# Ch. 15 Acids and Bases

7th Science

| ACID | BASE |
| --- | --- |
| • Citrus fruit (ascorbic acid $C_6H_8O_6$)<br>• Vinegar (acetic acid $C_2H_4O_2$)<br>• Toilet-bowl cleaners (HCl)<br>• Soda (carbonic acid $H_2CO_3$)<br>  <br>• Sour<br>• Turns pH paper red<br>• pH < 7 | ○ Baking soda (sodium bicarbonate NaHCO3)<br>○ Ashes (alkaline) Potassium carbonate $K_2CO_3$<br>○ Soap (react base with animal oil) so is basic<br>○ Drain cleaner sodium hydroxide NaOH<br>○ Bitter<br>○ Slippery (turns your oils to soap!)<br>○ pH > 7 |

(a)



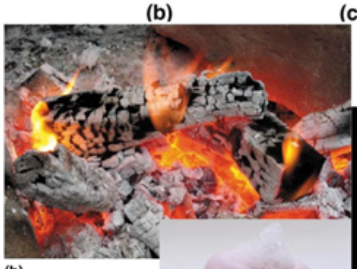

(b)


(c)


(d)


(a)

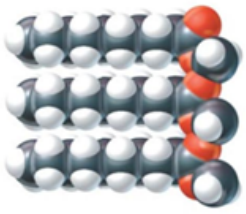




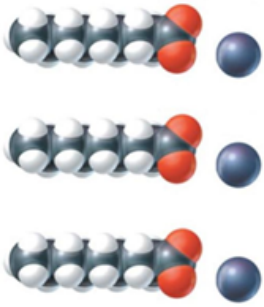
(b)

(c)


(d)



Treat with NaOH

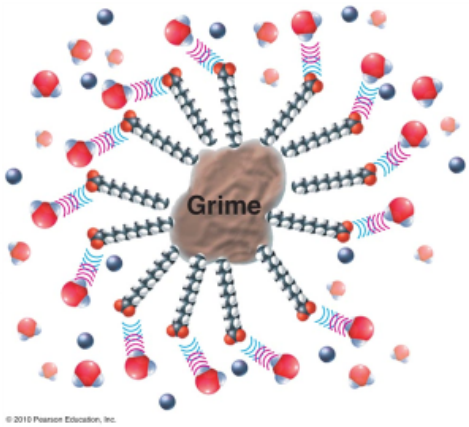


Fat molecule

Three fatty acid soap molecules

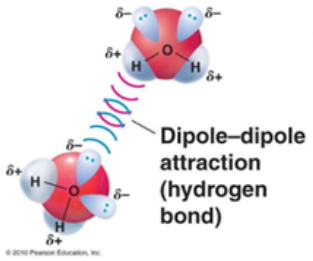
Glycerol molecule



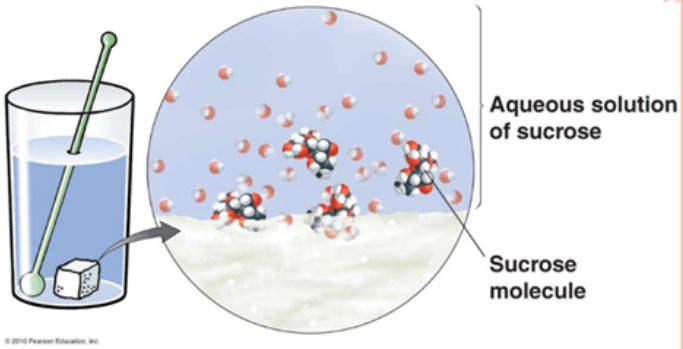


## 18.3 Solutions

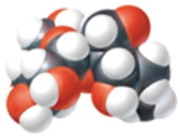
- Bonds between molecules
  - "sticky" = polar
  - Hydrogen bond

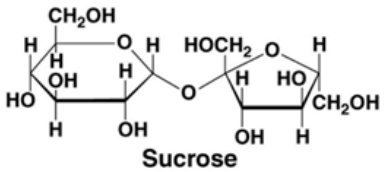


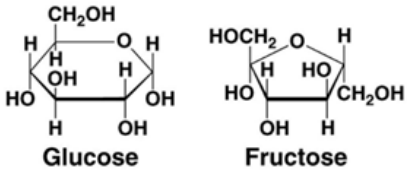

- Sugar water solution




## Side Note: Sucrose (Pg. 460)

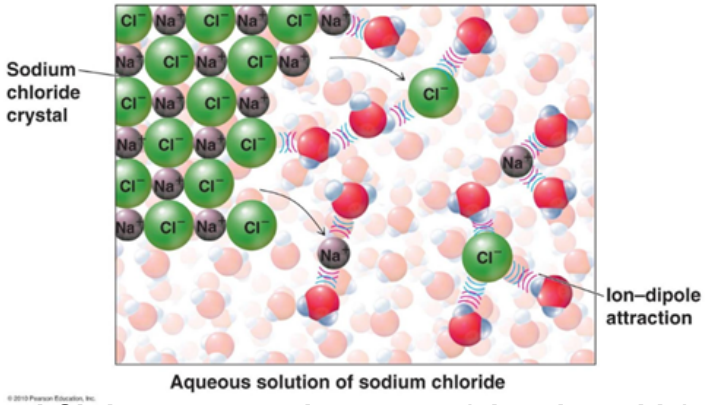





## 18.3 Making Solutions: Saltwater

- Is this ion-dipole, dipole-dipole, or dipole-induced dipole?
  - Ion-dipole
- Does dissolving table salt dissolve the ionic bonds? Yes.




