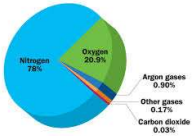
TWO TYPES OF SUBSTANCES

MIXTURES

Two Types: Heterogeneous & Homogeneous

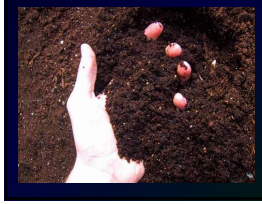
- Matter that consists of two or more substances mixed together.
- Substances in mixture KEEP their chemical and physical properties

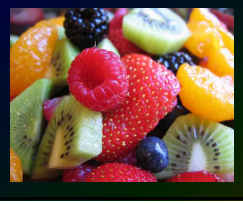
- Nothing new is created. It is the just the same substances mixed together.



Heterogeneous Mixtures

- Does not have a uniform in composition.
  - –Every spoonful will have a different amount of each component
    - ❖Ex) fruit salad, dirt, granite





Homogeneous Mixtures

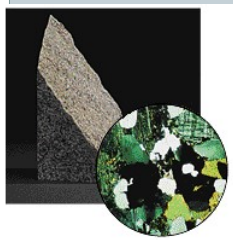
- Mixture looks uniform even because the components are too small to be seen.
  - –Solutions
    - Ex: Alloys

Amalgam=mercury dissolved in solid silver. Used in tooth fillings

- Ex: Kool-Aid, tea

Homogeneous vs Heterogenous

- Examples:



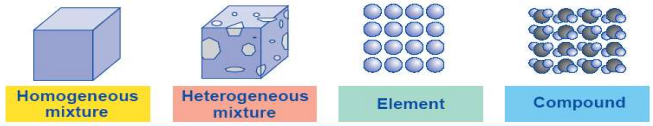
A Granite, a heterogeneous mixture

B Human blood, a heterogeneous mixture

C Copper(II) sulfate ($CuSO_4$) in water, a homogeneous mixture (solution)

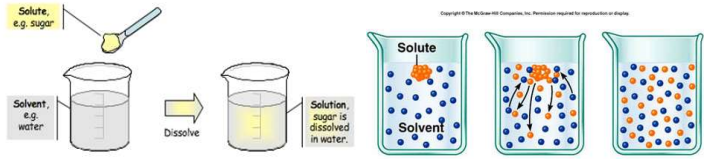
Types of Mixtures

Types of Matter

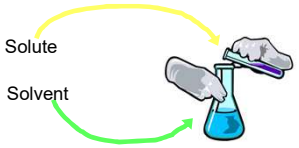


Type of matter	Definition	Examples
Homogeneous mixture	A mixture that contains more than one type of matter and is the same throughout.	soda pop, air, chocolate ice cream
Heterogeneous mixture	A mixture that contains more than one type of matter and is not the same throughout.	chicken soup, soil, fudge ripple ice cream
Element	A substance that contains only one type of atom.	copper metal, oxygen gas, liquid nitrogen
Compound	A substance that contains more than one type of atom.	table salt, rust (iron oxide), carbon dioxide gas

Properties of Solution



- Solution = A homogeneous mixture (ex: salt water)
- 2 Parts:
  - Solute - substance being dissolved (ex: salt)
  - Solvent - substance solute dissolves in (ex: water)



Water: A Common Solvent

Water is the "Universal Solvent"

- Water is found in almost everything.
  - –2/3 of Earth's surface is water.

Properties of Solution

Soluble – anything that dissolves in another substance. **Ex: Salt is soluble in water.**

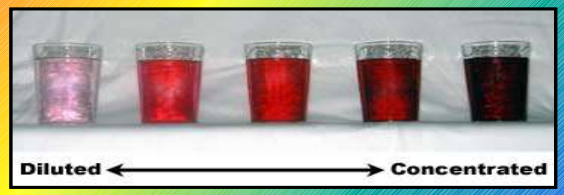
Insoluble – anything that does not dissolve in another substance. **Ex: Oil is insoluble in water.**

Insoluble **Soluble**

Properties of Solution

- **Concentration: the quantity of solute dissolved in a given quantity of solution.**
  - **different concentrations, depending on how much solute and solvent are present.**

Dilute – weak solution "less" solute present



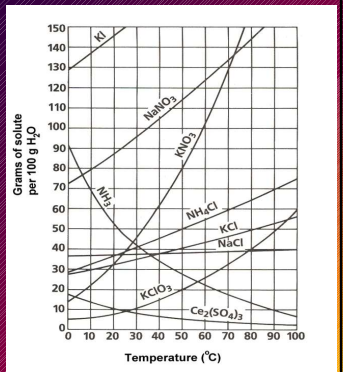
Properties of Solution

Rate Solutes Dissolves

- **Solubility : is the maximum amount of a solute that can be dissolved in a given amount of solvent at a given temperature.**

How much can dissolve?

