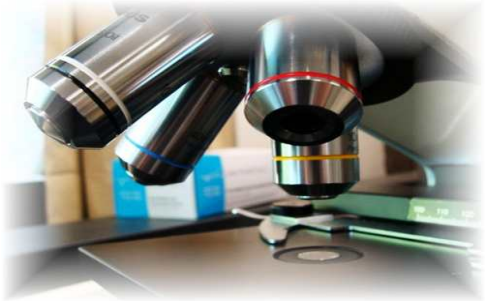

About Science Prof Online PowerPoint Resources

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• The SPO Virtual Classrooms offer many educational resources, including practice test questions, review questions, lecture PowerPoints, video tutorials, sample assignments and course syllabi. New materials are continually being developed, so check back frequently, or follow us on Facebook (Science Prof Online) or Twitter (ScienceProfSPO) for updates.

• Many SPO PowerPoints are available in a variety of formats, such as fully editable PowerPoint files, as well as uneditable versions in smaller file sizes, such as PowerPoint Shows and Portable Document Format (.pdf), for ease of printing.

• Images used on this resource, and on the SPO website are, wherever possible, credited and linked to their source. Any words underlined and appearing in blue are links that can be clicked on for more information. PowerPoints must be viewed in *slide show mode* to use the hyperlinks directly.

• Several helpful links to fun and interactive learning tools are included throughout the PPT and on the Smart Links slide, near the end of each presentation. You must be in *slide show mode* to utilize hyperlinks and animations.

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Image: Compound microscope objectives, T. Port

Chemistry 101

The Basics: Periodic Table, Bonds, pH & Molecules

WATCH THIS!

[Amazing Chemical Reactions]

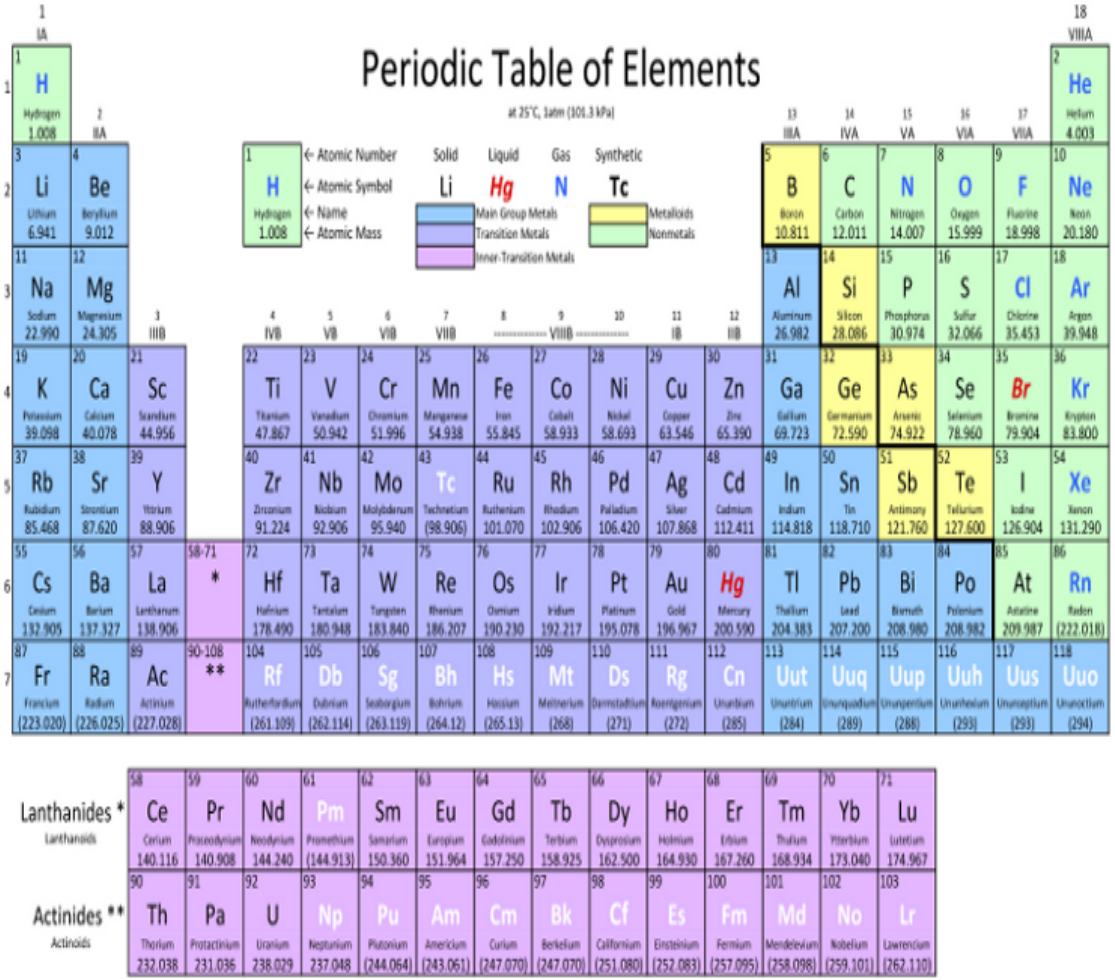


Image: Periodic Table of Elements

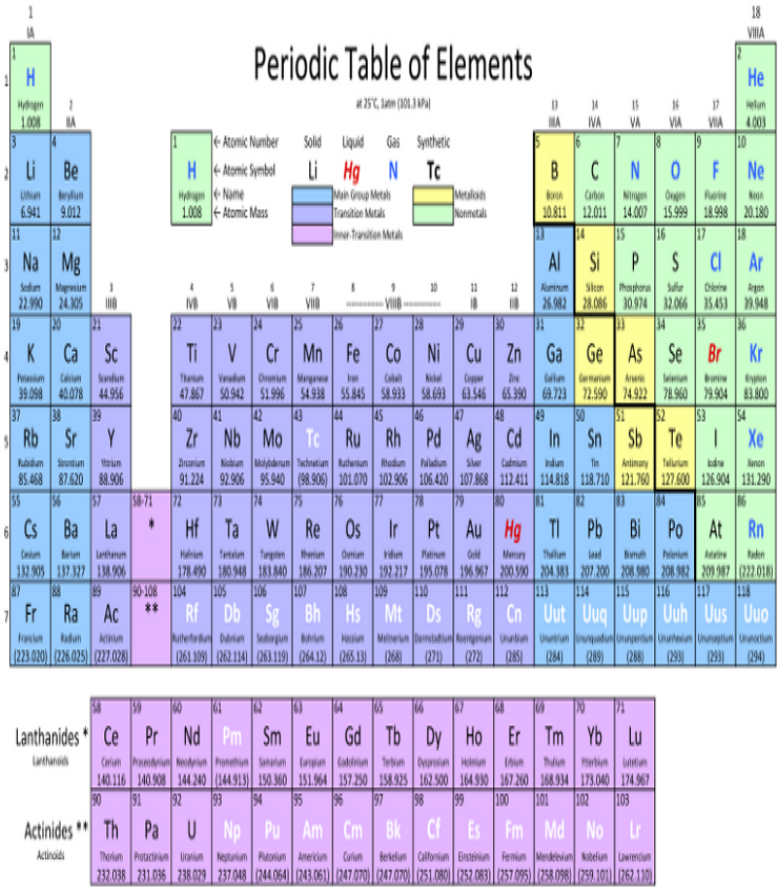
Elements, Atoms & Chemical Symbols

Elements: Substances that can't be broken down any further.

Atom: The smallest unit of an element.

Chemical Symbol:

- Begins with **one or two letters** based on elements name.
- ***Q:*** *What if there is more than one element that starts with the same letter?*
- Example: Carbon (C), Calcium (Ca), Chlorine (Cl)



WATCH THIS! Daniel Radcliff (Harry Potter) sings "The Element Song"!

Image: Periodic Table of Elements

The Structure of an Atom

Atoms are the basis for everything in the universe.

Q: *What are the three basic parts of an atom?*

- **?** = "+" positive charge.
  Part of the atomic nucleus.
  Repel each other.

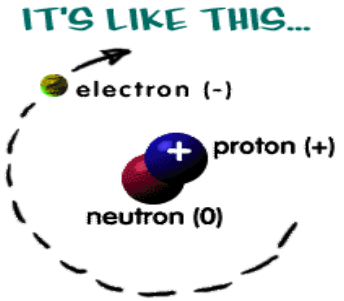
- **?** = neutral (a charge of zero).
  Part of the atomic nucleus.
  Separate protons, making an atom more stable.

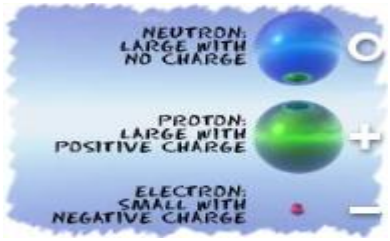
- **?** = "-" negative charge.
  Orbit nucleus in different shells, or energy levels.

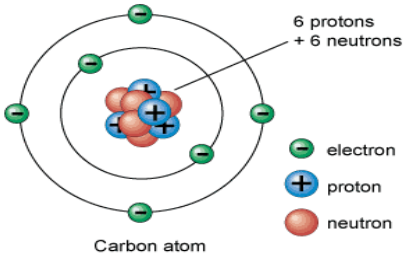
The thing that makes each element unique is the number of protons, since the number of neutrons and electrons can vary.

Q: *If there is an equal number of electrons and protons in an atom, what is it's charge?*

Here are some examples:







NERDY SCIENCE JOKE: A neutron walks into a bar and asks "How much for a drink?"

Q: What does the bartender tell him?

Images: Structure of Atom, Chem4Kids Website; Carbon, Universe Today Website

Protons & Neutrons:
Atomic Number, Mass Number & Atomic Mass

Atomic Number: The ***number of protons*** in the nucleus of an atom.

Q: *What is the atomic number of carbon?*

Atomic Mass: (aka atomic weight): The atomic mass of an element is rarely an even number. This happens because of the **isotopes**.

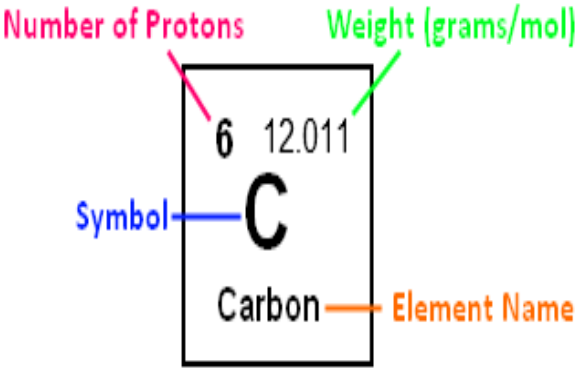
Many elements occur as **isotopes**. They vary in the # of **neutrons** they have.

When an atom has a different number of protons and neutrons, its nucleus becomes unstable.

Q: *What is the atomic mass of carbon?*

Mass Number: The number of protons, plus the number of neutrons.

Q: *How do we know the mass number, if the number of neutrons in an element may vary? Lets look at out Lab Exercise*

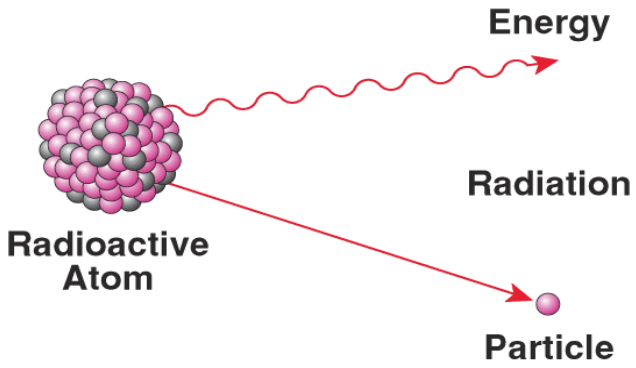


Atomic mass is calculated by figuring out the amounts of each type of atoms isotopes there are in the Universe.

Example: For carbon, there is a lot of C-12, some C-13, and some C-14 atoms. When you average out all of the masses, you get a number that is a little bit higher than 12 (the weight of a C-12 atom). The average atomic mass for Carbon is actually 12.011.

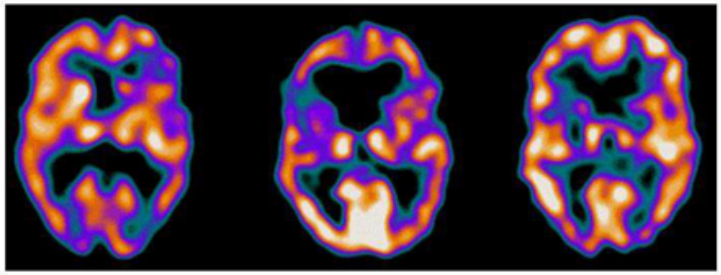
Let's listen to part of the Radiolab podcast episode "Elements" (starting at time 35:00) to learn more about the interesting new use of C-14.

Isotopes & Radioactivity



- Isotope is **radioactive** if nucleus is unstable.
- Most isotopes disintegrate spontaneously with the release of energy by processes of **nuclear** or **radioactive decay**.
- When the nucleus changes in structure, energy and/or subatomic particles are given off.
- Other than radioactivity, isotopes of an element behave similarly: They can participate in molecule / chemical reactions that involve that element.
- When controlled, radioactive isotopes can be valuable medical tools. (Ex. Gamma camera can produce images of soft tissue when radiopharmaceuticals are injected into or ingested by patient.)

1. Schizophrenic female
2. Female with depression
3. Healthy female



What about electrons?

In a neutral atom, there are the same number of protons (+) and electrons (-).

Electrons orbit around the atomic nucleus in **shells**.

The inner shell of an atom, closest to the nucleus, can have a maximum of two electrons.

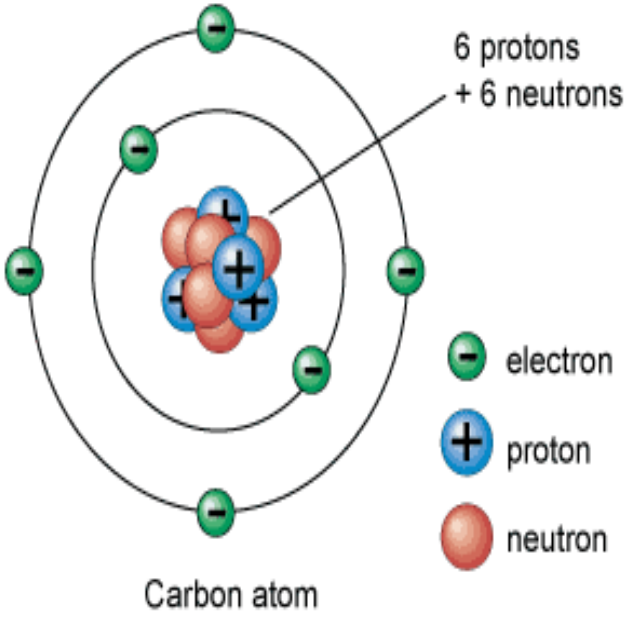
The outermost shell is called the valence shell.

Eight (8) is the max number of valence electrons for a full valence shell.

Number of valence electrons governs an atom's bonding behavior.

Atoms are much more stable, or less reactive, with a full valence shell.

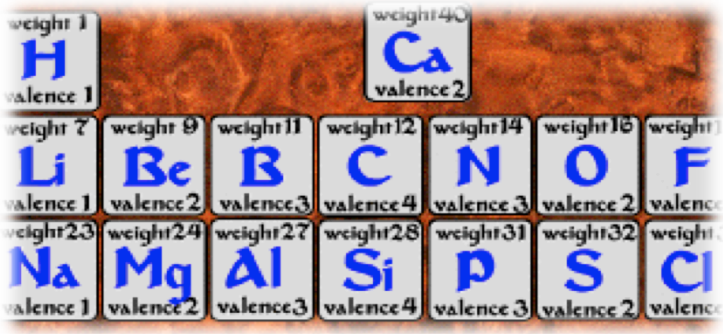
By moving electrons, the two atoms become linked. This is known as **chemical bonding**.