Aqueous solution of sodium chloride

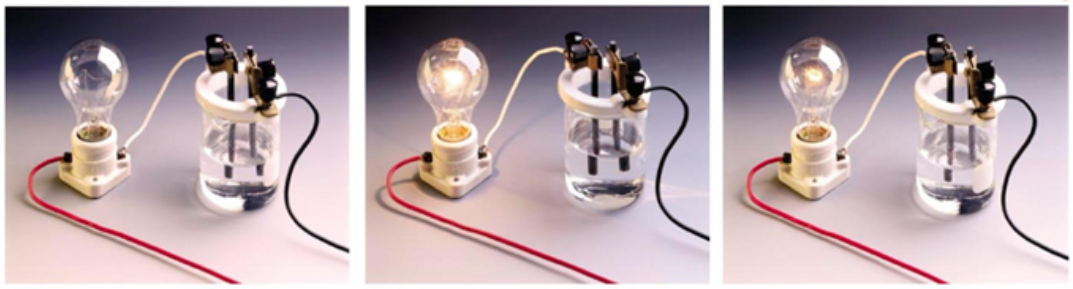
**$Na^+$ and $Cl^-$ ions are not dangerous (already stable), unlike the elemental neutral forms.**

## Electrolyte or not? (covalent? Ionic?)

- **Pure water**
- **Sugar water**
- **NaOH**
- **HCl**
- **Salt water**
- **Vinegar**
- **Baking soda in water**

http://www.youtube.com/watch?v=1XWnovm6JLs

- electrolyte

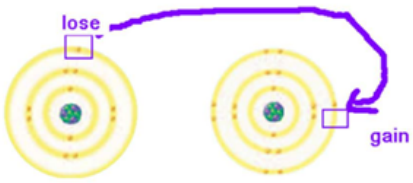


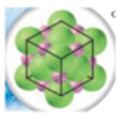

Lemon Battery: Redox
http://www.youtube.com/watch?v=D23JH30ZMK0

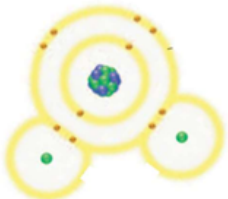
Water Electrolysis:
http://www.youtube.com/watch?v=HQ9Fhd7P_HA

## 15.1 Compounds: Fill in the chart

- Compound names:
  - Ionic compound
  - Molecule
  - Covalent compound
- Examples
  - Nonmetal-nonmetal
  - Metal-metal
  - Table salt
  - Water
  - Tight valence electrons
- Structure
  - Cotton
  - protein
  - Crystal lattice
  - Brittle
  - Non-crystalline (except diamond, sugar)
  - Pattern shifts → like charges repel
  - Organic compounds
  - DNA

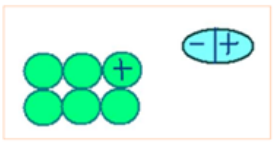


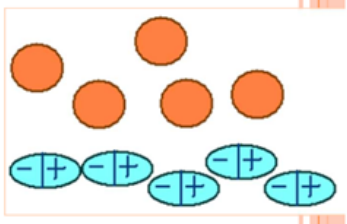


## COMPOUNDS: FILL IN THE CHART

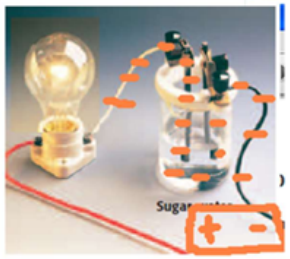
- Melting Point
  - Low
  - High
  - Loose bonds between molecules easily shaken apart
  - Strong bonds between compounds need more energy to loosen



- Solubility in water
  - Low
  - High

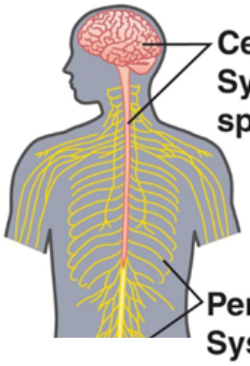


- Electrical conductivity
  - Good
  - Bad
  - No ions
  - Ions are charged



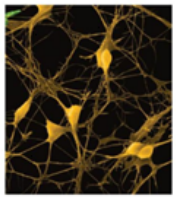
## SOMETHING TO ADD...