- If you continue adding sugar to lemonade, eventually the point is reached when no more sugar dissolves and the excess granules sink to the bottom of the glass.



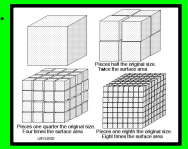
Properties of Solution

Rate Solutes Dissolves

What makes solutes dissolve faster?

1. Larger surface area

- small pieces dissolves faster than the same substance in big pieces. Smaller pieces have a great surface area.

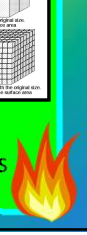


2. Agitation

- **Stirring or shaking**

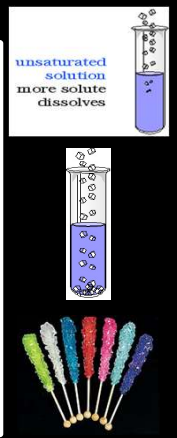
3. Temperature (Heat)

- more collisions between particles

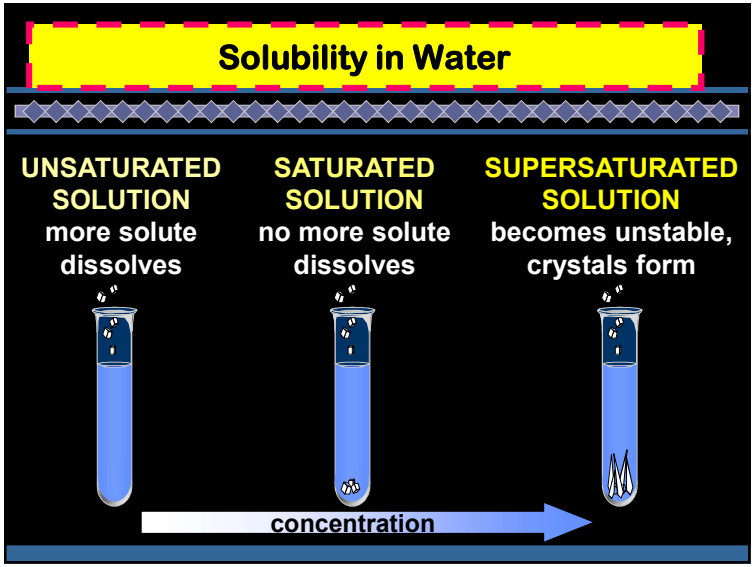


Solubility in Water

- Unsaturated
  - more solute can be dissolved in the solvent
- Saturated
  - no more solute can be dissolved in the solvent at the current temperature
- Supersaturated
  - the temperature of the solution is raised so more solute can be dissolved. When the temperature drops, the solution holds more solute than normally capable.



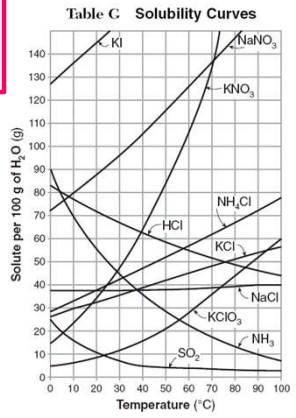
Solubility in Water



Solubility Curves

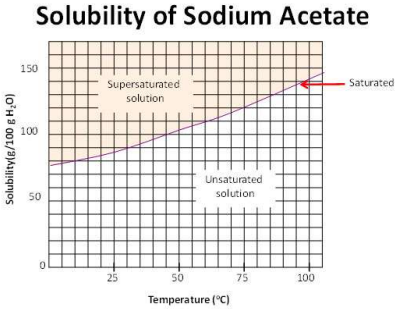
Solubility curves: show the relationship between ***solubility*** and ***temperature***.