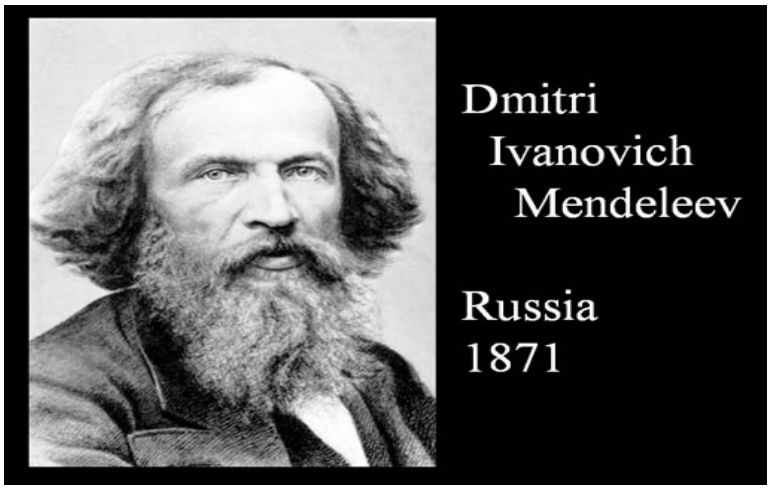


See Rader's Chem4Kids web page on the Periodic Table. Their explanations are extremely helpful!

Images: Carbon, Universe Today Website

The Periodic Table

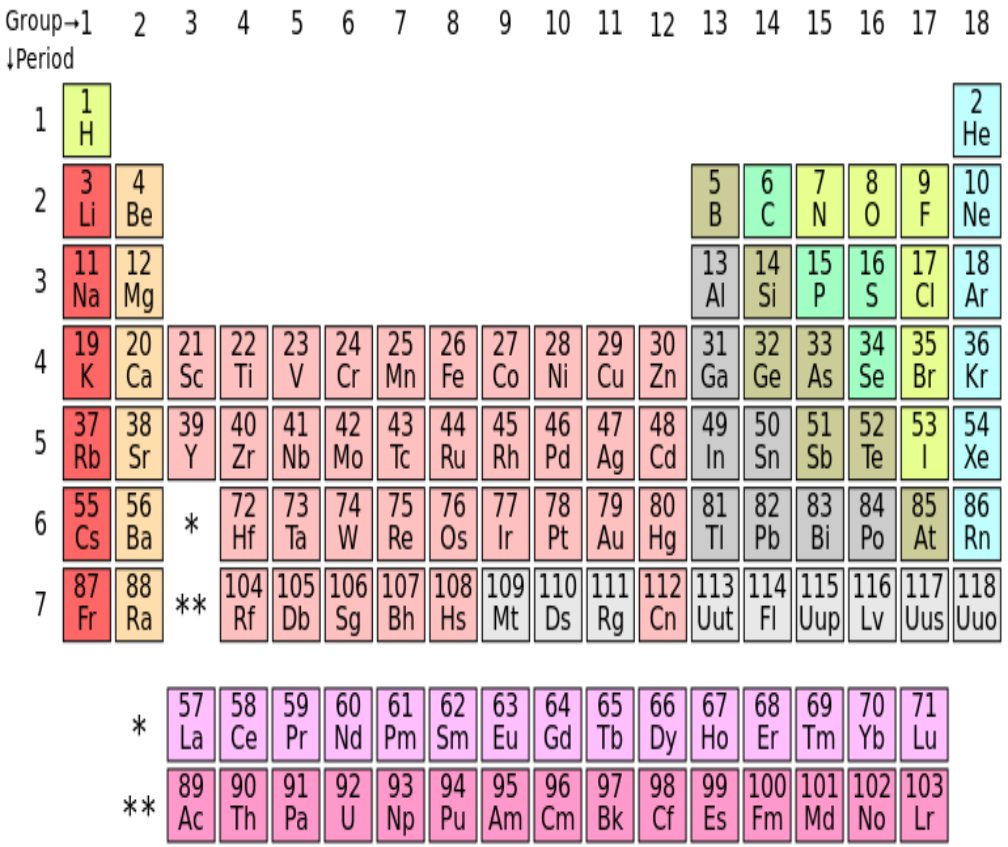




Dmitri Ivanovich Mendeleev
(1834 –1907)

Russian chemist and inventor.

Formulated Periodic Law.
Created his own version of the periodic table of elements, and used it to correct the properties of some already discovered elements and to predict the properties of eight elements that had not been discovered yet.



Listen to Radiolab podcast segment on Mendeleev and the periodic table from the episode
"Yellow Fluff and Other Curious Encounters"
(starting at 4:30 into the podcast).

Go to the SPO Virtual Biology Classroom to find a homework assignment based on this podcast.

Image: Periodic Table of Elements

Electrons:

How can I determine the number of **electron shells**? Period ! ⬇

Electrons in an atom are located in different shells or **energy levels**.

Each ROW of the periodic table is called a **Period**.

Period Rule 1: All of the elements in a **Period** have the same number of electron shells.

For example, every element in the top row (the first period) has one shell for its electrons. All elements in the second row (the second period) have two shells for their electrons.

Period Rule 2: As you move down the table, every row adds a shell, up to seven.

Period Rule 3: The innermost (closest to the nucleus) shell of all atoms (other than hydrogen) has two electrons.

Period Rule 4: The electrons in the outermost shell are called **valence electrons**.

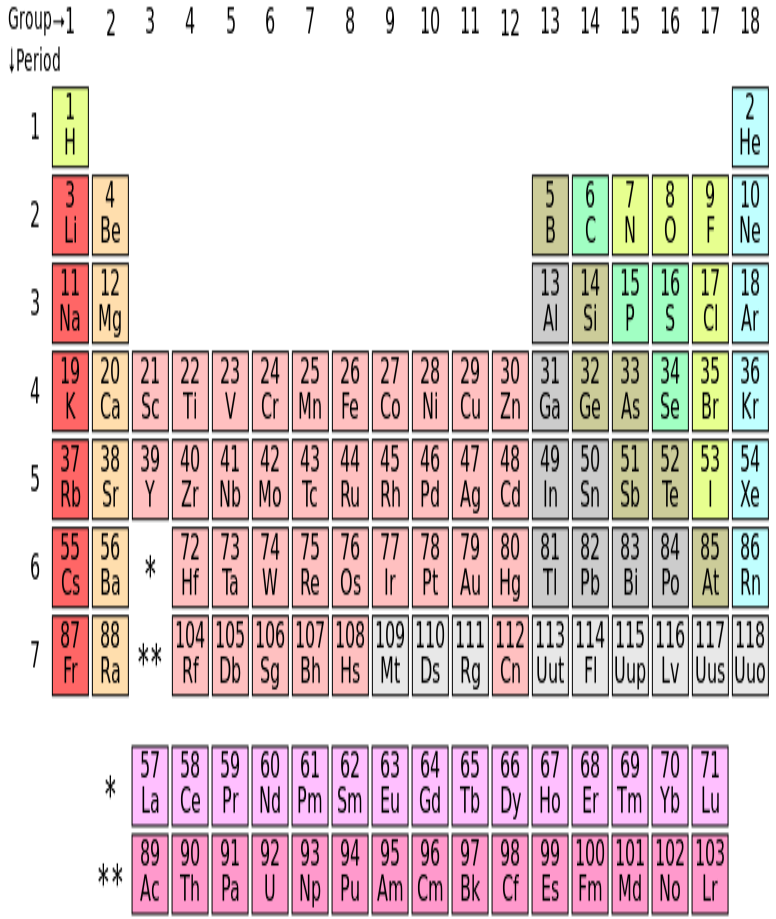


Image: Periodic Table of Elements

Electrons:

How can I determine the number of **outer shell electrons**? Group! ➡

Electrons in the outermost shell are called **valence electrons**.

Each COLUMN of the periodic table is called a **Group**.

Group Rule 1: All elements in the same **Group** (vertical column) have the same number of valence electrons.

Group Rule 2: As you move across the table, (ignoring columns 3 – 12, the transition elements) every row adds a valence electron, up to 8.

Key! If you know the number of shells and valence electrons, you can draw an **electron shell diagram** for any of the non-transitional elements.

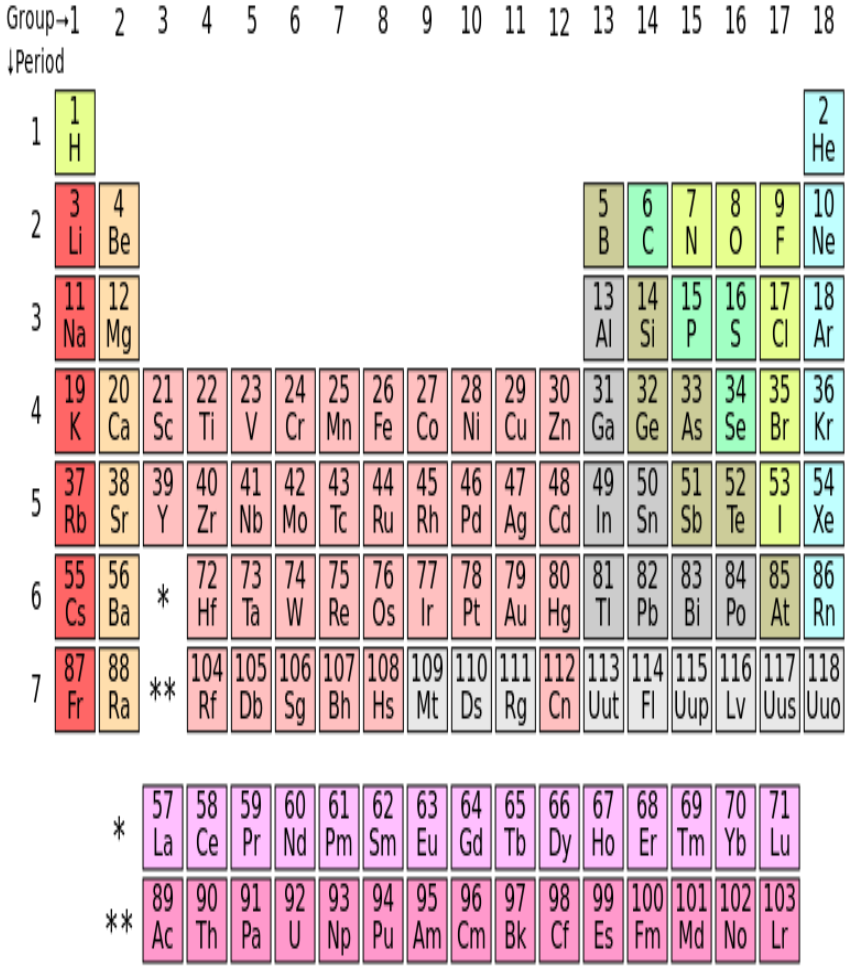


Image: Periodic Table of Elements

Remind me why we care about these valence electrons…

Number of valence electrons governs an atom's bonding behavior.

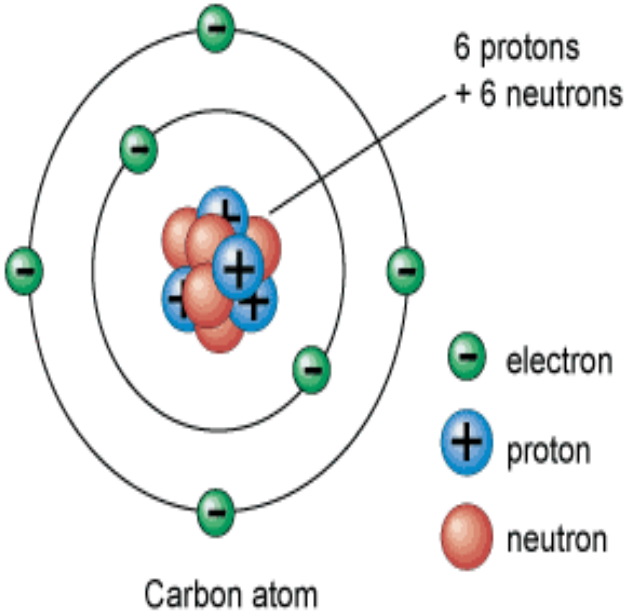
Eight (8) ***is the max number of valence electrons for a full valence shell.***

Atoms are much more stable, or less reactive, with a full valence shell.

By moving electrons, the two atoms become linked. This is known as **chemical bonding**.

This stability can be achieved one of two ways:

- **Ionic** bond
- **Covalent** bond



See Rader's Chem4Kids web page on the Periodic Table. Their explanations are extremely helpful!

Images: Carbon, Universe Today Website

Let's listen to "The Periodic Table: Rapping the Elements"

Periodic Table of Elements

at 25°C, 1atm (101.3 kPa)

	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1 H Hydrogen 1.008																	2 He Helium 4.003
2	3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
3	11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948
4	19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.390	31 Ga Gallium 69.723	32 Ge Germanium 72.590	33 As Arsenic 74.922	34 Se Selenium 78.960	35 Br Bromine 79.904	36 Kr Krypton 83.800
5	37 Rb Rubidium 85.468	38 Sr Strontium 87.620	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.940	43 Tc Technetium (98.906)	44 Ru Ruthenium 101.070	45 Rh Rhodium 102.906	46 Pd Palladium 106.420	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.600	53 I Iodine 126.904	54 Xe Xenon 131.290
6	55 Cs Cesium 132.905	56 Ba Barium 137.327	57 La Lanthanum 138.906	58-71 *	72 Hf Hafnium 178.490	73 Ta Tantalum 180.948	74 W Tungsten 183.840	75 Re Rhenium 186.207	76 Os Osmium 190.230	77 Ir Iridium 192.217	78 Pt Platinum 195.078	79 Au Gold 196.967	80 Hg Mercury 200.590	81 Tl Thallium 204.383	82 Pb Lead 207.200	83 Bi Bismuth 208.980	84 Po Polonium 208.982	85 At Astatine 209.987	86 Rn Radon (222.018)
7	87 Fr Francium (223.020)	88 Ra Radium (226.025)	89 Ac Actinium (227.028)	90-108 **	104 Rf Rutherfordium (261.109)	105 Db Dubnium (262.114)	106 Sg Seaborgium (263.119)	107 Bh Bohrium (264.12)	108 Hs Hassium (265.13)	109 Mt Meitnerium (268)	110 Ds Darmstadtium (271)	111 Rg Roentgenium (272)	112 Cn Ununbium (285)	113 Uut Ununtrium (284)	114 Uuq Ununquadium (289)	115 Uup Ununpentium (288)	116 Uuh Ununhexium (293)	117 Uus Ununseptium (293)	118 Uuo Ununoctium (294)

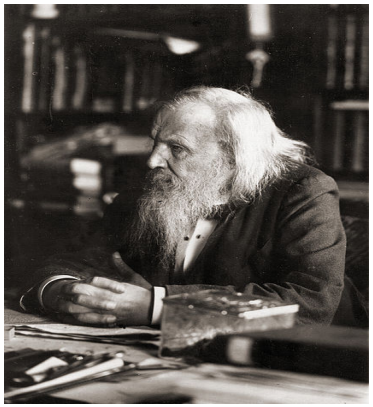
← Atomic Number
← Atomic Symbol
← Name
← Atomic Mass

Example: 1 H Hydrogen 1.008

Solid: Li
Liquid: Hg
Gas: N
Synthetic: Tc

Main Group Metals
Transition Metals
Inner-Transition Metals
Metalloids
Nonmetals

Lanthanides * Lanthanoids	58 Ce Cerium 140.116	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.240	61 Pm Promethium (144.913)	62 Sm Samarium 150.360	63 Eu Europium 151.964	64 Gd Gadolinium 157.250	65 Tb Terbium 158.925	66 Dy Dysprosium 162.500	67 Ho Holmium 164.930	68 Er Erbium 167.260	69 Tm Thulium 168.934	70 Yb Ytterbium 173.040	71 Lu Lutetium 174.967
Actinides ** Actinoids	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium (244.064)	95 Am Americium (243.061)	96 Cm Curium (247.070)	97 Bk Berkelium (247.070)	98 Cf Californium (251.080)	99 Es Einsteinium (252.083)	100 Fm Fermium (257.095)	101 Md Mendelevium (258.098)	102 No Nobelium (259.101)	103 Lr Lawrencium (262.110)