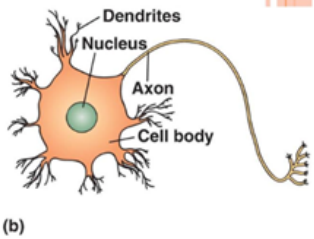
## Stress Response – Nervous System



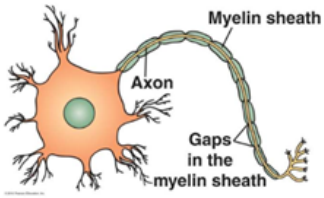
Central Nervous System (brain and spinal cord)

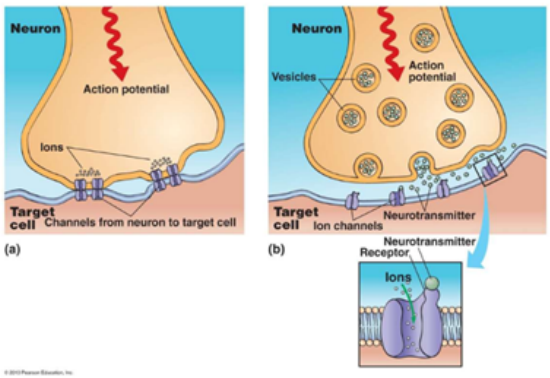
Peripheral Nervous System (other nerves in the body)