- **Solubility - amount of a solute that will dissolve in 100 g of water at a particular temperature**



Solubility Curves

Unsaturated: below the line
Saturated: On the line
Supersaturated: above the line



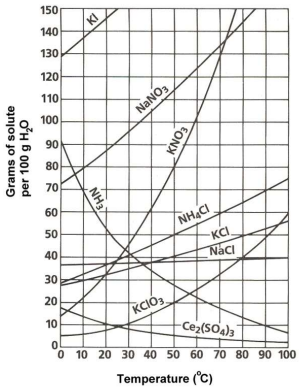
Reading a Solubility Curve

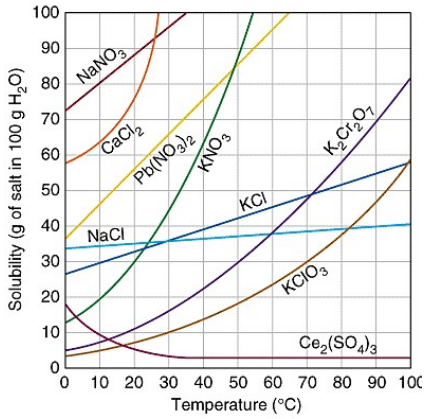
- How much KCl will dissolve in 100 g of water at 30ºC?

  34 grams

- At what temperature will 50 g of KNO_3 dissolve in 100 g of water?

  32°C





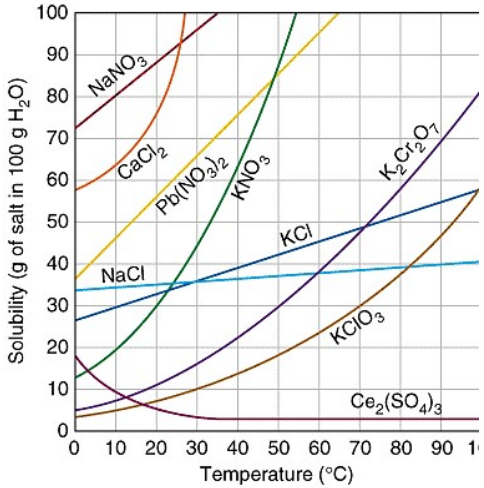
How much H_2O is required to just dissolve 100 g $NaNO_3$ at 20°C?

89 g

At 60°C, 50 grams of KCl is dissolved in 100 g of water. Is this solution saturated, unsaturated or supersaturated?

Supersaturated

Problem:



How much KCl will dissolve in 100g of water at 50°C?

42 g

At 20 °C, 45 grams of Pb(NO3)2 is dissolved at 100 grams of water. Is this solution saturated, unsaturated or supersaturated?

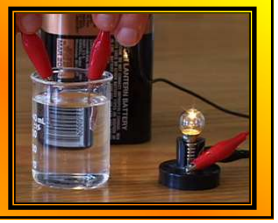
unsaturated

Properties of Solution

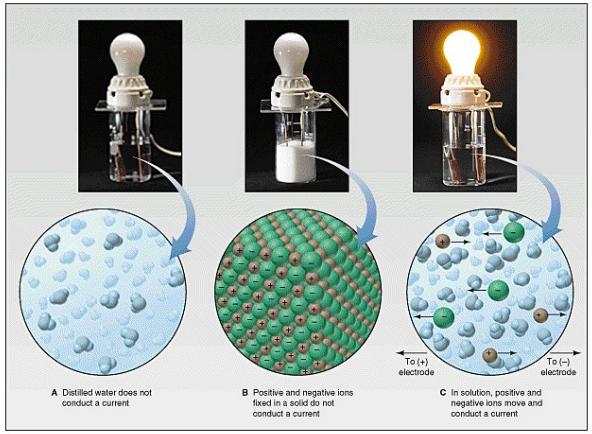
- **Conductivity** : the ability of an aqueous solution to carry an electrical current.
- Electrolyte solution: **solution** that generally contains ions, atoms or molecules that have lost or gained electrons, and is electrically conductive.