From the Virtual Cell Biology Classroom on ScienceProfOnline.com

Images: Periodic Table of Elements; Mendeleev, Wiki

Chemical Bonds, Reactions & Notation

Making Molecules & Compounds

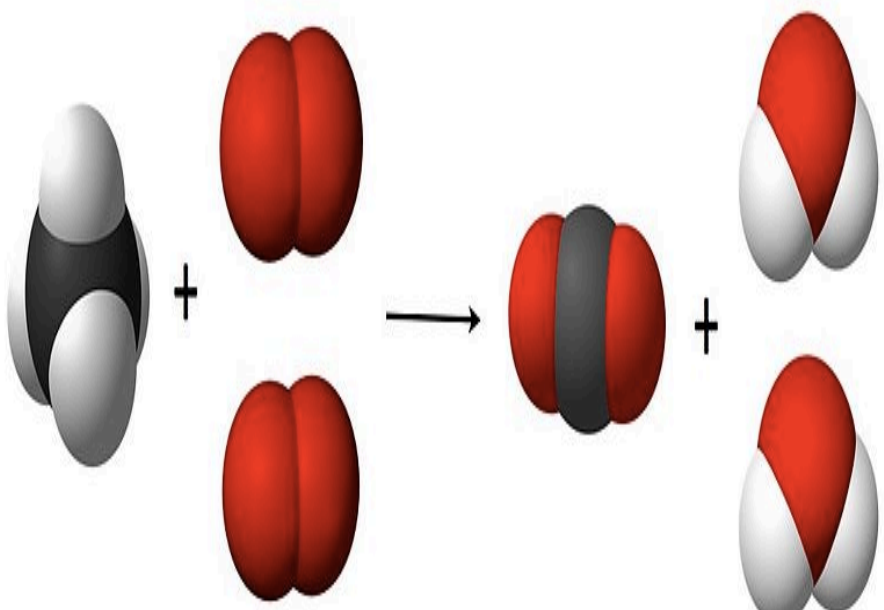


Image: Combustion Reaction of Methane, Wiki

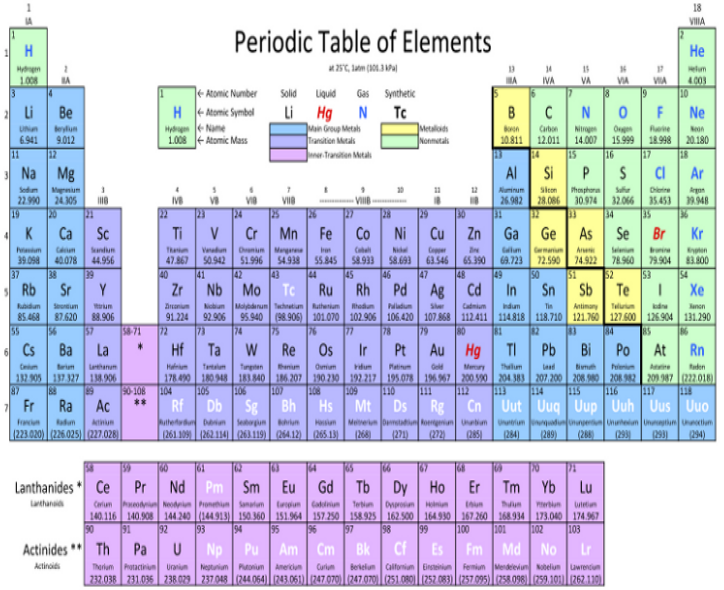
Chemical Shorthand

Chemical Symbol

- Begins with **one or two letters** based on elements name.

- ***Q:*** *What if there is more than one element that starts with the same letter?*

- Example: Carbon (C), Calcium (Ca), Chlorine (Cl)



Chemical Formula

- "Shorthand" for a compound.

- Contains chemical symbols of the elements that make up the molecule.

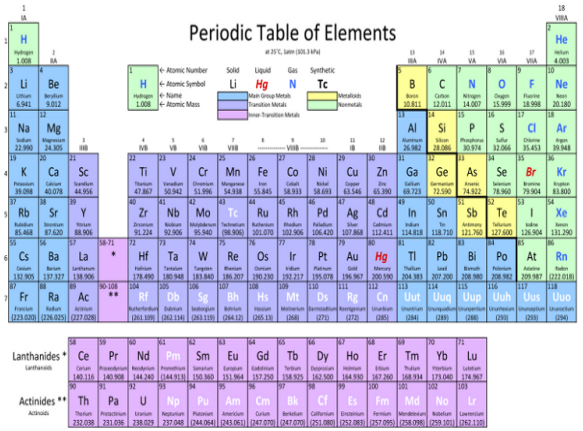
- Numerical subscripts represent number of atoms of each element in molecule.
  Example: ***H_2O*** *= water; has two hydrogen atoms and one oxygen.*

- More than one molecule of same type…the group of letters is preceded by number.
  Example ***$2H_2O$*** *= two water molecules.*

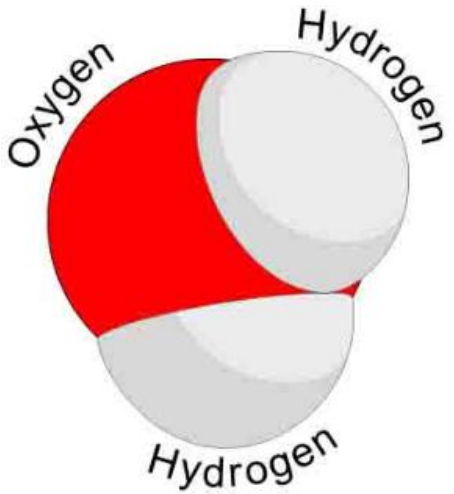
Image: Periodic Table of Elements

Elements, Atoms, Molecules & Compounds

- **Elements** → Substances that can't be broken down any further.



- **Atom** → The smallest unit of an element.
- Two or more atoms joined together chemically: **Molecule**
- Molecule containing at least two different
- Elements: **Compound**
- ***Examples of molecules:*** Carbon dioxide (CO_2) and methane (CH_4), molecular hydrogen (H_2), molecular oxygen (O_2) and molecular nitrogen (N_2).



- ***Examples of compounds***: Only molecules containing two or more elements, such as carbon dioxide (CO_2) and methane (CH_4).
- ***Q: Explain why all compounds are molecules but not all molecules are compounds.***

Image: Periodic Table of Elements; Water Molecule, Wiki

Chemical Bonding and Electron Valences

The electrons in an atom are located at different **energy levels**.

Electrons in the highest energy level are called **valence electrons**.

Number of valence electrons governs an atom's bonding behavior.

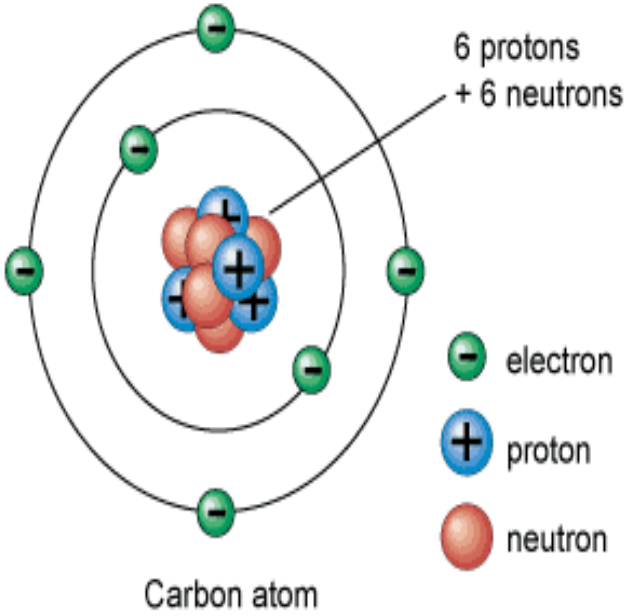
Q: What is the max number of valence electrons for a full valence shell?

Atoms are much more stable, or less reactive, with a full valence shell.

By moving electrons, the two atoms become linked. This is known as **chemical bonding**.

This stability can be achieved one of two ways:

- **Ionic** bond
- **Covalent** bond



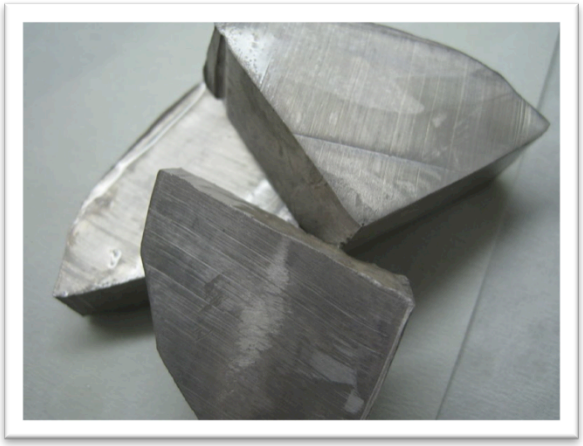
Watch Video:
Bill Nye
The Science Guy
on Chemical Reactions

Images: Carbon, Universe Today Website

Compounds Have Their Own Properties

Compound has physical and chemical characteristics unique from the elements that make it up

Example: NaCl



Sodium Metal: Na

Chlorine Gas: Cl

Sodium Chloride: NaCl

Click here to watch this reaction in action!

Image: Sodium Metal, Chlorine gas, Sodium Chloride in shaker, Wiki

Types of Chemical Bonds:

1. **Ionic**
2. Covalent

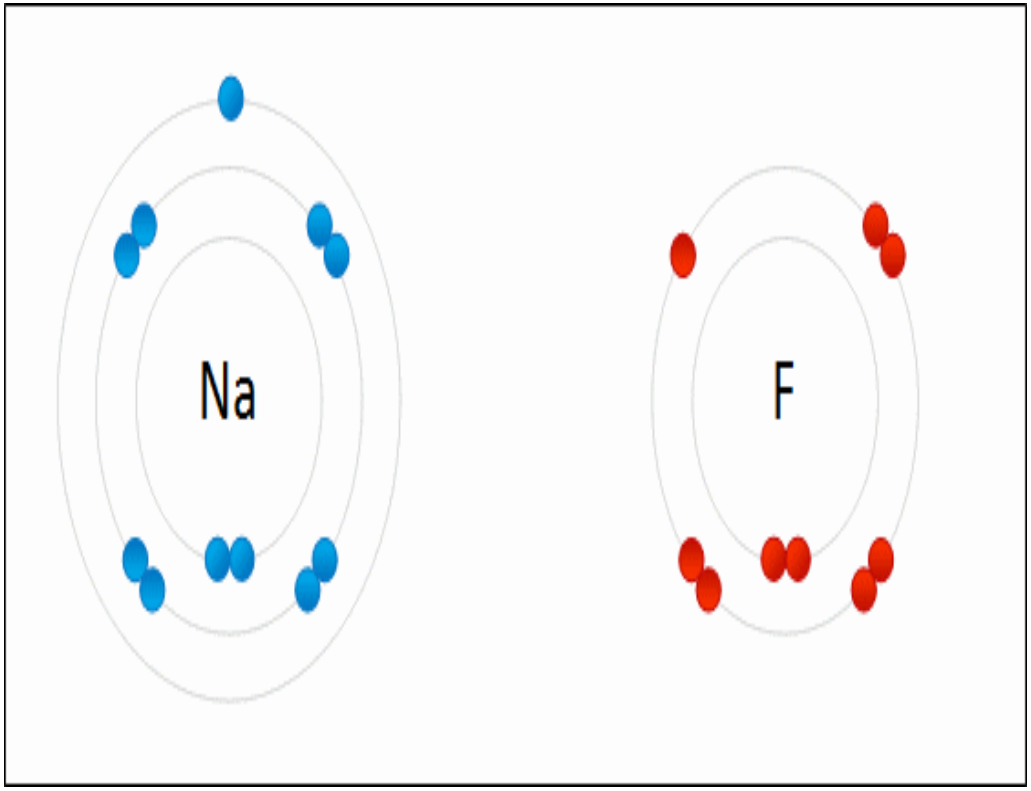


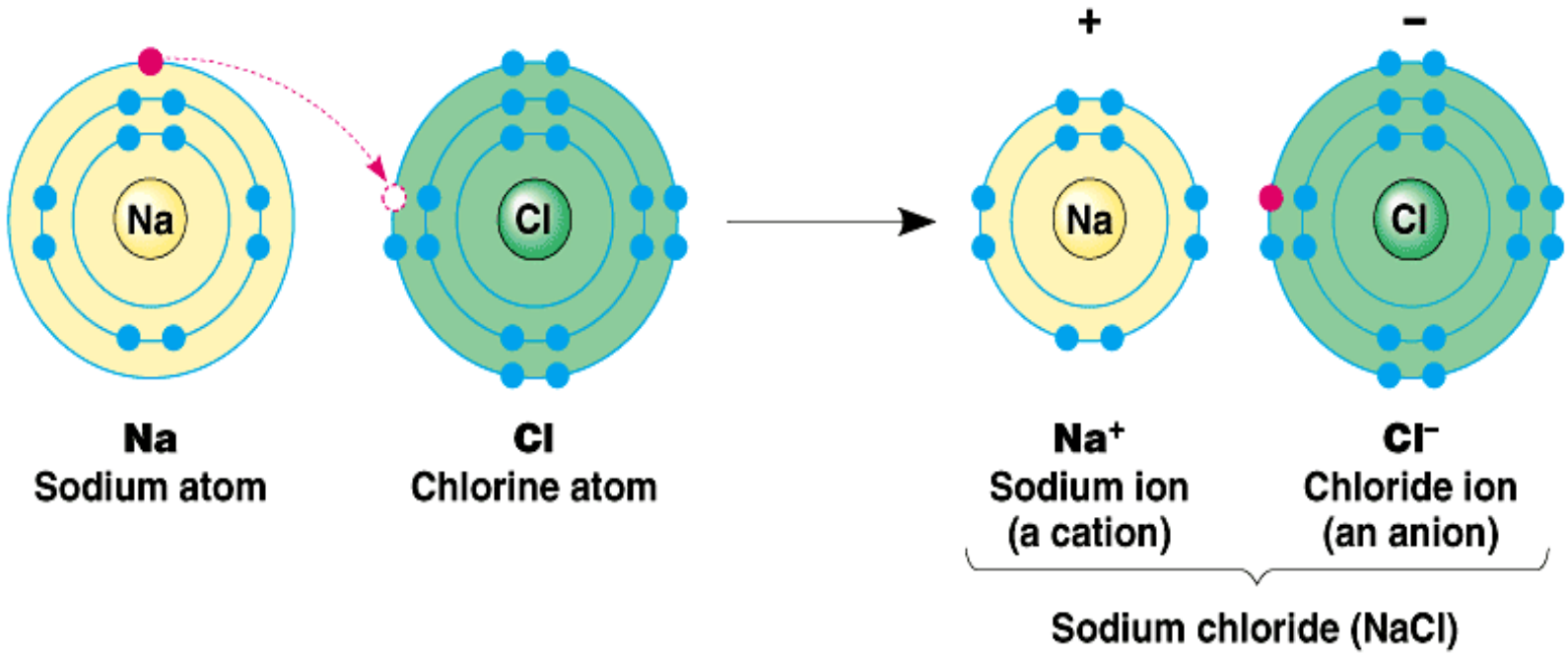
Image: Formation of ionic sodium fluoride, Wdcf

Ionic Bonds

Click here for Ionic Bonding Animations

Involves transfer of electrons between two atoms.

Found mainly … inorganic compounds.

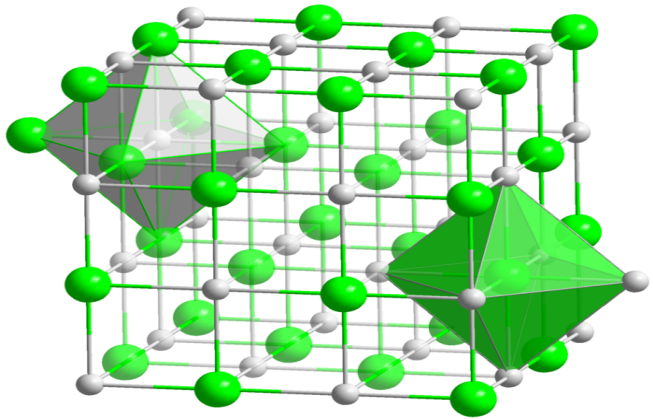


Ion = an atom or group of atoms which have lost or gained one or more electrons, making them negatively or positively charged.

***Q**: What are positively charged ions (+) called?*

***Q**: What are negatively charged ions (-) called?*

Ionic compounds are made of oppositely charged ions



- Ionic Bonds are atoms held together by attraction between a **(+) and a (–) ion**
- **Compound is neutral overall,** but still charged on the inside.
- Makes solid crystals.