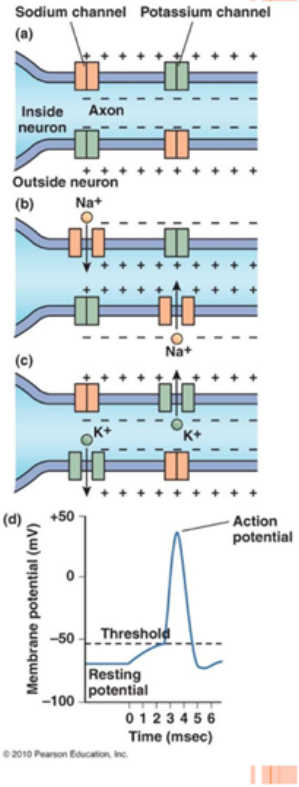




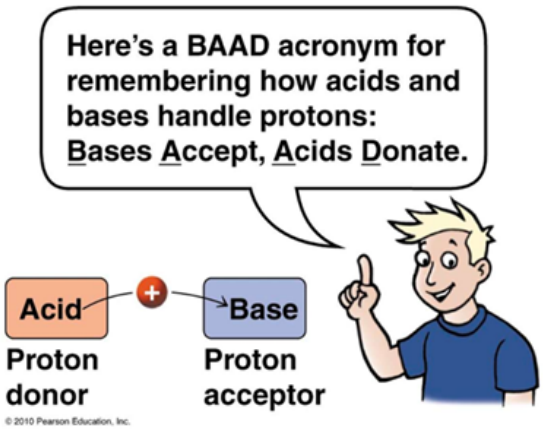

## Stress Response – Nervous System



## Acid- Base Reaction: Bronsted – Lowry definition

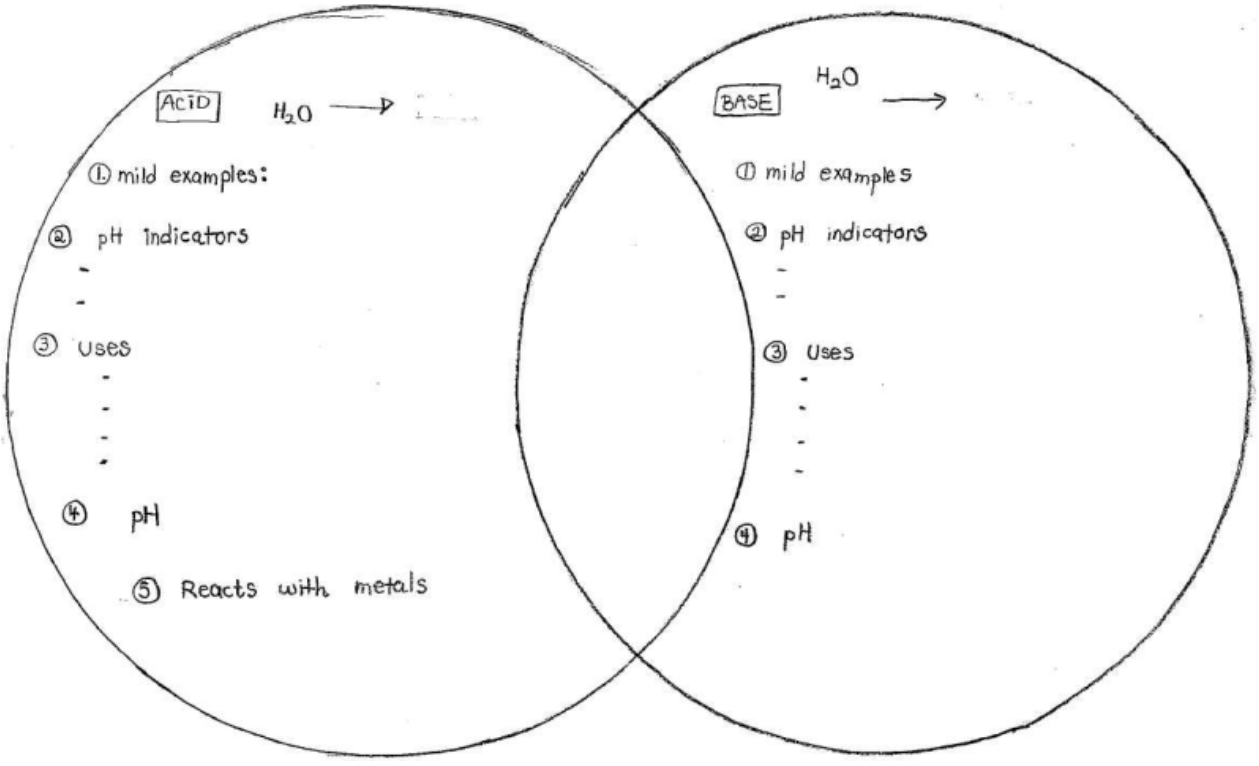



## 15.2 Fill in Pg. 4 (Acids – Base Venn Diagram)

15.2

ACID → BASE

proton = ____ ion



## 15.2 Fill in Pg. 4 (Acids – Base Venn Diagram)

- Bromthymol blue is a pH indicator


**indicator** a compound that can reversibly change color depending on conditions such as pH

## 15.3

## Acids ~ hydronium ion

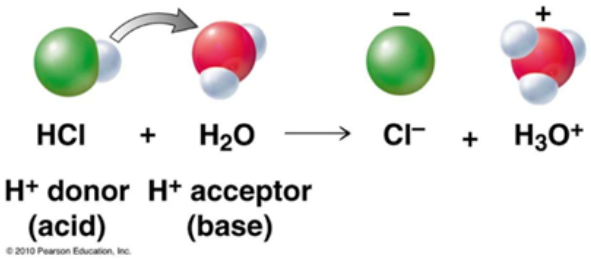
## Base ~ Hydroxide ion

- Pg. 5
- When dissolved in water, acid increases _____ ion concentration.
- Show how hydrochloric acid in water makes ions.

- What is a "strong acid"?
- Strong acid examples:
- Weak acid examples:

## Acid- Base Reaction: Bronsted – Lowry definition

- Draw the Bohr models. Show how the proton transfers. Show how the hydronium ion appears.




15.3

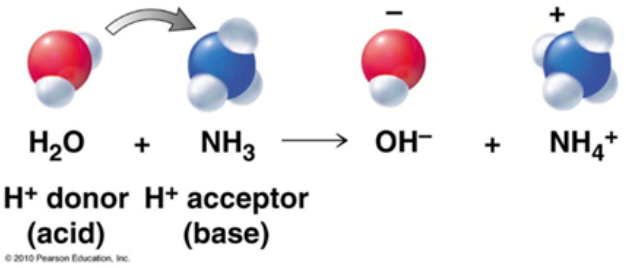
## Acids ~ hydronium ion

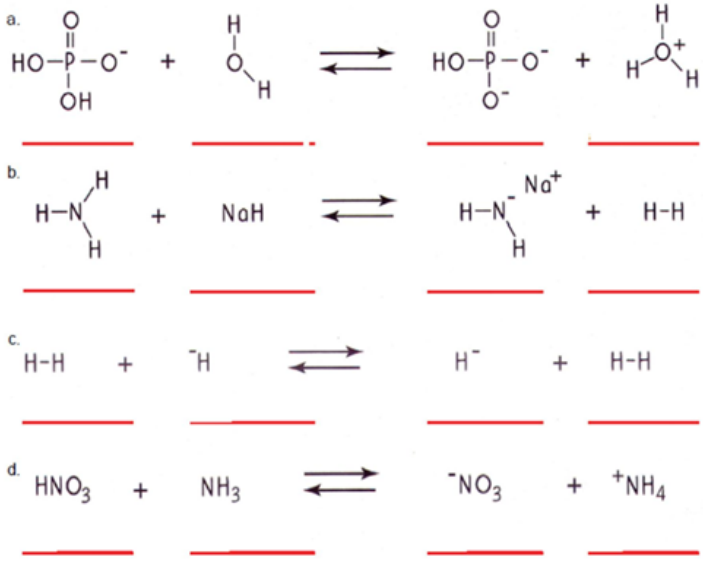
## Base ~ Hydroxide ion

- Pg. 5
- When dissolved in water, base increases _____ ion concentration.
- Show how sodium hydroxide decomposes into ions.
- Save room to show how ammonia makes OH- in water.
- What is a "strong base"?
- Strong base examples:
- Weak base examples:

## Acid- Base Reaction: Bronsted – Lowry definition

- Draw the Bohr models. Show how the proton transfers. Show how the hydronium ion appears.