Ex: Ions (Na+ & Cl-)

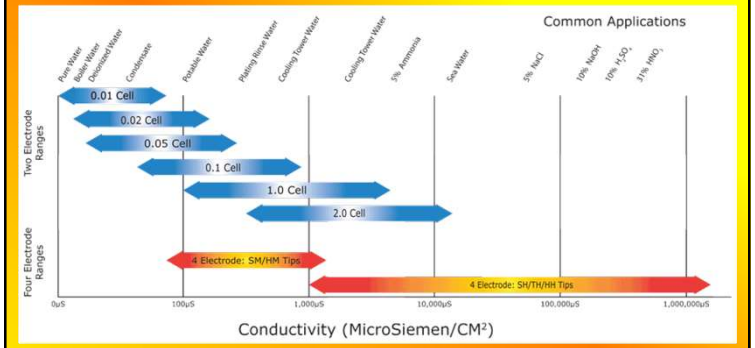
- Strong acids are strong electrolytes.
- Strong bases are also strong electrolytes.

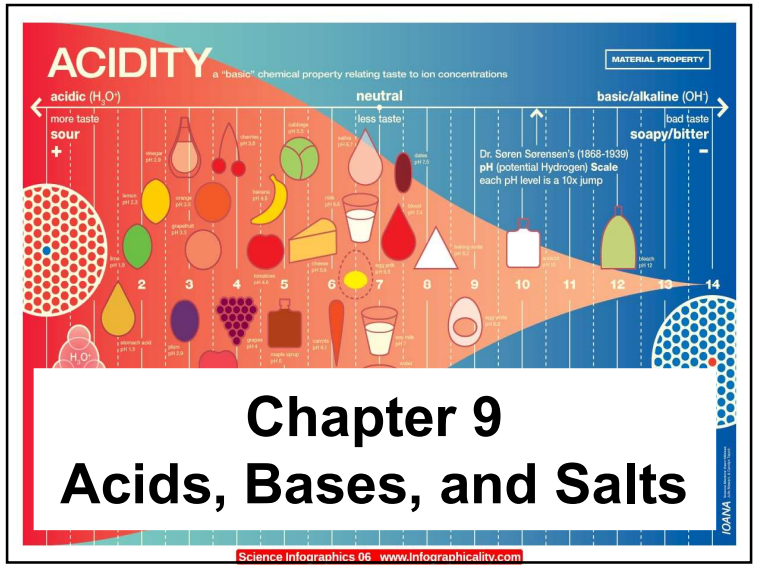


Conductivity



Conductivity





Chapter 9
Acids, Bases, and Salts

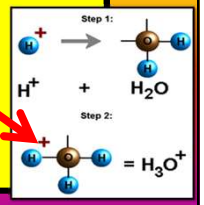
Acids

Acids are substances which release hydrogen ions (H^+) when added to water.

A **hydrogen ion (H+)** combines with a water molecule (H_2O) to produce a hydronium ion (H_3O^+)

$$H^+ + H_2O \rightarrow H_3O^+$$

The more **hydronium ions** that are produced, the stronger the acid.



Acids

Properties of Acids

- Sour taste.
- pH below 7
- Changes blue litmus paper red.
- Very corrosive to metals (meaning that they react with metals producing hydrogen gas)
- Acids react with bases to produce salts and water
- React with metals (Tomatoes turn Aluminum foil black.)

Uses of Acids

Acids

- Acetic Acid = **Vinegar**
- **Citric** Acid = lemons, limes, & oranges. It is in many sour candies such as lemonhead & sour patch.
- Ascorbic acid = **Vitamin C** which your body needs to function.
- Sulfuric acid is used in the production of fertilizers, steel, paints, and plastics.
- **Car batteries**

Table 1 Common Acids and Their Uses

Name, Formula	Use	Other Information
Acetic Acid, CH_3COOH	Food preservation and preparation	When in solution with water, it is known as vinegar.
Acetylsalicylic Acid, $HOOC-C_6H_4-OOCCH_3$	To reduce inflammation	
Ascorbic Acid, $H_2C_6H_6O_6$	Antioxidant, vitamin	Called vitamin C
Carbonic Acid, H_2CO_3	Carbonated drinks	Involved in cave, stalactite, and stalagmite formation and acid rain
Hydrochloric Acid, HCl	Digestion as gastric juice in stomach, to clean steel in a process called pickling	Commonly called muriatic acid
Nitric Acid, HNO_3	To make fertilizers	Colorless, yet yellows when
Phosphoric Acid, H_3PO_3	To make detergents, fertilizers, and soft drinks	Slightly sour but pleasant taste, detergents containing phosphates cause water pollution
Sulfuric Acid, H_2SO_4	Car batteries, to manufacture fertilizers and other chemicals	Dehydrating agent, causes burns by removing water from body cells

