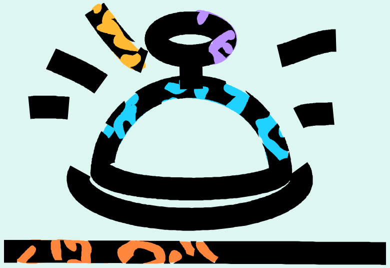
Bellringer

Think about substances that you encounter in a typical day and make two lists:

- One list should contain substances that might be acids.

- The other should contain substances that might be bases.



Did you Know?

The *hydrangea macrophylla* blossoms in pink or blue, depending on soil pH. In acid soils the flowers will be blue, in alkaline soils the flowers will be pink.

What Are Acids and Bases?

Objectives:

- list the properties of acids and bases.
- define and give examples of Arrhenius acids and bases.
- Compare the Brønsted-Lowry definition of acids and bases with the Arrhenius definitions of acids and bases.

Properties of Acids and Bases

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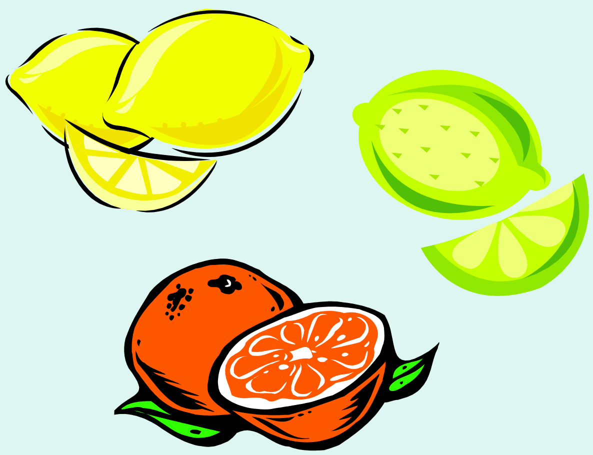
- **Tart, sour, or sharp taste.**

  Think of citrus fruits.

  Think of sour candy—look at ingredient list for an acid.



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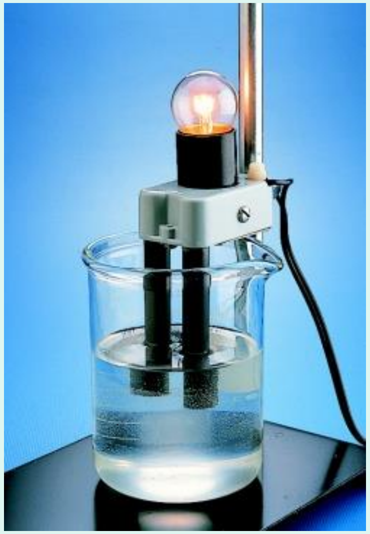

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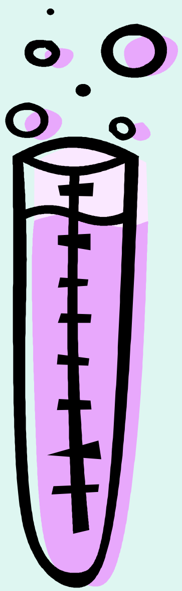
  If the metal is above hydrogen in the activity series, H_2 gas will be generated.



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- Litmus paper is red
  Phenolphthalein is clear.

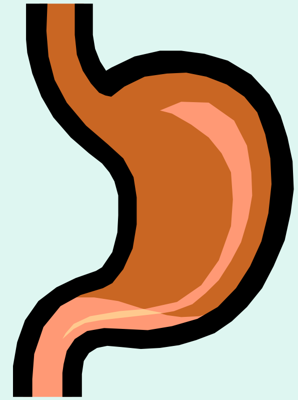
Some acids you may recognize:

Strong acids → dissociate completely	Weak acids – dissociate partially
hydrochloric acid, HCl	acetic acid, CH_3COOH
hydrobromic acid, HBr	hydrocyanic acid, HCN
hydriodic acid, HI	hydrofluoric acid, HF
nitric acid, HNO_3	nitrous acid, HNO_2
sulfuric acid, H_2SO_4	sulfurous acid, H_2SO_3
perchloric acid, $HClO_4$	hypochlorous acid, $HOCl$
periodic acid, HIO_4	phosphoric acid, H_3PO_4

Examples of Acids

Toilet bowl cleaner

battery



Gastric juices

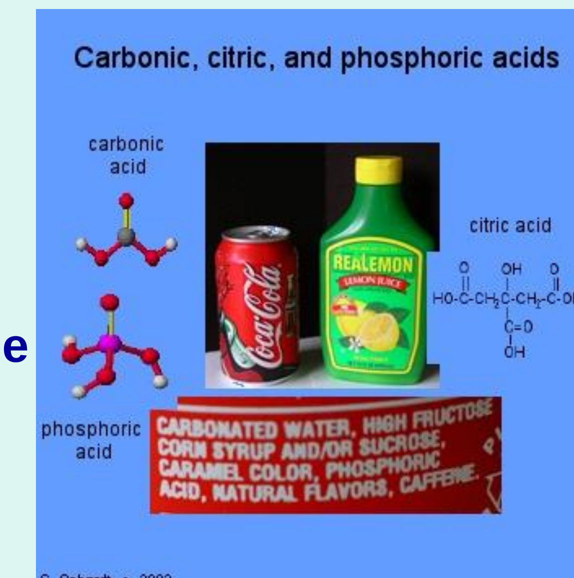
Vinegar

Lactic acid build up in muscles

Coffee / tea

Soda

Lemon juice



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Bases

- **Slippery to the touch.**

  Slippery because bases react with the oils in your skin, converting them into soaps.