## 15.3 Neutralization Reaction

- Idea

## Acid- Base Reaction (neutralization)

- Metal from base switches with hydrogen from acid

**TABLE 20.1** Acid–Base Reactions and the Salts Formed

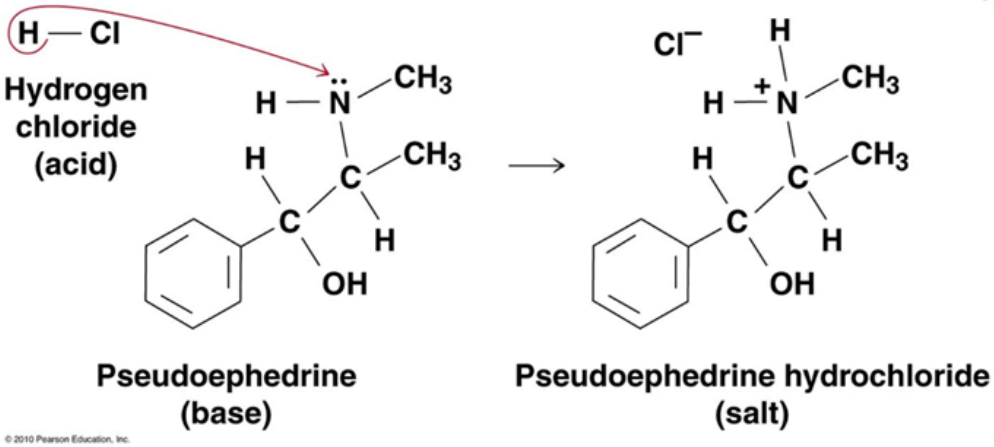
| Acid | | Base | | Salt | | Water | |
|---|---|---|---|---|---|---|---|
| HCN<br>Hydrogen cyanide | + | NaOH<br>Sodium hydroxide | → | NaCN<br>Sodium cyanide | + | $H_20$ | Poison |
| $HNO_3$<br>Nitric acid | + | KOH<br>Potassium hydroxide | → | $KNO_3$<br>Potassium nitrate | + | $H_20$ | Saltpeter |
| 2HCl<br>Hydrogen chloride | + | $Ca(OH)_2$<br>Calcium hydroxide | → | $CaCl_2$<br>Calcium chloride | + | $2H_20$ | De-ice |
| HF<br>Hydrogen fluoride | + | NaOH<br>Sodium hydroxide | → | NaF<br>Sodium fluoride | + | $H_20$ | Toothpaste |

## Acid- Base Reaction: Bronsted – Lowry definition

- Pg. 410
- Hydrogen chloride + sodium hydroxide → table salt + water


- Hydrogen chloride + potassium hydroxide →
  potassium chloride + water
- Sodium (Na) and potassium (K) are needed for our signals to flow along nervous system

## Medicine: Water-Soluble salt Can be ABSORBED



## Neutralization

- Is it a chemical or physical change?

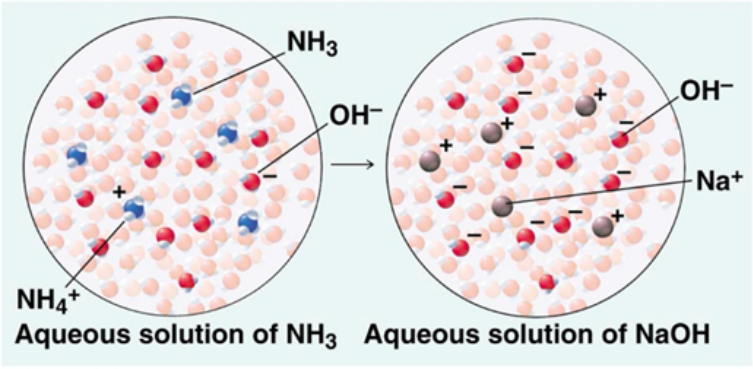
## 15.3 Neutralization Reaction (Pg. 6)

## Strength of Acid and Base

- Strong acid:
  - almost all donates $H^+$
  - and forms $H_3O^+$ (hydronium ion)
- Strong base:
  - almost all ~~donates~~ takes $H^+$ or splits into metal + $OH^-$
  - and forms $OH^-$ (hydroxide ion)
- Corrosive:
  - Strong acid in medium concentration
    - (not very corrosive if low concentration)
  - Weak acid in high concentration

## Strength of Acid and Base

- In these aqueous solutions, which is the stronger base?



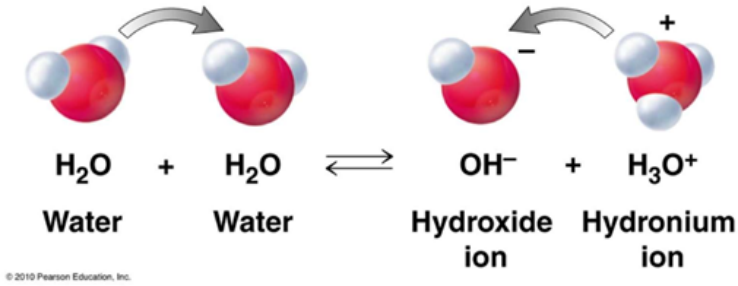

ammonia

sodium hydroxide

## 15.3 pH

- Both ways reaction

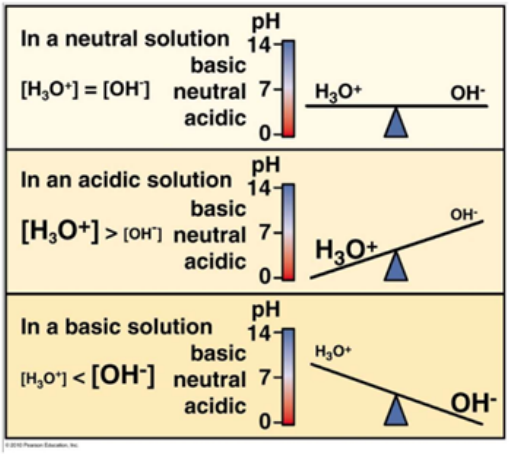
Acid or base?