Images: Halit crystal, Crystal structure of NaCl, Wiki

Everyday Science

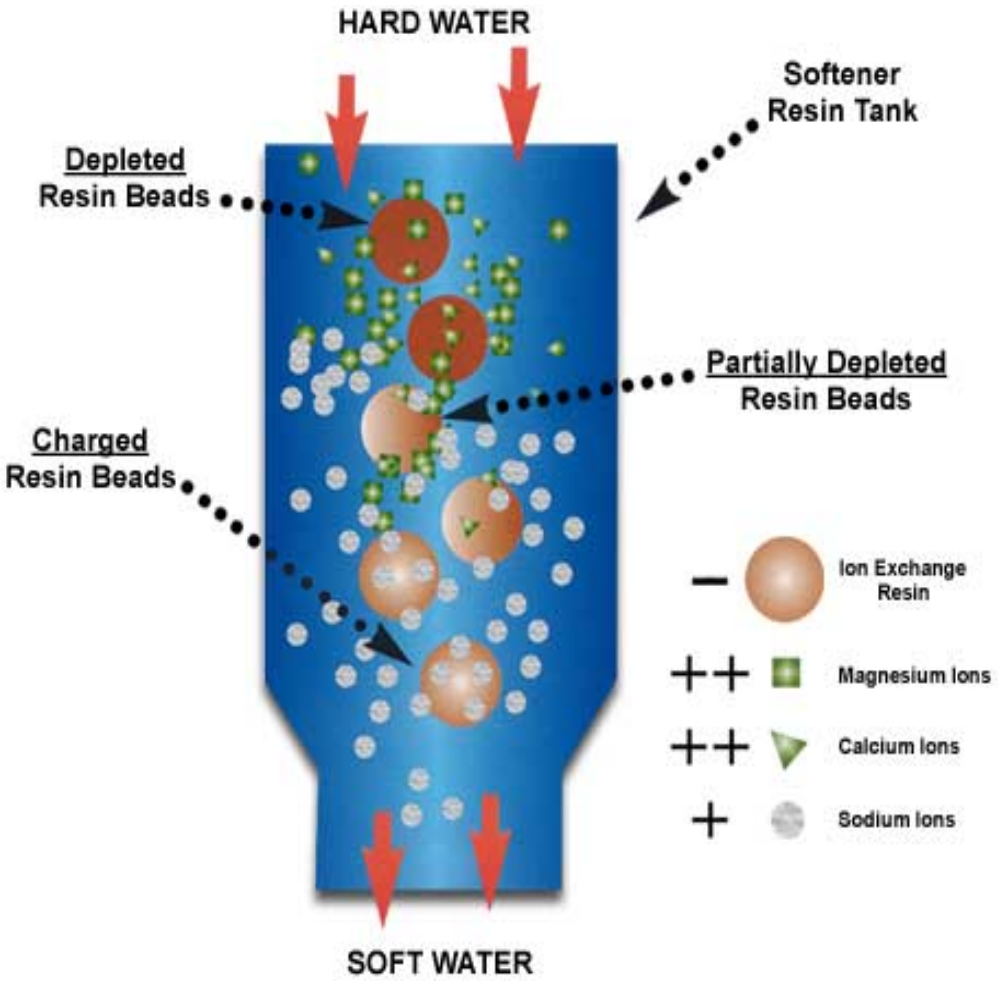
Reactions Involving Ions

Remember… ion = an atom which has lost or gained one or more electrons, so it's negatively or positively charged.

The Principle of

ion exchange

is a common water softening method.



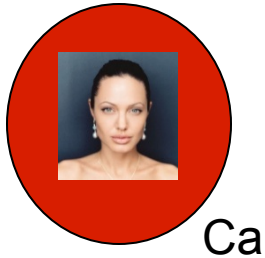
Lets use a **Branganalogy** to help us Understand the Concept of Ion Exchange…

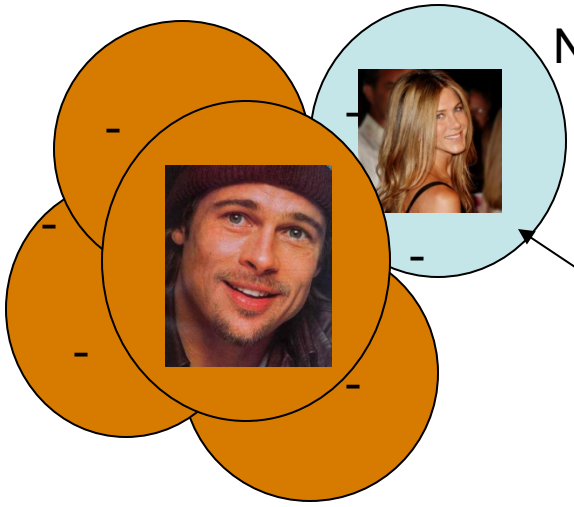
1. Brad Pitt is a negatively charged resin bead

2. Jennifer Anniston is a positively charged Sodium Ion

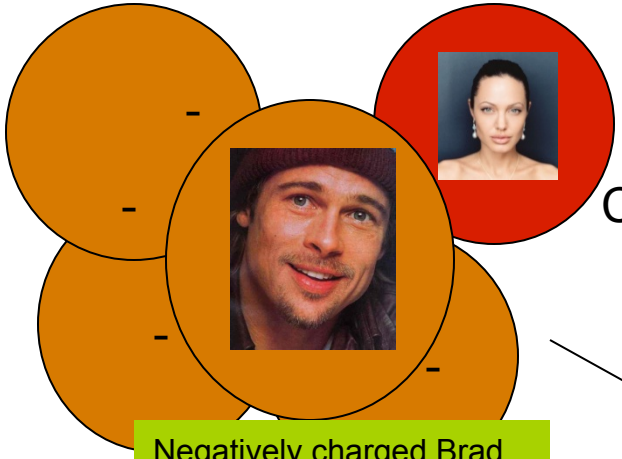
Now lets say that 'positiveness' equates with 'drop-dead gorgeousness'

3. Angelina Jolie is a positively charged Calcium Ion

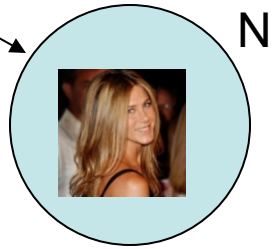




Negatively charged Brad is attracted to reasonably positive Jennifer.



Negatively charged Brad lets go of reasonably positive Jennifer in the presence of insanely positive Angelina.



Importance of Ions/Electrolytes in the Body:

K^+ ,Na^+, Cl^-

- Carry electrical impulses in the nervous system
- Maintain cellular function with the correct concentrations electrolytes
- **Watch This!**
  "Brawndo" Video Clip
  from movie Idiocracy.

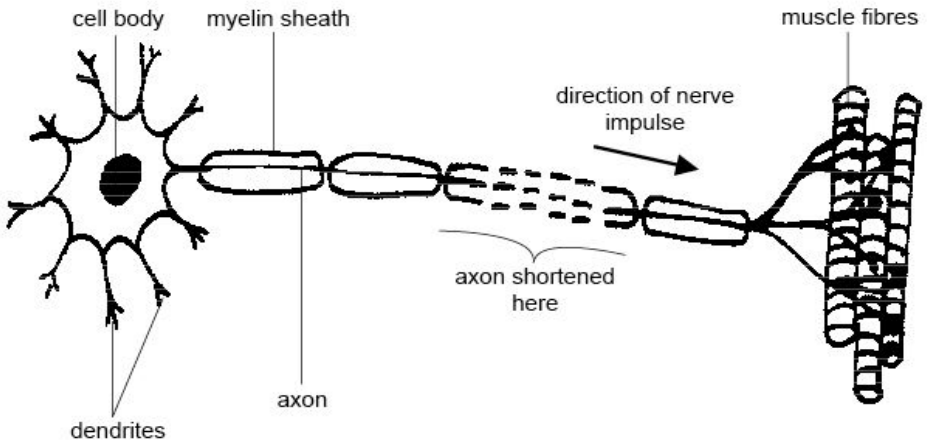
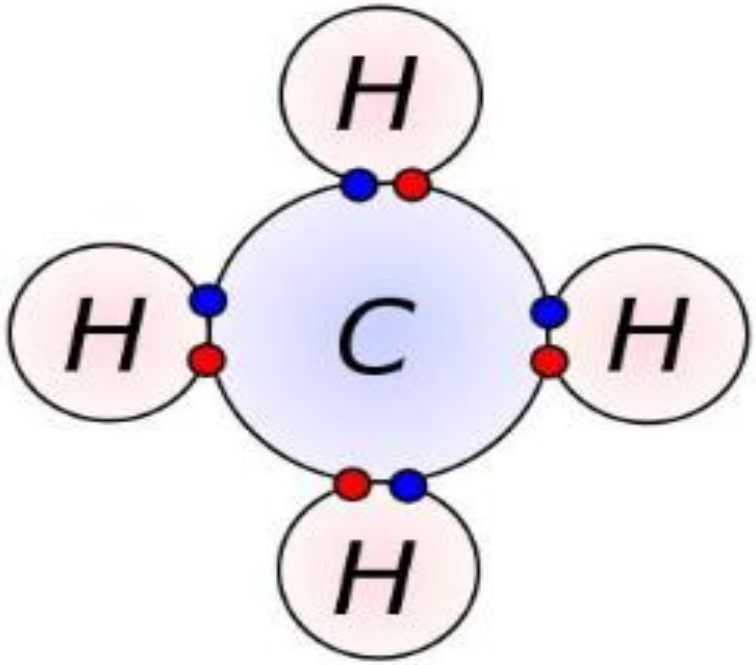


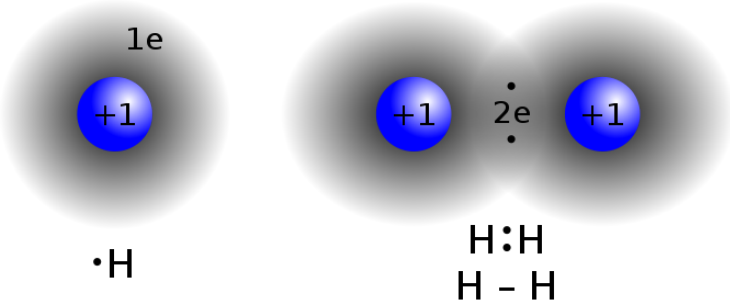
Image: Motor neuron, Wiki

Types of **Chemical Bonds**:

1. Ionic

2. **Covalent**





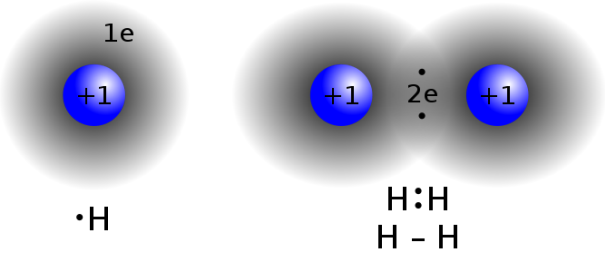
Covalent Bonds

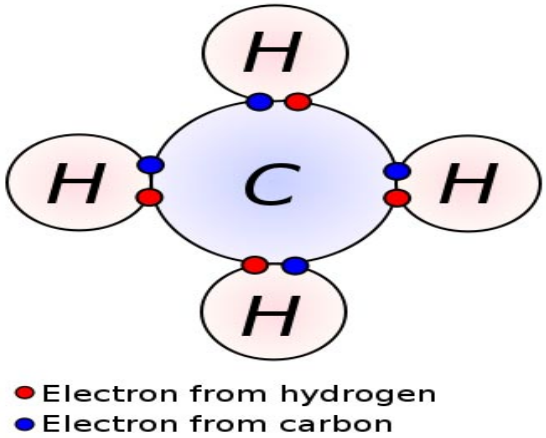
Involves the sharing of a pair of electrons between atoms.

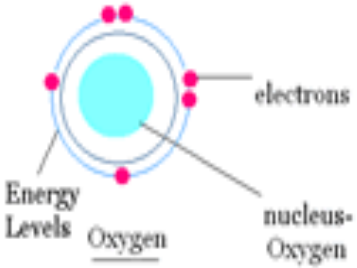
One covalent bond = 1 pair of shared electrons.

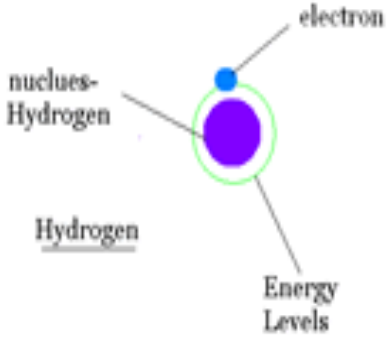
Covalent Compounds can make single (2 electrons), double (4 electrons) or even triple bonds (6 electrons) depending on the number of electrons they share.

Found mainly … organic compounds









If combined you get...

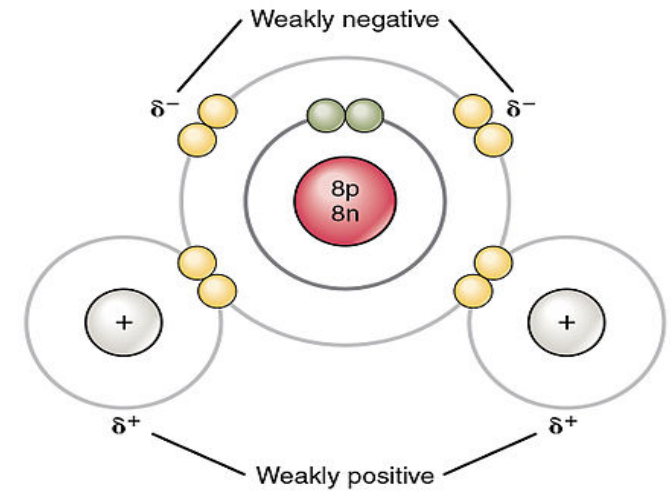
H_2O

Because the Oxygen and Hydrogen are sharing two electrons. It has two have two Hydrogen Atoms , because Hydrogen only has one electron.

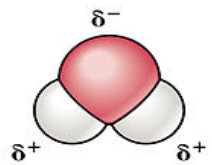
Image: Covalent Bond H2; Methane Covalent Bonds, Dynablast, Wiki

Polar vs. Non-Polar Covalent Bonds

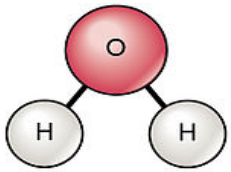
Polar molecules unequally share electrons between atoms, so have a slight positive charge at one end and a slight negative charge at the other.



(a) Planetary model of a water molecule



(b) Three-dimensional model of a water molecule



(c) Structural formula for water molecule

Non-polar molecules have electrons equally shared between their atoms.

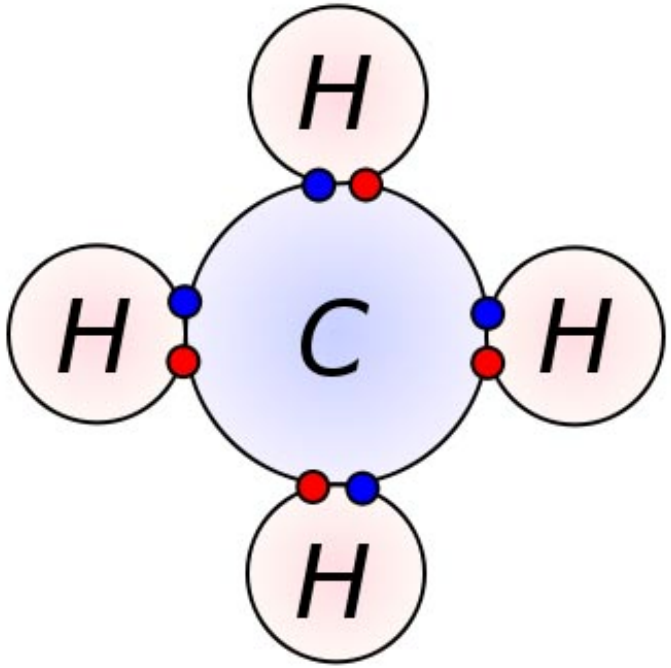
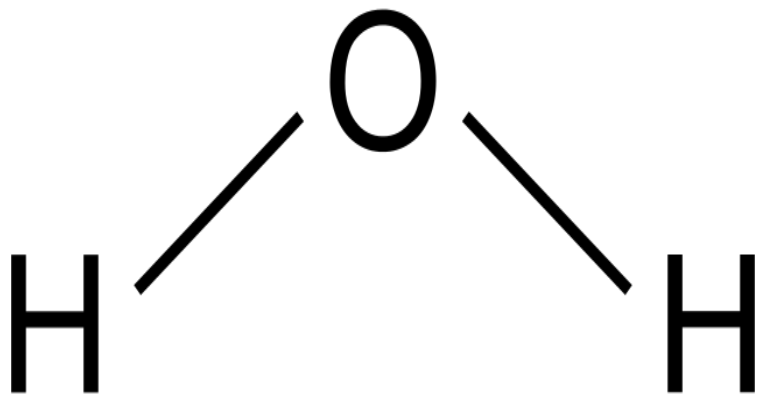


Image: Polar water molecule, Non-polar methane molecule, Wiki

Water is a very common covalent compound. The lines between the O and H's indicate a covalent bond



Click here to watch a video that compares Ionic and Covalent Bonds!