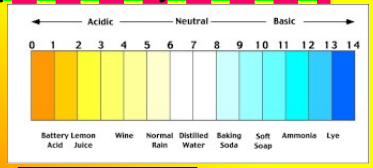
Four Important acids to remember

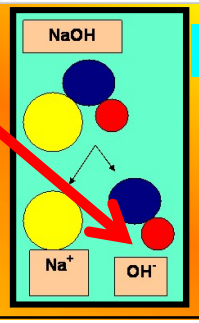
Other interesting acids

Bases (Alkali)

- **What is a base?**
  - Any compound that increases the number of **hydroxide ions** (OH^-)when dissolved in water.

Therefore, most bases have hydroxide in the name or formula.





Example: NaOH
Sodium Hydroxide

Bases

Properties of Bases

- Bitter taste.
- Feels slippery.
- pH above 7.
- Changes red litmus paper blue.
- Very corrosive
- Bases react with acids to produce salts and water
- Do not react with metals

Uses of Bases (Alkali)

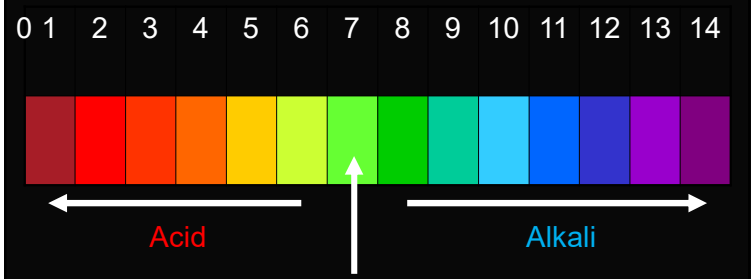
- Bases give **soaps**, ammonia, and many other **cleaning products** some of their useful properties.
- The OH- ions interact strongly with certain substances, such as dirt and grease.
- **Chalk** and oven cleaner are examples of familiar products that contain bases.
- Your blood is a slightly **basic** solution.

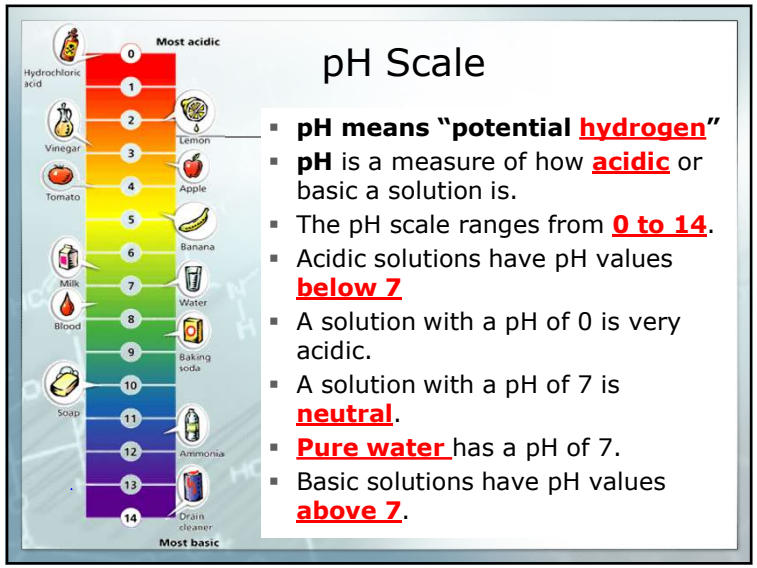
Why do bases feel slippery?