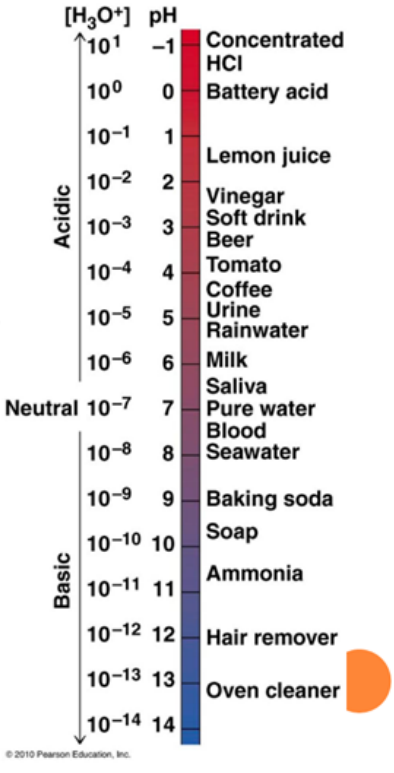



- Do water molecules react with one another?
- Is water neutral? Why?

## 15.3 pH

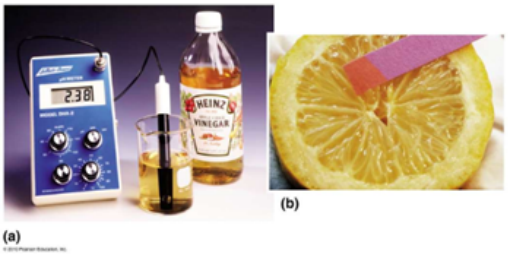
- Acidic solution
  - pH < 7
- Basic solution
  - pH > 7

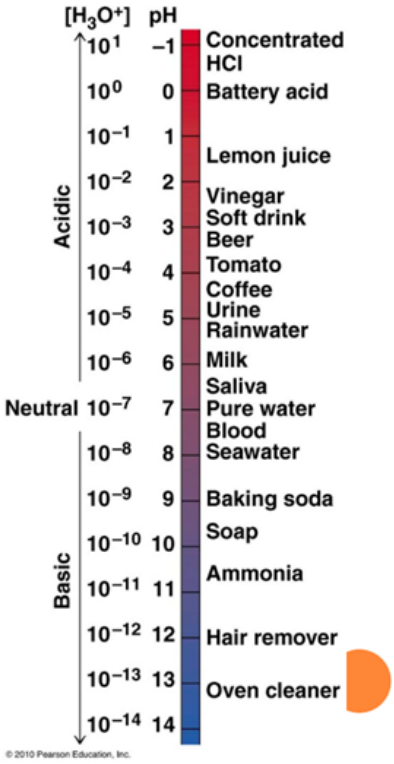


## 15.3 pH

- pH is used to describe acidity
  - $pH = -\log[H_3O^+]$
    - (molarity)




**On the back (blank) side of P. 7, please answer a few questions:**

## DEMO: Making Salt

- $HCl + NaOH \rightarrow NaCl + H_2O$
- http://www.youtube.com/watch?v=erWTsWut7Vc
  - No glove and high concentration is dangerous!!
  - http://www.youtube.com/watch?v=Iiu5mcAA8pU Great explanation
  - http://www.youtube.com/watch?v=erWTsWut7Vc

First, titration of NaOH and HCl with phenolphthalein
http://www.youtube.com/watch?v=8UiuE7Xx5l8

**#1 Making Salt:**
**a) Equation:**
**b) Type of reaction:**
**c) What is the phenolphthalein for?**
**d) See the second video. Is making salt an exo or endothermic reaction? How can you tell?**

## #2 Sulfuric Acid video:

**a) Why should you add acid to water? Include a description of the first demo and "hydrogen bonds".**

**b) Another name for sulfuric acid is _____ chemical formula: _____**

**Sketch here:**

**c) What does sulfuric acid do to sugar?**

**d) Why is sulfuric acid dangerous to organisms?**

**e) What is a fume hood?**

**f) Why is sulfuric acid made in millions of tons per year?**

Sulfuric Acid and Sugar
Fast
http://www.youtube.com/watch?=_gG0UAX3V7c&feature=player_embedded
Periodic table of videos
http://www.youtube.com/watch?v=100Bk580mPY&feature=player_embedded

15.3 pH

- pH and the Environment
  - Hydrangeas
    - Pink (high pH)  blue (low pH)

**Figure 4** *To grow blue flowers, plant hydrangeas in soil that has a low pH. To grow pink flowers, use soil that has a high pH.*

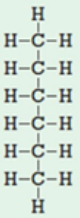
## 15.4 Organic Compounds

- Organic compound = covalent compounds with carbon-based molecules
- Why is carbon so diverse?

## 15.4 Carbon Backbones

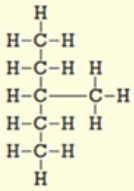
**Figure 1** Three Models of Carbon Backbones

**Straight chain**



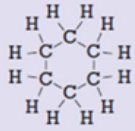
All carbon atoms are connected in a straight line.

**Branched chain**



The chain of carbon atoms branches into different directions when a carbon atom is bonded to more than one other carbon atom.

**Ring**



The chain of carbon atoms forms a ring.