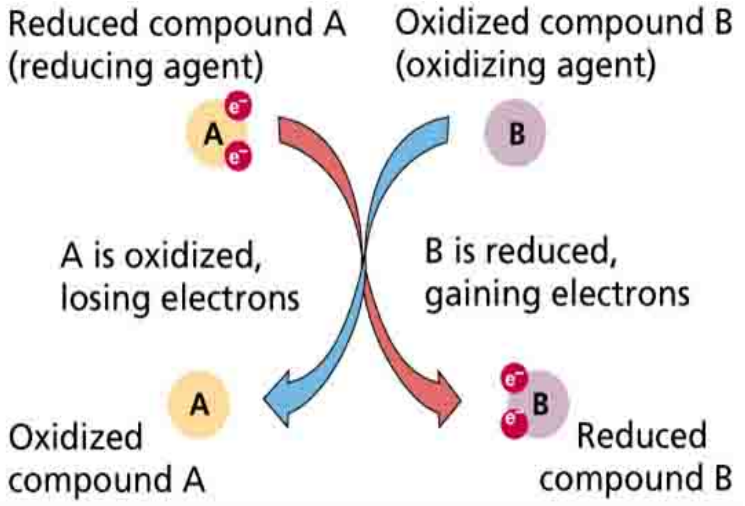
Image: 2-D diagram of H20 molecule, 3-D diagram of Water Molecule, Wiki

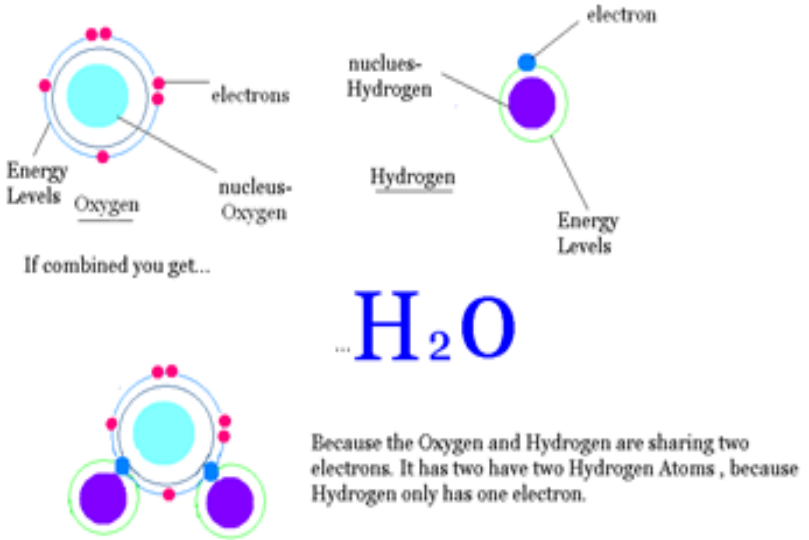
Oxidation - Reduction Reactions

- Or **Redox** reaction = chemical reactions in which electrons are ***gained, lost*** (*Q: What kind of bond?*) or ***shared*** (*Q: What kind of bond?*) in a chemical reaction.

- **oxidation**: ***loss*** of electrons by a molecule, atom or ion.

- **reduction**: ***gain*** of electrons by a molecule, atom or ion.





Oil Rig

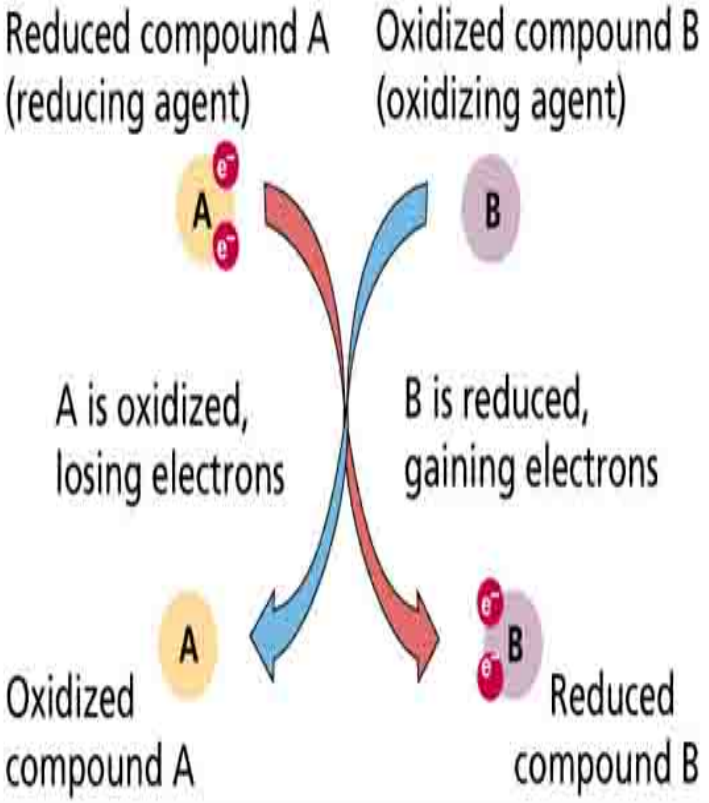
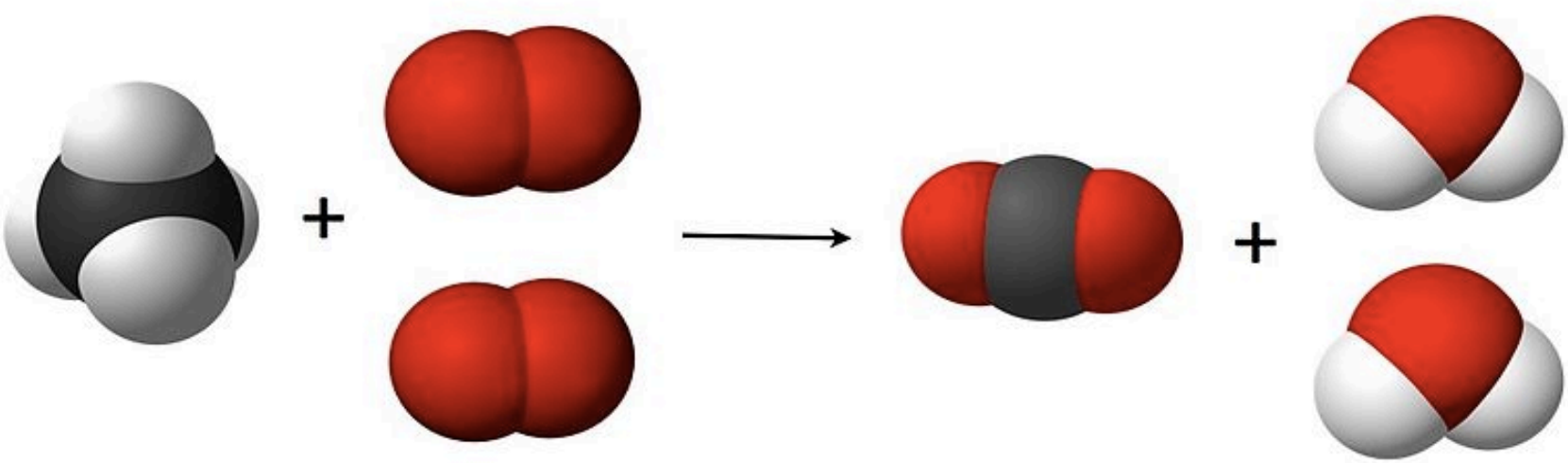


Image: Oil Rig Platform, Nasa

Chemical Bonds hold molecules together, but can be broken during a chemical reaction

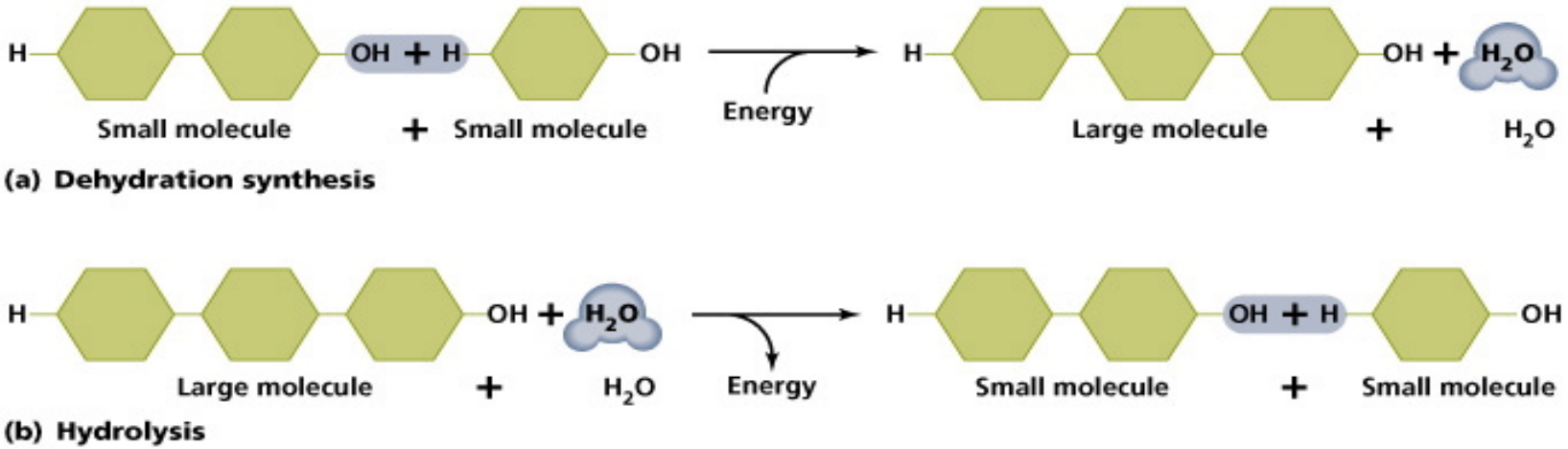


$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

Reactants are the starting materials
Products are the end materials

Image: Combustion Reaction of Methane, Wiki

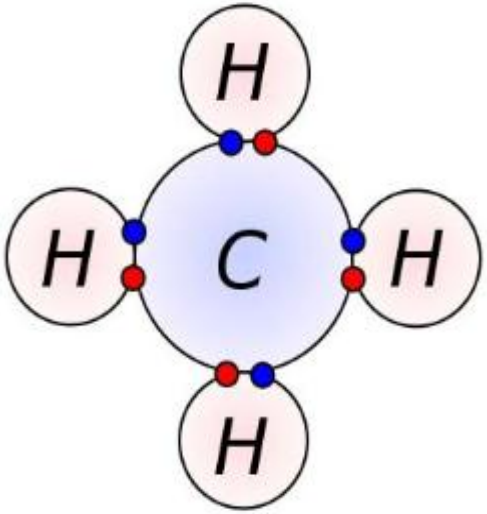
Simple Reactions Types

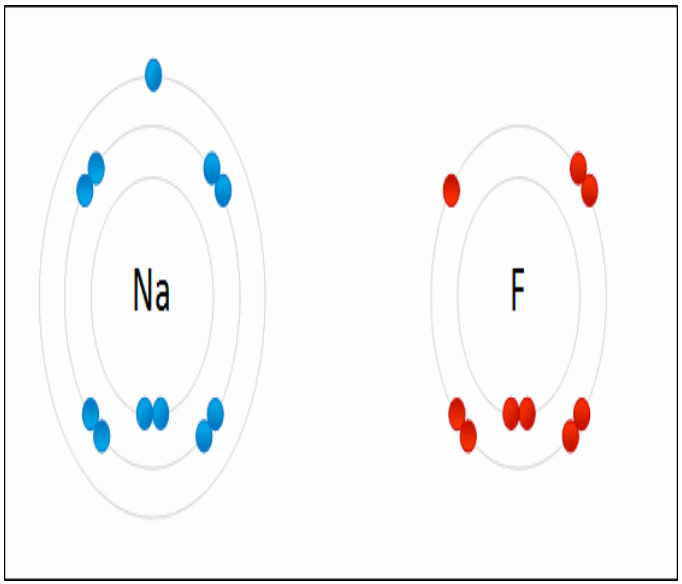


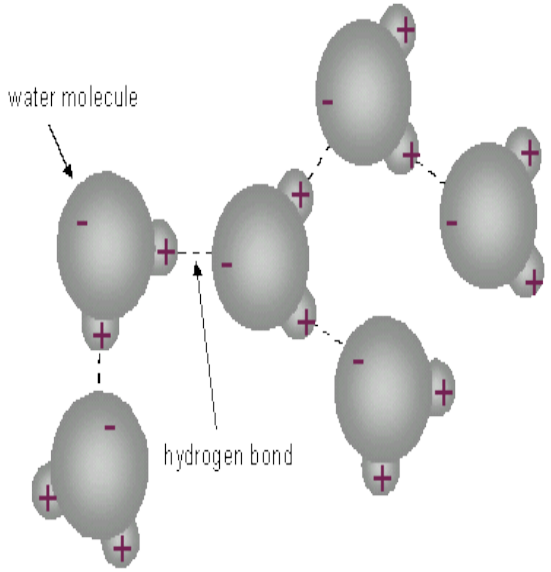
REVIEW!

Animated lessons on Chemical Bonding:

1. Ionic vs. Covalent Bonding
2. Chemical Structures & Bonding





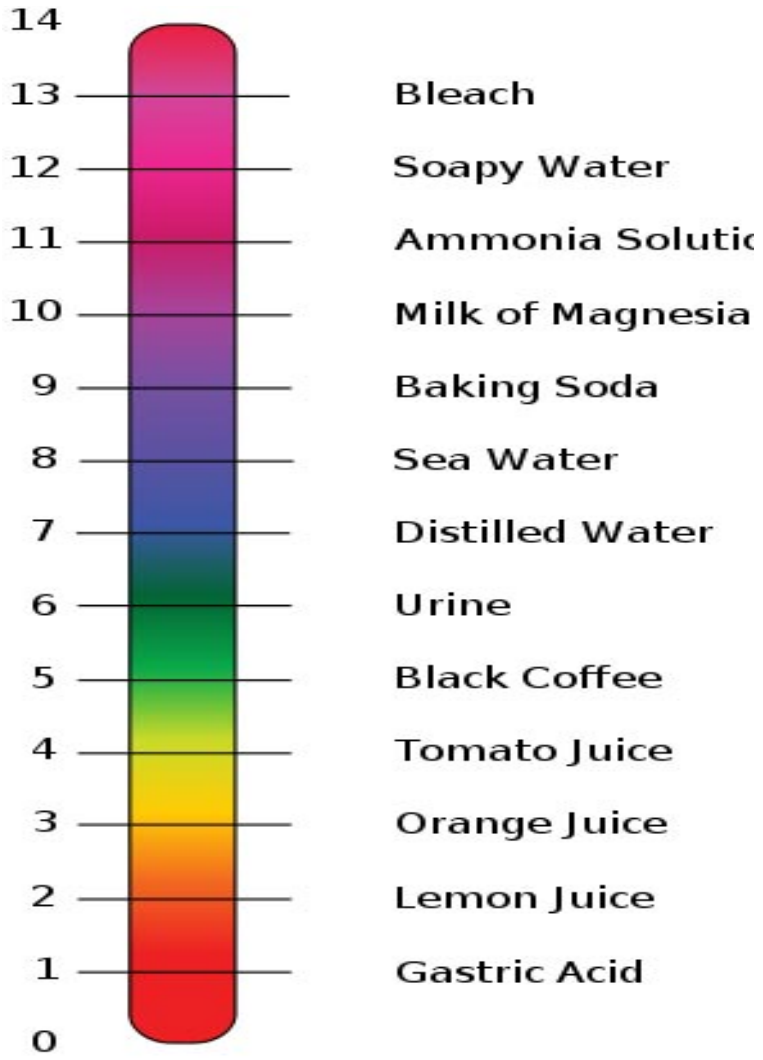


From the Virtual Cell Biology Classroom on ScienceProfOnline.com

Image: Methane Covalent Bonds, Dynablast; Formation of ionic sodium fluoride,

Acids, Bases & Buffers

Importance of The pH Scale in Biology

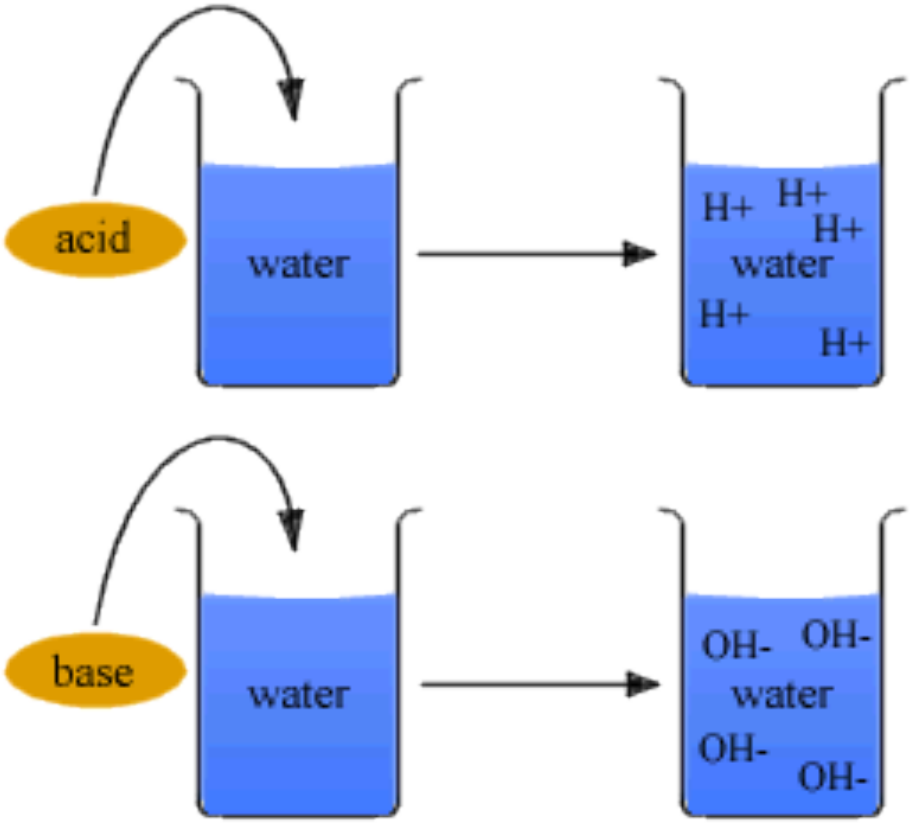


Images: pH scale, Edward Stevens, Wiki

Ions: Acids & Bases

An **acid** is any ionic compound that releases **hydrogen** _____ (H^+) in solution.