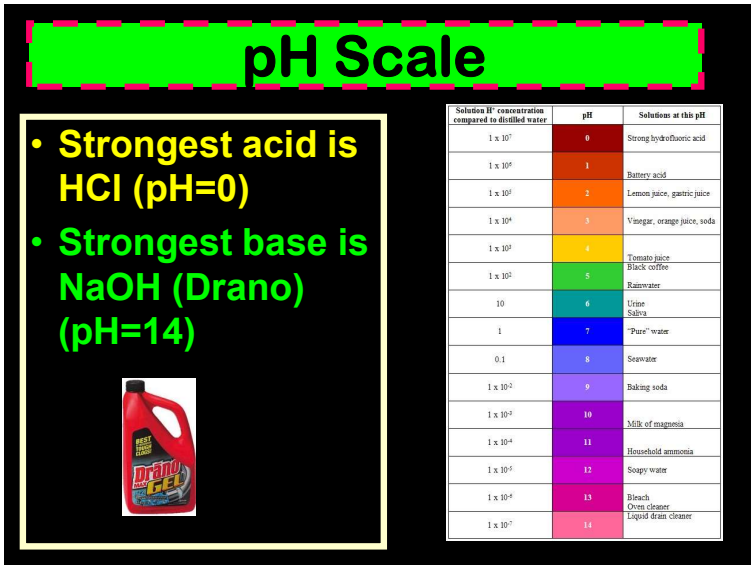
- Bases react with oils and fats on the skin. Getting bases and bleaches on your fingers literally turns the fat in your skin, into soap, hence the slippery.

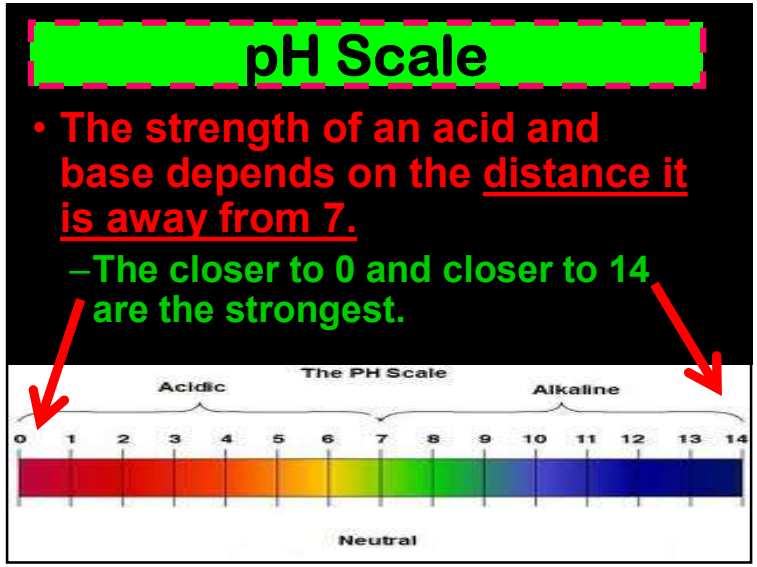
pH Scale

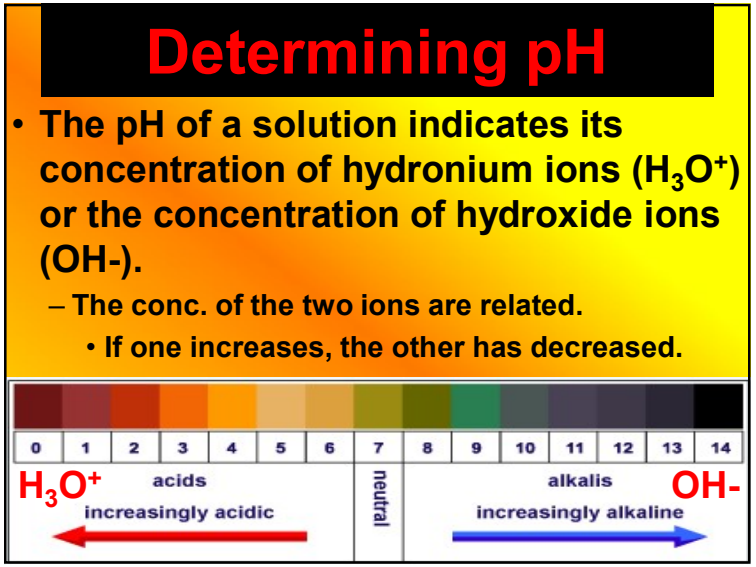
Draw in your notes




pH Scale
Most acidic
Most basic
Hydrochloric acid
Vinegar
Tomato
Milk
Blood
Soap
Lemon
Apple
Banana
Water
Baking soda
Ammonia
Drain cleaner
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
pH means "potential hydrogen"
pH is a measure of how acidic or basic a solution is.
The pH scale ranges from 0 to 14.
Acidic solutions have pH values below 7
A solution with a pH of 0 is very acidic.
A solution with a pH of 7 is neutral.
Pure water has a pH of 7.
Basic solutions have pH values above 7.