## HYDROCARBONS = ORGANIC COMPOUNDS WITH ONLY C AND H

- Saturated hydrocarbon: each C has 4 single bonds
- Unsaturated hydrocarbon: double or triple bond
- Aromatic hydrocarbon: based on benzene

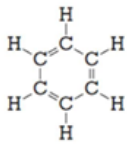
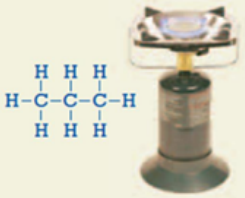


**Figure 3** *Benzene is the starting material for manufacturing many products, including medicines.*

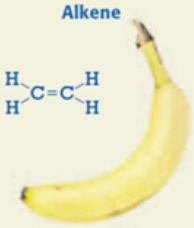
**Figure 2** **Three Types of Hydrocarbons**

**Alkane**



The **propane** in this camping stove is a saturated hydrocarbon.

**Alkene**



Fruits make **ethene,** which is a compound that helps ripen the fruit.

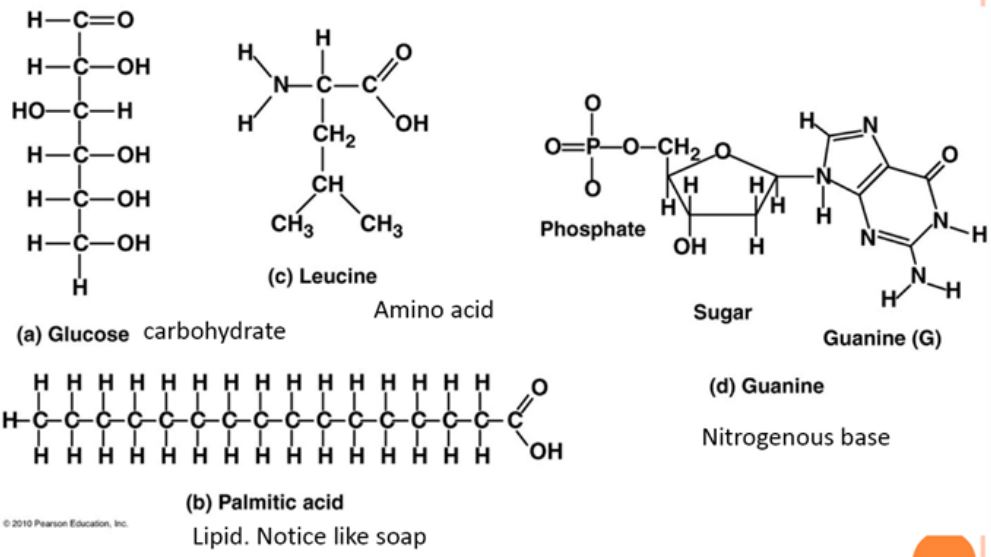
**Alkyne**

**Ethyne** is better known as acetylene. It is burned in this miner's lamp and in welding torches.

## #3 Please write down the 4 main biochemicals

### 15.4 BIOCHEMICALS

- Carbohydrates: food (sugars)
- Lipids: fats, oils, waxes (stores energy)
- Proteins: most cell molecules are proteins
- Nucleic Acids: (genes) instructions to build proteins




## 15.4 Biochemicals

- Carbohydrates
  - Sugars (food for energy)
  - glucose,
  - Cellulose (plant cell walls). Glycogen (energy to muscle cells)

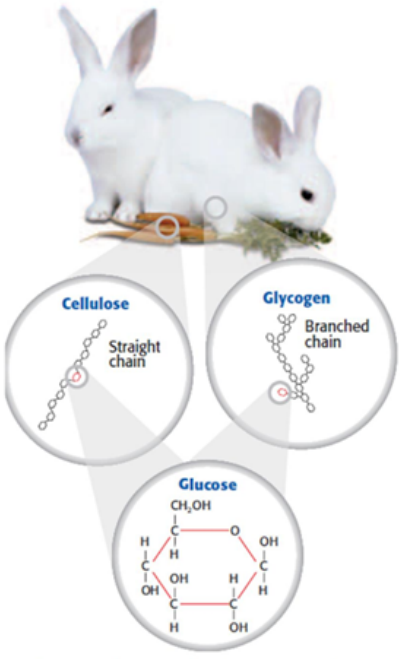
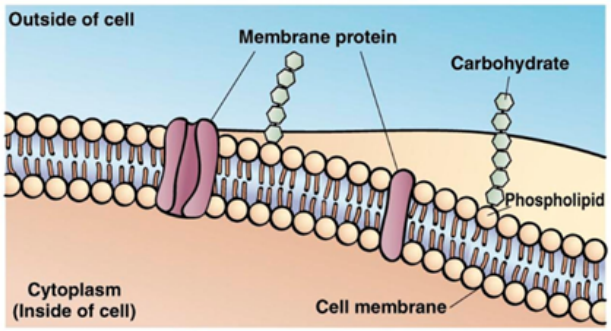



**Figure 4** *Glucose molecules, represented by hexagons, can bond to form complex carbohydrates, such as cellulose and glycogen.*