A **base** is any ionic compound that releases **hydroxide** _____ (^-OH) in solution.



Measurements of Acidity & Alkalinity (pH)

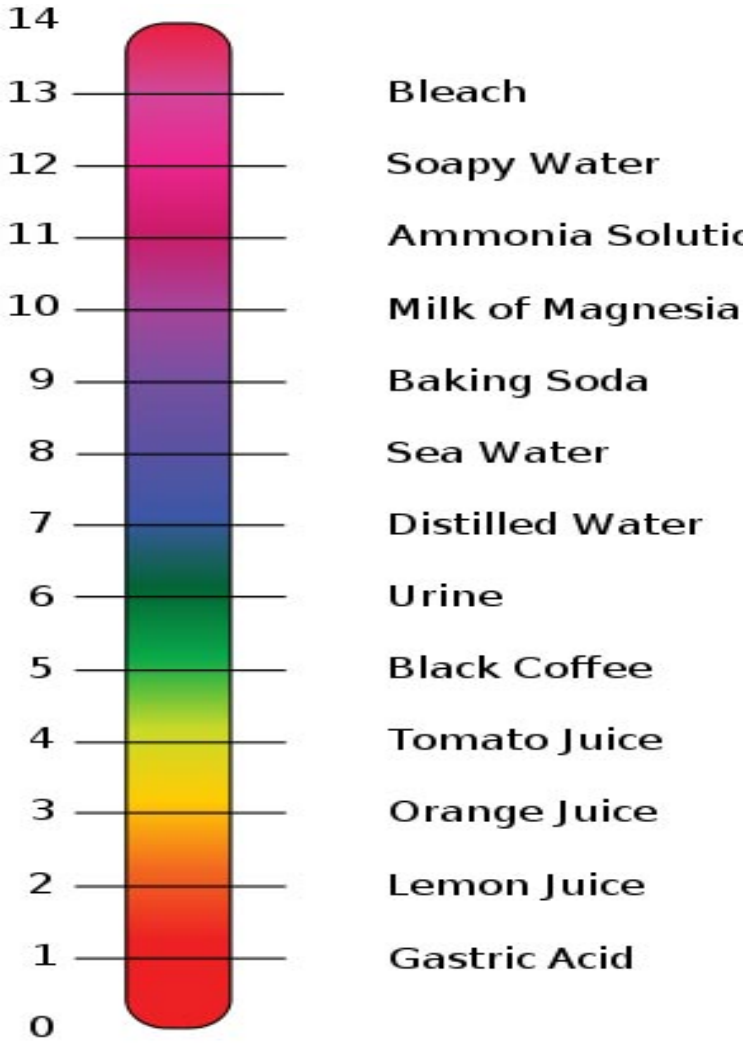
Acidity of a solution > measured by concentration of hydrogen ions (H+) vs. hydroxyl ions (OH-).

pH ranges: 0 (very acidic) to 14 (very basic).

pH scale is logarithmic.

Change in just one unit of scale = tenfold change in H+ concentration.

If concentration of H+ = OH - … neutral.



Images: pH scale, Edward Stevens, Wiki

pH scale is logarithmic

Change in just one unit of scale

= tenfold change in H+ concentration

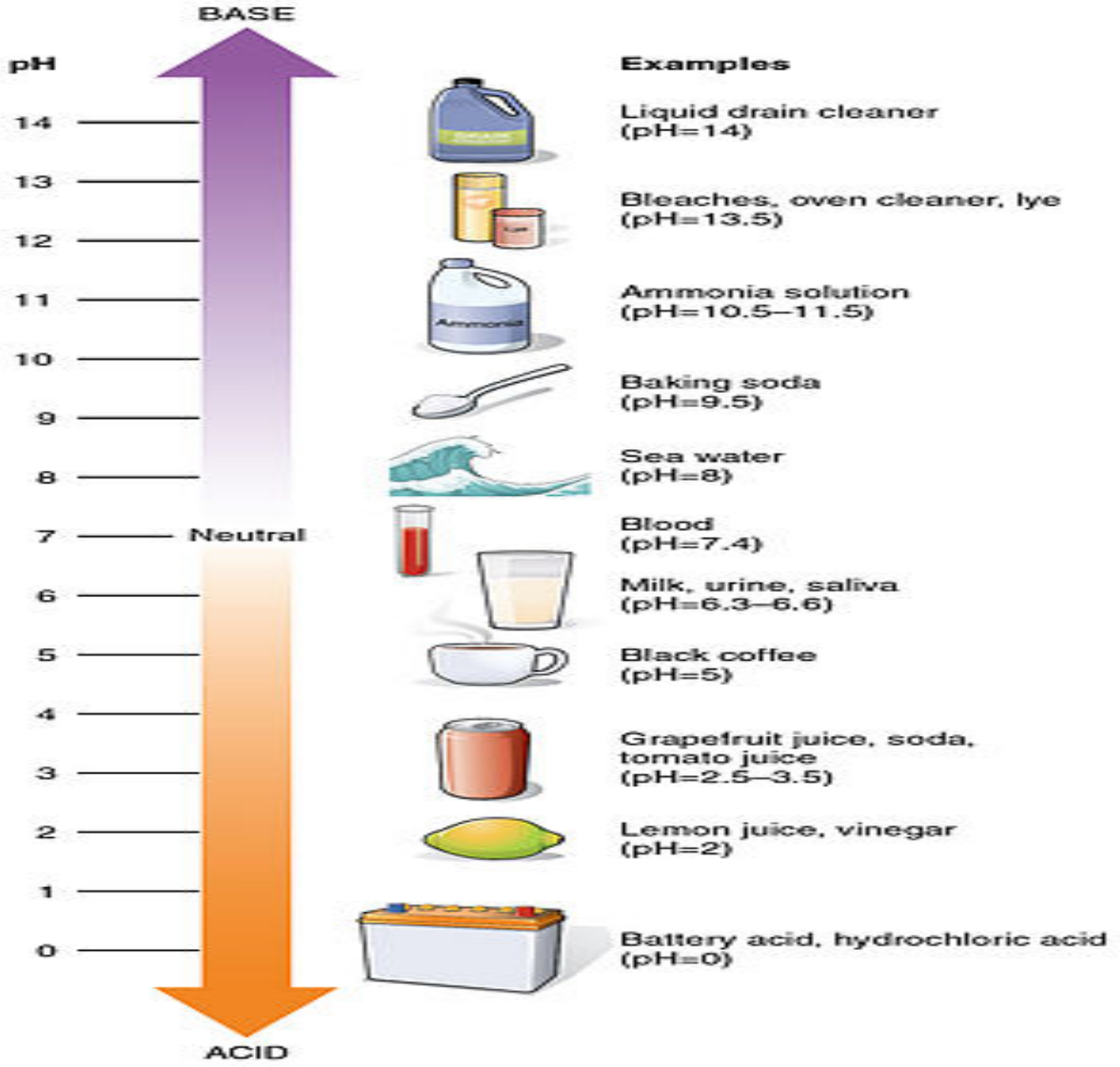
.

Table 1. Correlation of pH values and Hydronium ion concentrations

pH	Hydronium ion concentration (moles/L)
1	.1 (1×10^{-1})
2	.01 (1×10^{-2})
3	.001 (1×10^{-3})
4	.0001 (1×10^{-4})
5	.00001 (1×10^{-5})
6	.000001 (1×10^{-6})
7	.0000001 (1×10^{-7})
8	.00000001 (1×10^{-8})
9	.000000001 (1×10^{-9})
10	.0000000001 (1×10^{-10})
11	.00000000001 (1×10^{-11})
12	.000000000001 (1×10^{-12})
13	.0000000000001 (1×10^{-13})
14	.00000000000001 (1×10^{-14})

Image: pH & hydronium ion concentration, UBC Wiki

More Examples of pH from Daily Life



Images: pH scale, Wiki

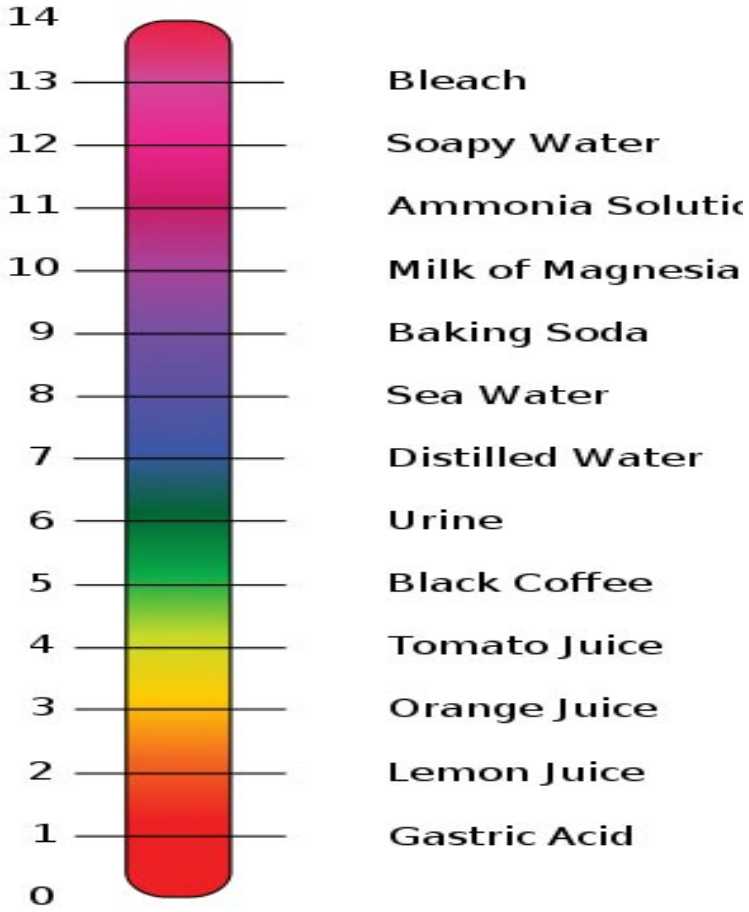
Acid/Base Balance in Biology

pH balance is important to homeostasis of organisms.

Homeostasis = tendency of the body to maintain a balanced internal environment, even when faced with external changes. Such as the body's ability to maintain an internal temperature around 98.6 degrees F, whatever the temperature outside.

Examples:

- Digestion needs acidic environment (pH 2-3)
- Urine is slightly acidic
- Blood must stay in neutral range near 7.35 to 7.45



Acids, Bases & You, and in-depth YouTube video.

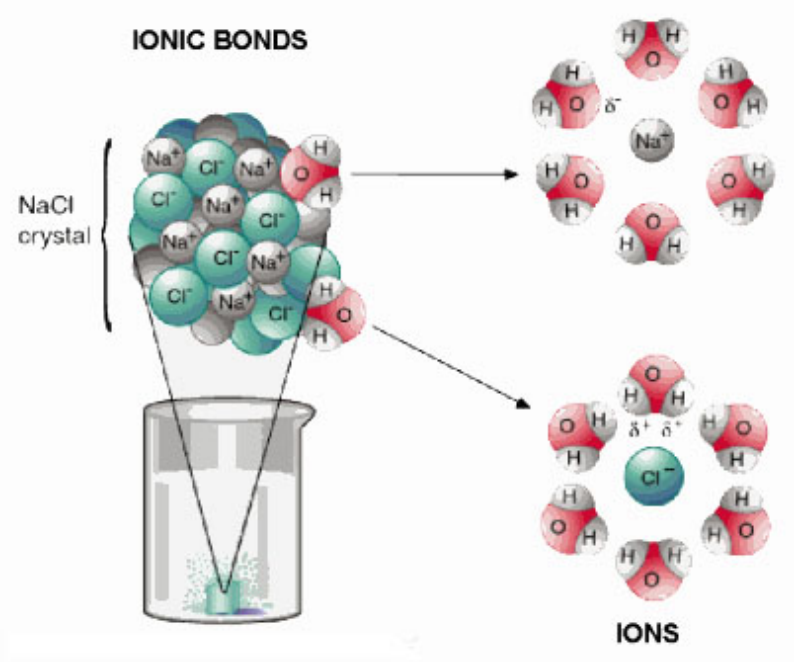
Images: pH scale, Edward Stevens, Wiki

Ions & Salts

- Compounds that dissociate in water and produce cations other than H+ and anions other than OH- are called **salts**.

- The most familiar salt is **sodium chloride**, the principal component of **common table salt**.

- **Other examples of salts:**
  - Baking soda (NaHCO3)
  - Epsom Salts (MgSO4)



Salts: The Role of Buffers

- Certain salts, called **buffers**, can combine with excess hydrogen (H+) or hydroxide (OH-) ions.

- Produce substances less acidic or alkaline.

- Act like a chemical sponge to soak up excess acid or base, keep pH constant.

- Buffers can be "used up". Once used up, no longer help regulate pH.

- Buffers are vital to maintaining pH in organisms.

- ***Example:***
Antacids are buffers made of the salt calcium carbonate (CaCo3).

Images: Antacid Tablets, Wiki

REVIEW!