pH Scale
Strongest acid is HCl (pH=0)
Strongest base is NaOH (Drano) (pH=14)
Solution H+ concentration compared to distilled water
pH
Solutions at this pH
1 x 10^7
0
Strong hydrofluoric acid
1 x 10^6
1
Battery acid
1 x 10^5
2
Lemon juice, gastric juice
1 x 10^4
3
Vinegar, orange juice, soda
1 x 10^3
4
Tomato juice
1 x 10^2
5
Black coffee
Rainwater
10
6
Urine
Saliva
1
7
"Pure" water
0.1
8
Seawater
1 x 10^-2
9
Baking soda
1 x 10^-3
10
Milk of magnesia
1 x 10^-4
11
Household ammonia
1 x 10^-5
12
Soapy water
1 x 10^-6
13
Bleach
Oven cleaner
1 x 10^-7
14
Liquid drain cleaner


pH Scale
The strength of an acid and base depends on the distance it is away from 7.
–The closer to 0 and closer to 14 are the strongest.
The PH Scale
Acidic
Alkaline
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Neutral


Determining pH
The pH of a solution indicates its concentration of hydronium ions (H_3O^+) or the concentration of hydroxide ions (OH-).
– The conc. of the two ions are related.
• If one increases, the other has decreased.
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
H_3O^+
acids
increasingly acidic
neutral
alkalis
increasingly alkaline
OH-

Determining pH

The pH of a substance is easily measured by comparing the color the substance turns a strip of pH paper with the color scale on the pH paper dispenser.

Acids Bases

Acids are high in Hydrogen ion concentration

Bases are high in Hydroxide ion concentration

The pH is the negative of the power of 10.

The hydronium ion [H_3O^+] concentration of apple juice is

0.001 mol/L or $1x10^{-3}$ M

pH of apple juice: _3_,

	[H+]	pH	Common examples
Acids	1×10^{0}	0	Hydrochloric acid
	1×10^{-1}	1	Stomach acid
	1×10^{-2}	2	Lemon juice
	1×10^{-3}	3	Vinegar
	1×10^{-4}	4	Soda (carbonic acid)
	1×10^{-5}	5	Rainwater
	1×10^{-6}	6	Milk
Neutral	1×10^{-7}	7	Pure water
Bases	1×10^{-8}	8	Egg whites
	1×10^{-9}	9	Baking soda
	1×10^{-10}	10	Antacid
	1×10^{-11}	11	Ammonia
	1×10^{-12}	12	Quicklime (calcium hydroxide)
	1×10^{-13}	13	Drain cleaner
	1×10^{-14}	14	Lye (sodium hydroxide)

Acid-Base Reactions

Neutralization

- A neutralization reaction is the reaction between an acid and a base.

A ***strong*** acid can neutralize a ***strong*** base.
A ***weak*** acid can neutralize a ***weak*** base.

- Antacids relieve indigestion, usually caused by excess stomach acid.
- Antacid (a weak base) reacts with the strong acid in the stomach to produce a weaker acid, and thus the person will feel better.

Acid + Base = Salt

- Acid reacts with a base, hydronium ions react with hydroxide ions to form water and a salt.