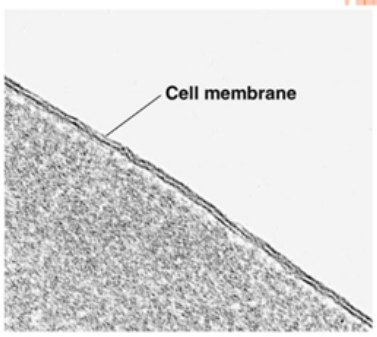
## 15.4 Biochemicals

- Lipids
  - Fats, oils, waxes (stores energy efficiently)
  - Cell membrane




(a)

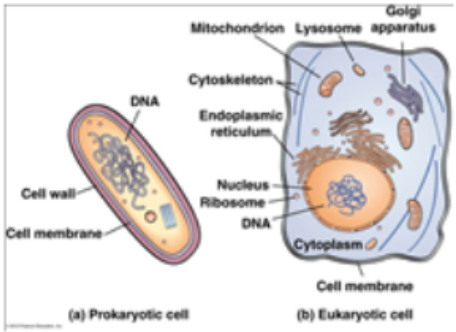





(b)

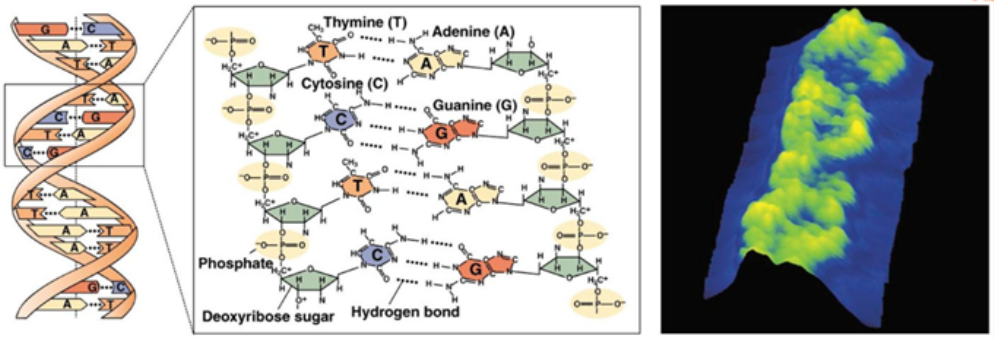
## 15.4 Biochemicals

- Proteins
  - Folded strings of amino acids
  - Amino acid = H, O, N, S
  - "gates" to cell membrane
  - Enzymes (catalysts), hormones, hemoglobin, hair structure
  - Only 20 amino acids are found in living things. (we can't make 8. eat)




## 15.4 Biochemicals

- Nucleic Acids: (genes) instructions to build proteins
  - DNA (deoxyribonucleic acid)
  - RNA (ribonucleic acid)
  - Nucleotides: molecules of C, H, O, N, P





## #4 Electrochemistry. Please write this down:

**Another kind of reaction:**

- **oxidation-reduction**
- **One compound gives an electron away to another.**

**1) Chemical reaction --> electrical energy**
**Battery**
**Electrolyte**

**2) Electrical energy --> chemical reaction**
**Electrolysis, electroplating**

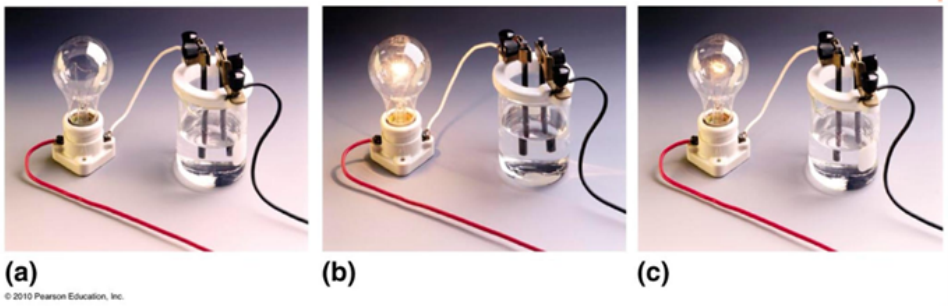
## 1) Chemical reaction --> electrical energy

**Battery**

**Electrolyte**

### #5 Why can electrolytes conduct current?

- electrolyte




Lemon Battery: Redox
http://www.youtube.com/watch?v=D23JH30ZMK0

## 2) Electrical energy --> chemical reaction

**Electrolysis, electroplating**

Water Electrolysis:
http://www.youtube.com/watch?v=HQ9Fhd7P_HA

### #6 Electrolysis

**a) What do you think the battery is for?**

**b) Which side is $H_2$? Which side is $O_2$? How can you tell?**

**c) Do not try this at home. Why do you think it is a bad idea to use salt water in electrolysis? (Hint: you will see a green gas emitted)**

**Did you know? Aluminum used to be more precious than gold!**

**Napolean served special guests with aluminum dinnerware instead of golden plates!**

**Electrolysis is used to purify aluminum from ore with small cost.**

| Year | Cost/pound (0.5 kg) |
|---|---|
| 1855 | $100,000/lb. |
| After electrolysis | |
| 1885 | 100 |
| 1890 | 2 |
| 1895 | 0.5 |
| 1970 | 0.3 |
| 1980 | 0.8 |
| 1990 | 0.74 |