Interactive animated lessons on

pH: Acids & Bases

and

Buffers

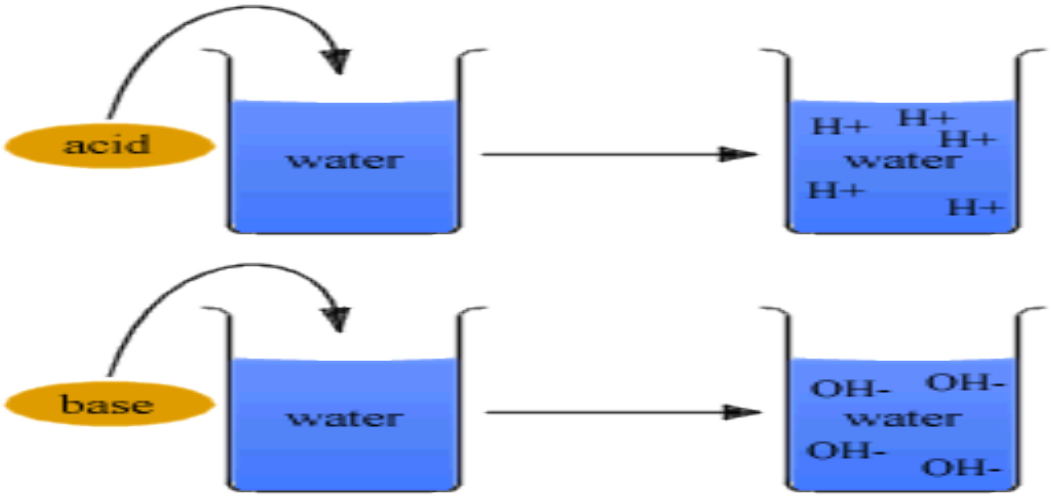


Image: Methane Covalent Bonds, Dynablast; Formation of ionic sodium fluoride,

Organic Chemistry

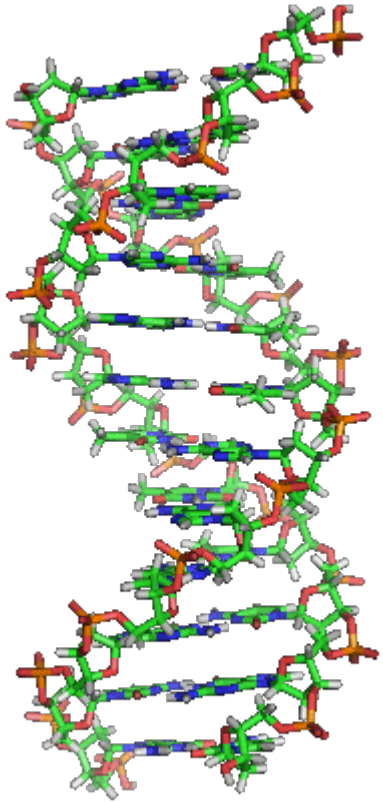


Image: DNA, Richard Wheeler

? Inorganic vs Organic Molecules ?

- **Inorganic Molecules >**
  Molecules that *don't* have Carbon Hydrogen (C-H) bonds.

- The major organic macromolecules (big molecules with carbon-hydrogen bonds) found in living things are:

1. carbohydrates
2. proteins
3. nucleic acids
4. lipids

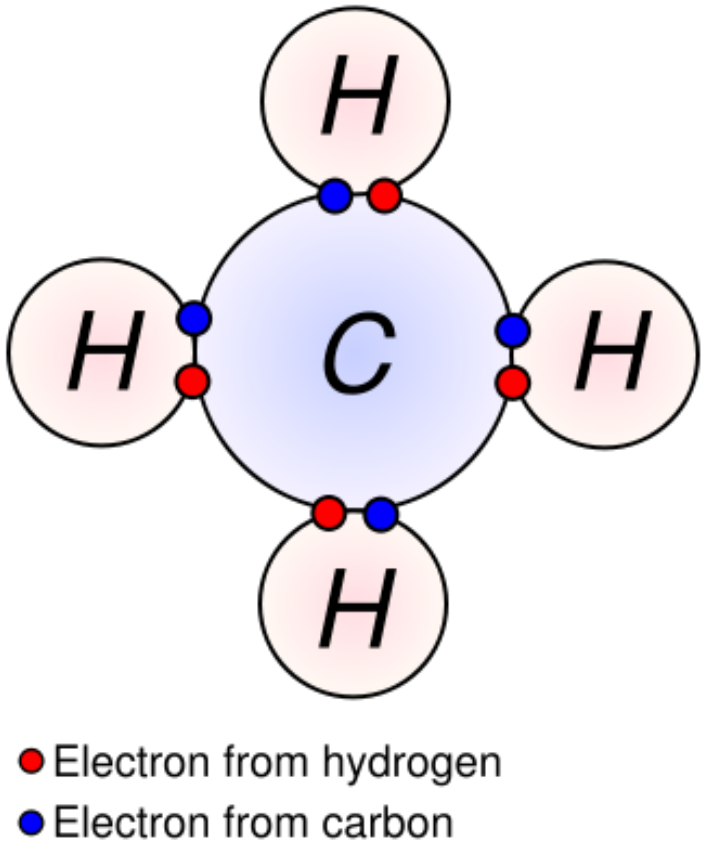
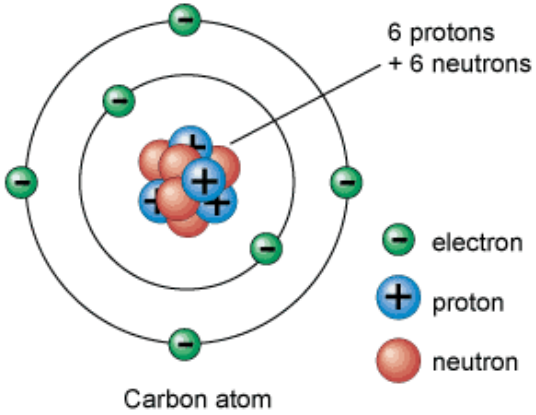


Image: Methane Covalent Bonds, Dynablast, Wiki

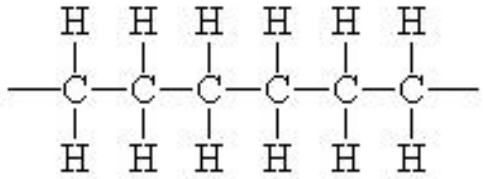
Carbon

Little Atom, Big Deal



The chemical basis of life. Abundant in all known life forms.

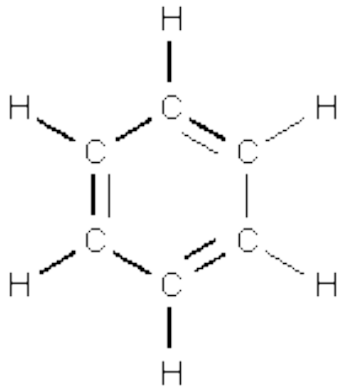
Essential to complex organic macromolecules, because each carbon atom can form ____ bonds (usually involving hydrogen , oxygen and/or nitrogen).



Polyolefin

Able to form polymers (big organic molecules).

- The atoms can bond with each other to form long chains.
- Sometimes the ends of these chains join together to form a ring.



Double bonds form when atoms share two pairs of electrons (two covalent bonds).

Images: Carbon, Universe Today Website

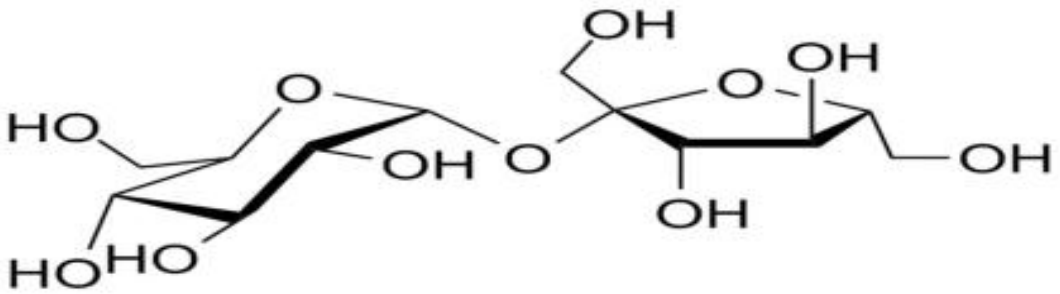
Study Table of Organic Macromolecules

(We will fill this in as we go through the rest of the lecture.)

Macromolecule (polymer)	**Made of what type of monomer?**	**Is there another name for this polymer?**	**What are the main elements in this macromolecule?**	**Examples**
1.				
2.				
3.				
4.				

Organic Molecules
Carbohydrates

- "carbon" - hydrates"
- One carbon molecule to one water molecule $(CH_2O)_n$.
- saccharide is a synonym for carbohydrate.
- The prefixes on the word "saccharide" relates to the size of the molecule (mono-, di-, tri- poly-).



BOOGERS!

You probably know that jelly beans are full of refined sugars…carbs. You may not know that boogers contain carbs as well. Boogers are dried-up mucus and dirty nose debris. Mucus is made mostly out of sugars and protein.

Images: Jelly beans, T. Port;
Giraffe picking nose with tongue, Sucrose moleculee Wiki

Organic Molecules - Proteins

Proteins are macromolecules, **polymers** composed of monomers called…

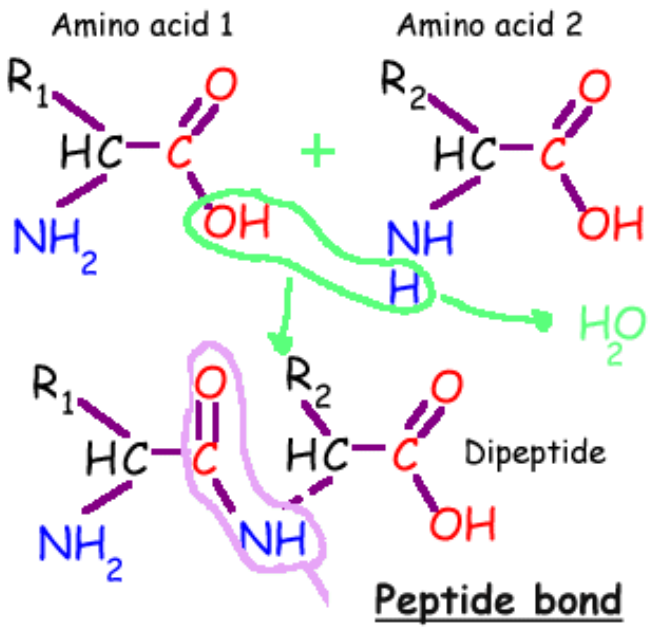
Amino acids contain a:

1. base amino group ($-NH_2$)
2. acidic carboxyl group (-COOH)
3. hydrogen atom

…all attached to same carbon atom (the a – carbon…alpha carbon).

4. Fourth bond attaches a-carbon to a side group (--R) that varies among different amino acids.

Side groups important … affects the way a proteins amino acids interact with one another, and how a protein interacts with other molecules.

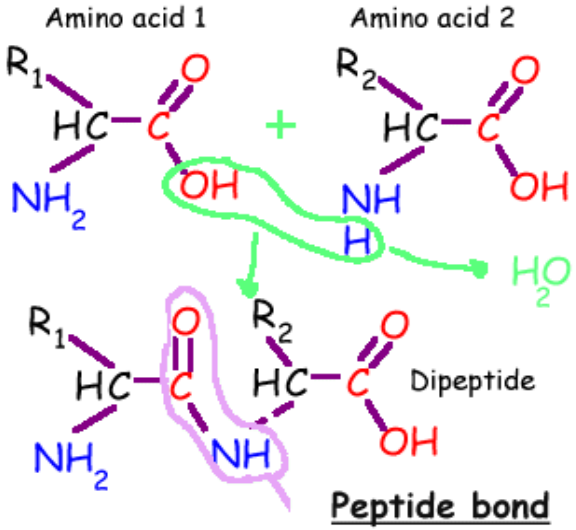


Essential amino acids:
Cannot be synthesized by the body. They must be ingested in the diet.

Arginine * Histidine * Methionine* Threonine * Valine * Isoleucine * Lysine * Phenylalanine * Tryptophan * Leucine

Organic Molecules – **Proteins**

Peptide Bonds



Link amino acids together in chains, like the beads on a necklace.

A **dipeptide** is 2 amino acids linked together.

A **polypeptide**, more than two.

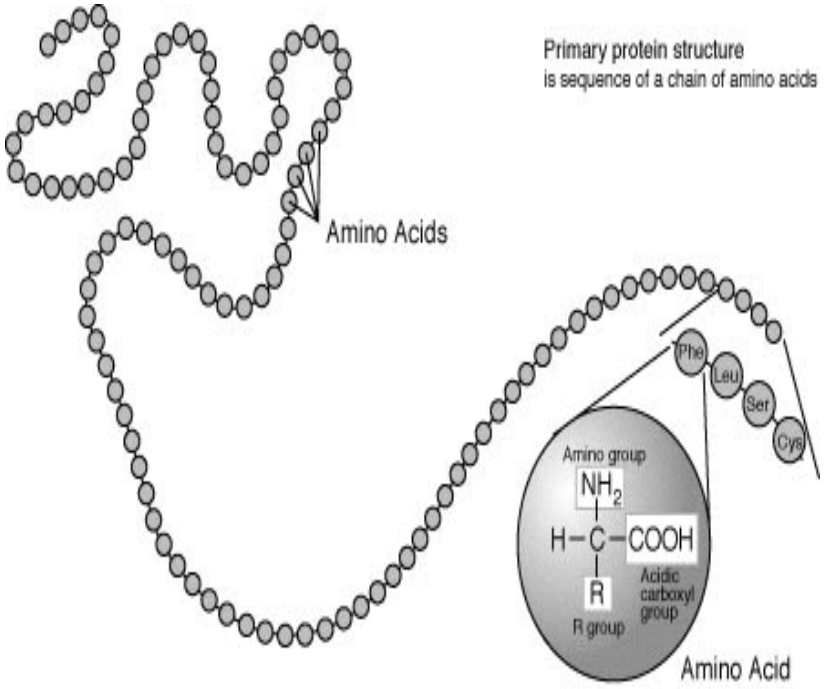


Image: Protein Primary Structure, Wiki

Organic Molecules – Nucleic Acids

Nucleic acids (both RNA and DNA) are macromolecules; polymers made up of monomers called **nucleotides**.

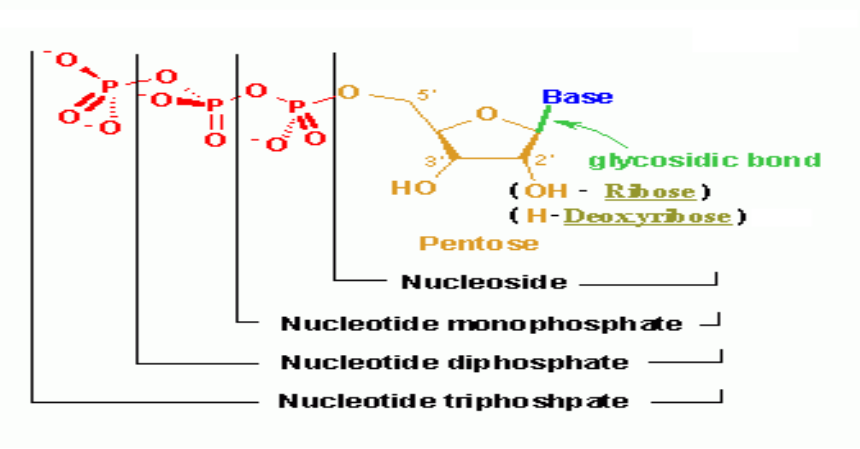
Nucleic acids **deoxyribonucleic acid** (DNA) and **ribonucleic acid** (RNA) = genetic material of cells.