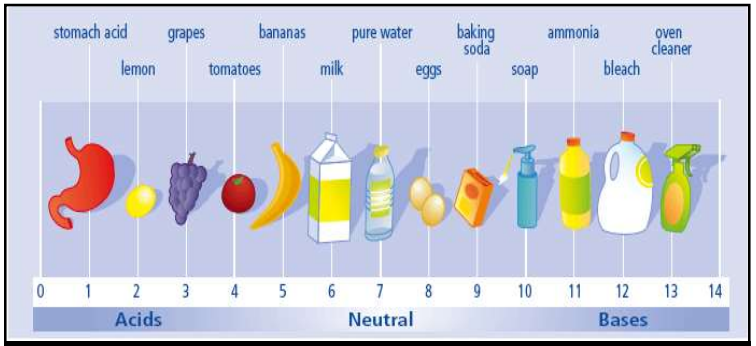
ACID + BASE → SALT + WATER

$-HCl + NaOH = H_2O + NaCl$

- **Made: by neutralization reactions**

Uses: cleaning, de-icing, ceramic glazes, water softeners, fire extinguishers…

Section 3: Acids, Bases, and Salts in the Home



ACIDIC	NEUTRAL	BASIC
Stomach Acid	Pure Water	Eggs
Lemon Juice		Baking Soda
Grapes		Soap
Tomatoes		Ammonia
Bananas		Bleach
Milk		Oven Cleaner

Household Acids

Lemon juice contains citric acid and vinegar contains acetic acid.

Commercial descaling solutions contain strong and corrosive acids to remove deposits of limescale.

- **Concentrated sulphuric acid is extremely dangerous. It is found in car batteries.**

Table 2 Common Bases and Their Uses

Name, Formula	Use	Other Information
Aluminum Hydroxide, $Al(OH)_3$	Color-fast fabrics, antacid, water purification as shown in **Figure 4A**	Sticky gel that collects suspended clay and dirt particles on its surface
Calcium Hydroxide, $Ca(OH)_2$	Leather-making, mortar and plaster, lessen acidity of soil	Called caustic lime
Magnesium Hydroxide, $Mg(OH)_2$	Laxative, antacid	Called milk of magnesia
Sodium Hydroxide, NaOH	To make soap, oven cleaner, drain cleaner, textiles, and paper	Called lye and caustic soda; generates heat (exothermic) when combined with water, reacts with metals to form hydrogen
Ammonia, NH_3	Cleaners, fertilizer, to make rayon and nylon	Irritating odor that is damaging to nasal passages and lungs

Table 3 Some Common Salts and Their Uses

Name, Formula	Common Name	Uses
Sodium Chloride, NaCl	Salt	Food preparation, manufacture of chemicals
Sodium Hydrogen Carbonate, $NaHCO_3$	Sodium bicarbonate Baking soda	Food preparation, antacids
Calcium Carbonate, $CaCO_3$	Calcite, chalk	Manufacture of paint and rubber tires
Potassium Nitrate, KNO_3	Saltpeter	Fertilizers
Potassium Carbonate, K_2CO_3	Potash	Manufacture of soap and glass
Sodium Phosphate, Na_3PO_4	TSP	Detergents
Ammonium Chloride, NH_4Cl	Sal ammoniac	Dry-cell batteries

What Are Some Names of Acids?

- **Acetic acid is found in vinegar**
- **Ascorbic acid is found in citrus fruits**
- **Hydrochloric acid is found in your stomach**
- **Phosphoric acid is found in fertilizers and the soft drinks you drink**
- **Nitric acid is used in some explosives like TNT**

Household Bases

disinfectant a substance that kills harmful bacteria or viruses

bleach a basic solution that can either be used as a disinfectant or to remove colors and stains

Figure 6-22
The hydroxide ions present in ammonia solutions allow dirt and water to mix and be removed.

What Are Some Names of Bases?

- Ammonia (NH_3) is often found in cleaning products
- Potassium hydroxide (KOH) has many uses in industry, and can be a precursor to making soaps
- Sodium bicarbonate ($NaHCO_3$) is found in baking soda
- Calcium carbonate ($CaCO_3$) is found in antacids
- Sodium hydroxide (NaOH) is found in lye

KOH in pure form

Antacids neutralize stomach acids

Battery Acid
Stomach Acid
Lemon Juice
Orange Juice
Acid Rain
Black Coffee
Vinegar
Urine
Saliva

Sea Water
Baking Soda
Drain Cleaner
Oven Cleaner
Ammonia
Soap
Bleach

Acids

Bases

Hydrangeas are blue when grown in acidic soil and pink when grown in basic (alkaline soil)

Which of these substances are acids?

Hydrochloric acid	√	Vinegar	√
Lemon juice	√	Bleach	
Toothpaste		Sulphuric acid	√
Bath salts		Washing up liquid	