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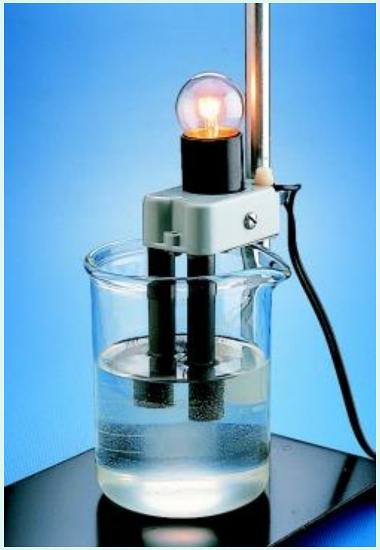

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- **pH above 7 → 14**
- **Litmus paper is blue; Phenolphthalein is pink**.

Some bases you may recognize:

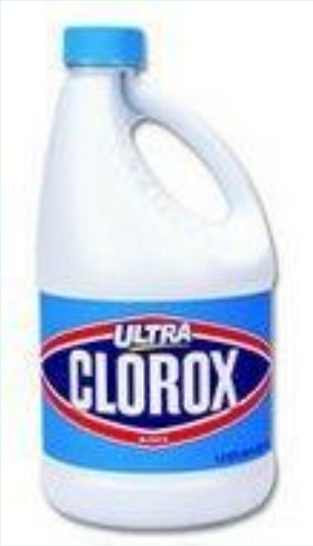
Strong bases	Weak bases
sodium hydroxide, $NaOH$	ammonia, NH_3
potassium hydroxide, KOH	sodium carbonate, Na_2CO_3
calcium hydroxide, $Ca(OH)_2$	potassium carbonate, K_2CO_3
barium hydroxide, $Ba(OH)_2$	aniline, $C_6H_5NH_2$
sodium phosphate, Na_3PO_4	trimethylamine, $(CH_3)_3N$

Examples of Bases

astringent
(causes contraction of pores)

Window cleaner

Baking soda



bleach

Milk of magnesia
(antacid)

ammonia

Hand soap

blood

Arrhenius

- <u>Acid</u>: any substance that, when added to water, increases the hydronium ion concentration $[H_3O^+]$ or $[H^+]$
  -Donate H^+
- <u>Base</u>: any substance that, when added to water, increases the hydroxide ion concentration $[OH^-]$
  - Donate OH^-

Identify Arrhenius acid and base

HCl	
H_2SO_4	
NaOH	
H_3PO_4	
$Ba(OH)_2$	
HNO_3	

Identify Arrhenius acid and base

NH_3	
Na_2CO_3	

Limitations of Arrhenius's acid and base model

Brønsted-Lowry

- Acid: any substance that can donate a proton (H^+)

- Base: any substance that accepts a proton(H^+)

Stop & Write & Discuss

- How are the Arrhenius and BrØnsted-Lowry definitions for acids and bases different?
- How are they the similar?
- What are the limitations of each?
- Which do you find easier to use?

*Brǿnsted-Lowry Acids

Acid - proton donor (H+)

All Arrhenius acids are Bronsted-Lowry acids

All Bronsted-Lowry acids are not Arrhenius acids

I. Acid = proton donor

$$\overset{\mathbf{H^+}}{\curvearrowright}$$

HCl + H_2O ==> $\mathbf{H_3O^+}$ + Cl^-

acid base conjugate acid conjugate base

*Brǿnsted-Lowry Bases

Base - proton acceptor

All Arrhenius bases are Brǿnsted-Lowry bases.

Not all Brǿnsted-Lowry bases are Arrhenius bases:

Ex: NH_3 (aq) Na_2CO_3 (aq)

II. Base = proton acceptor

H+

NH_3 + H_2O ==> NH_4+ + **OH^-**

base acid

*Conjugate Acids & Conjugate Bases

$NH_3 + H_2O \Longleftrightarrow NH_4^{+} + OH^{-}$

base acid conj. acid conj. base

A <u>conjugate acid</u> is the particle formed when a base has accepted a hydrogen ion.

A <u>conjugate base</u> is the particle formed when an acid has donated a hydrogen ion.

$HCl + H_2O \Longleftrightarrow H_3O^{+} + Cl^{-}$

acid base conj. acid conj. base

*Conjugate Acid-Base Pairs

Conjugate acid-base pairs differ only by one hydrogen ion. Ex: H_2O, OH^- or H_3O^+, H_2O

$$H_2O \quad + \quad H_2O \; < ==> \; H_3O^+ \quad OH^-$$

acid base acid base

<u>Amphoteric</u> - acting both as an acid and as a base

Example: water

- **Why? Because water can act as a proton donor and it can act as a proton acceptor.**

*Lewis Theory

Acid - electron pair acceptor

Base - electron pair donor

OPPOSITE OF PROTONS!