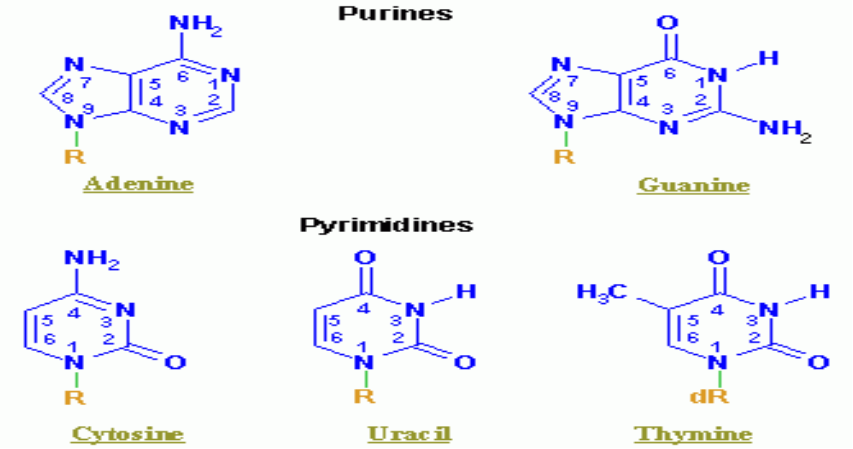
Names derived from type of **sugar** contained within molecules = **ribose**

Nucleotides

Each monomer of nucleic acid is a **nucleotide** and consists of 3 portions:

- a **sugar**
- one or more **phosphate**
- one of five cyclic **nitrogenous bases**
  - +adenine, guanine (double-ringed purines)
  - + cytosine, thiamine or uracil (single-ringed pyrimidines)





From the Virtual Biology Classroom on ScienceProfOnline.com

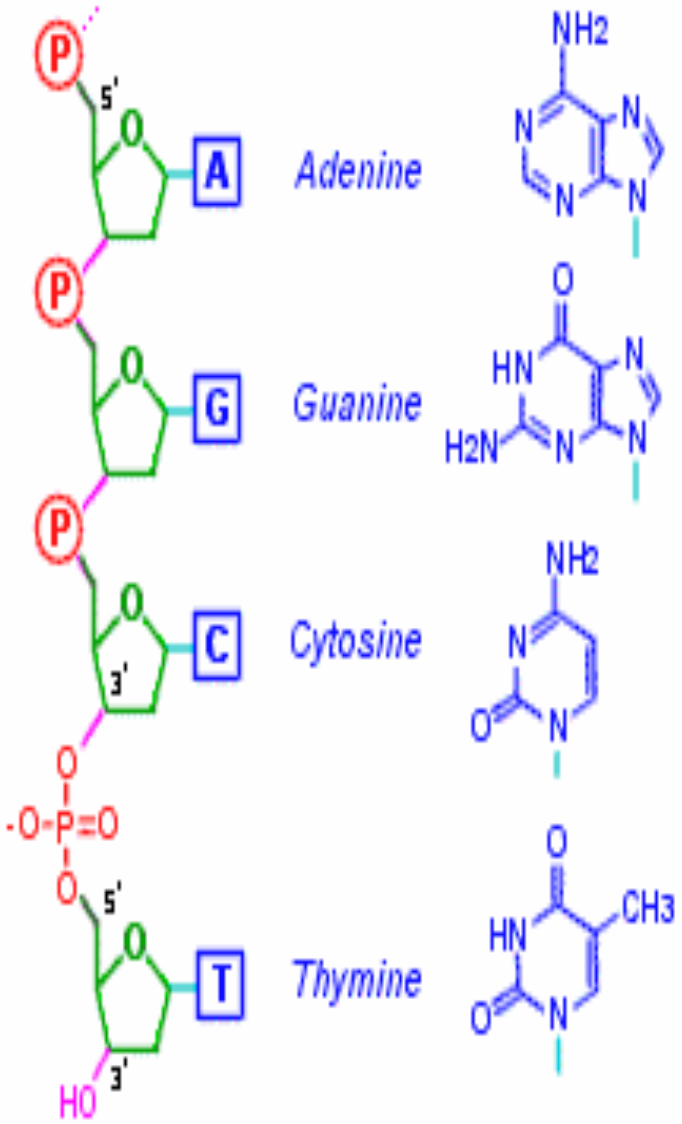
Image: Nucleotide Structure, Wikipedia

Organic Molecules – Nucleic Acids

Nucleic Acid Structure

Nucleotides linked by covalent bonds between **sugar** of one nucleotide and **phosphate** of next *(sugar-phosphate backbone).*

Nitrogenous **bases** extend from it like teeth of a comb.



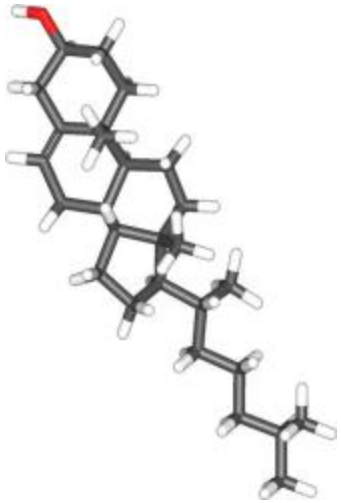
Organic Molecules – Lipids

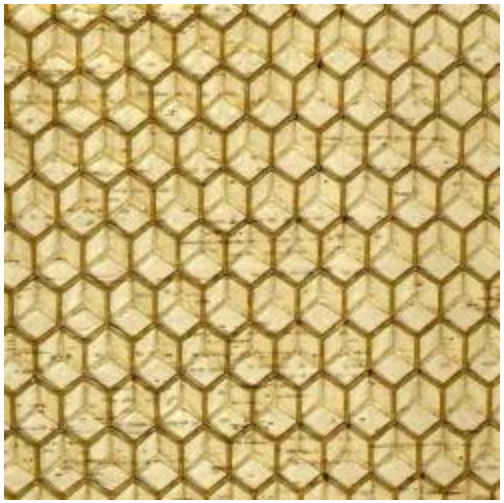
(Fats, Phospholipids, Waxes & Steroids)

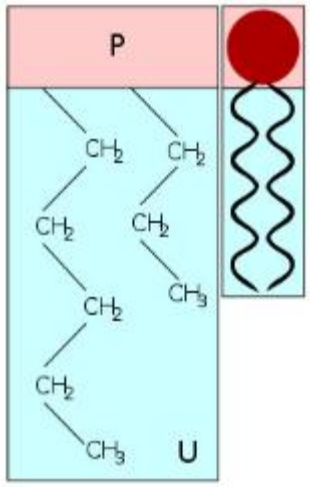
Hydrophobic macromolecules…insoluble in water.

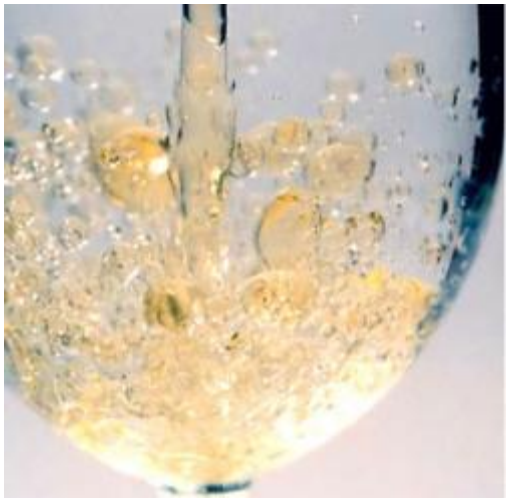
Not attracted to water because …

non-polar covalent bonds linking carbon & hydrogen aren't attracted to the *polar bonds of water.*





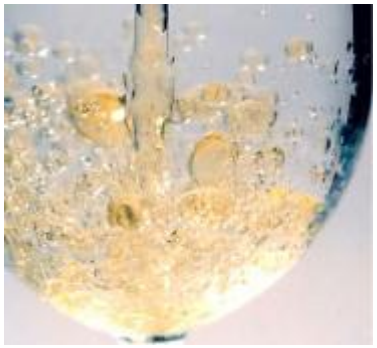




Images: Cholesterol, Wiki; Phospholipid Structure, Bryan Derksen. Wiki Honeycomb, Wikii; Oil & Water, Kidipede

Organic Molecules – Lipids

*(**Fats**, Phospholipids, Waxes & Steroids)*



Fats

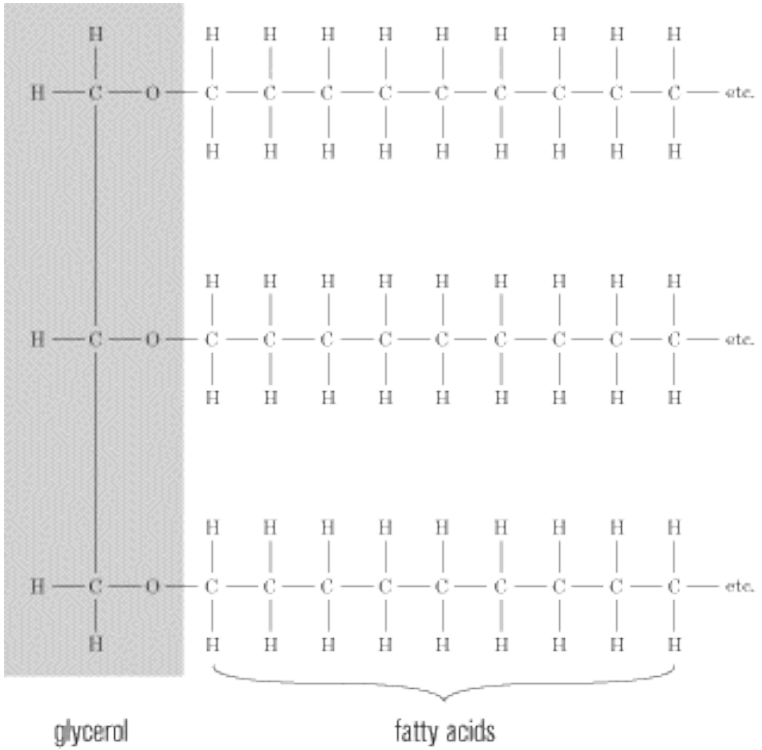
Fats and oils are made from two kinds of molecules:

- **glycerol**

  (a type of alcohol)

- **fatty acids**

  (triglycerides)



Images: Oil & Water, Kidipede

Organic Molecules – Lipids

*(Fats, **Phospholipids**, Waxes & Steroids)*

Phospholipids

- Phospholipids are a major component of all cell membranes.
- Most phospholipids contain a diglyceride as the tail, and a phosphate group for head.
- Hydrocarbon tails are **hydrophobic**, but phosphate heads are **hydrophilic**.
- So phospholipids are soluble in both water and oil.
- Tails from both layers facing inward and the heads facing outward = **phospholipid bilayer**.

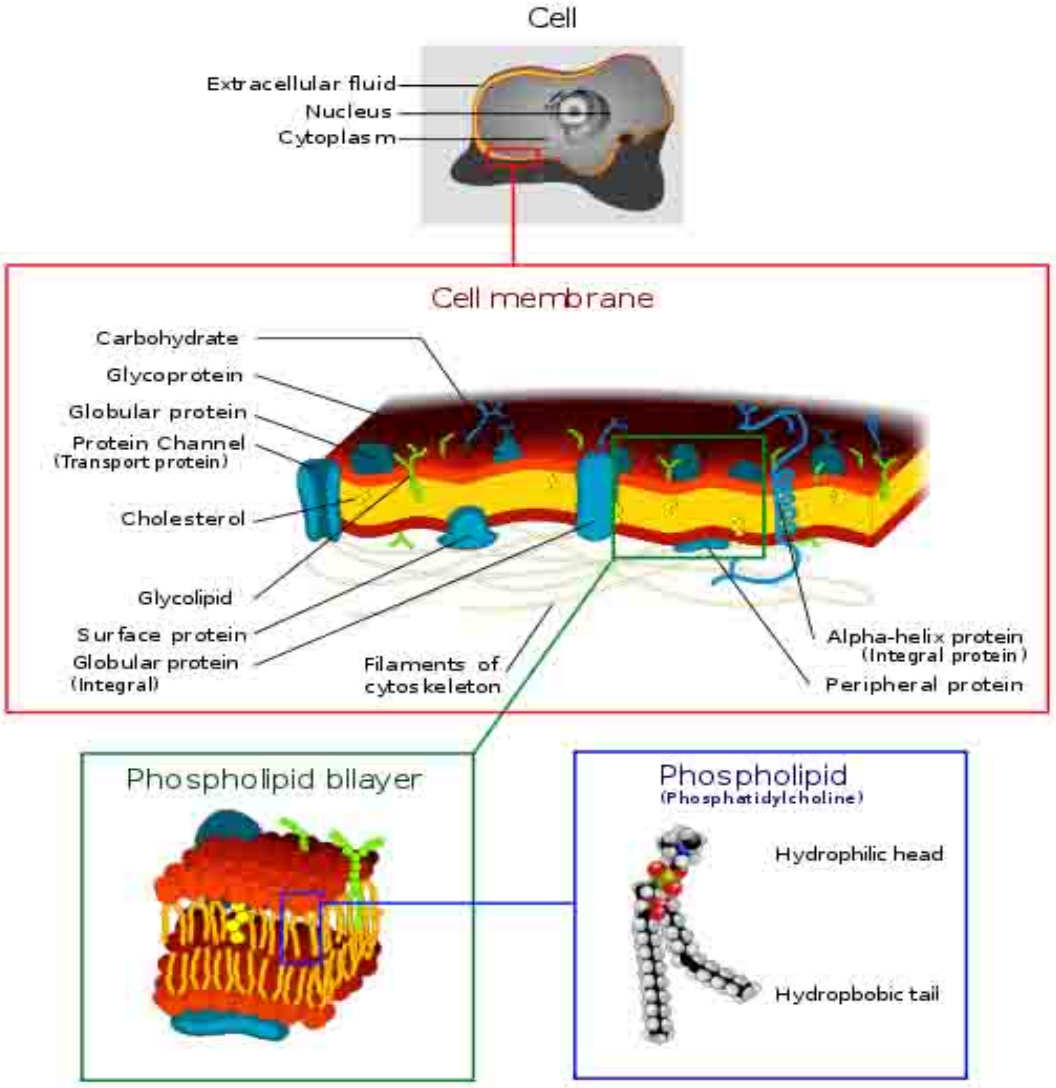
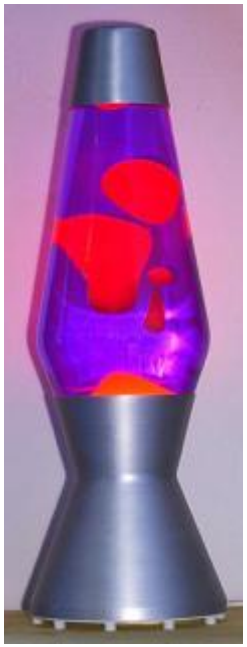


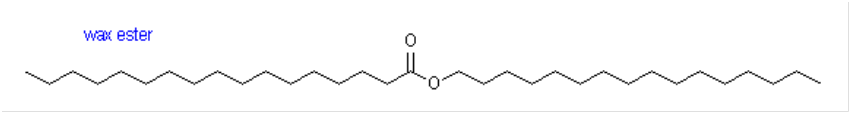
Image: Cell Membrane, Wiki;

Organic Molecules – Lipids

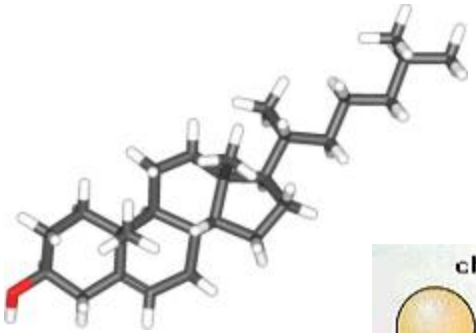
*(Fats, Phospholipids, **Waxes & Steroids**)*



Waxes



- Do not have a hydrophilic head: so completely water insoluble.



Steroids

- The central core of a cholesterol molecule (4 fused rings) is shared by all steroids.
- Cholesterol is precursor to our **sex** hormones and Vitamin **D**.
- Our cell membranes contain cholesterol (in between the phospholipids) to help keep membrane "fluid" even when exposed to cooler temperatures.

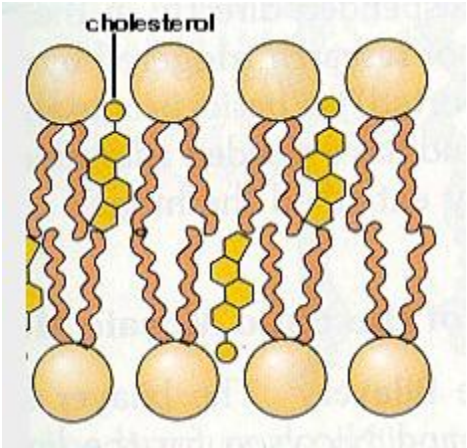
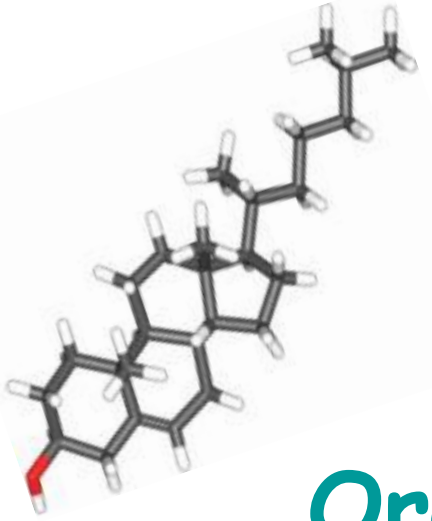
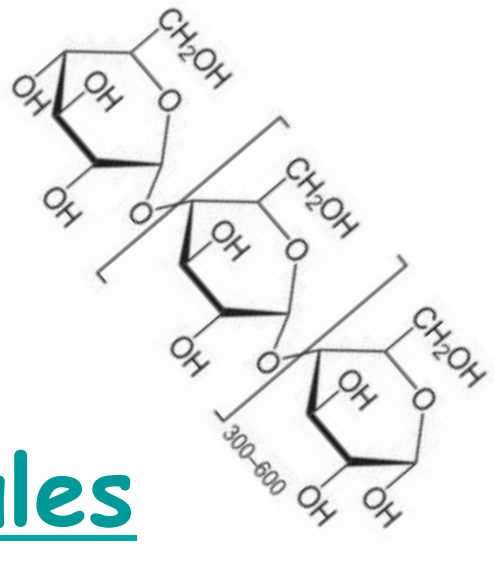


Image: Lava Lamp, Wiki; Cholesterol molecule, Wiki; Phospholipids & Cholesterol, Cytochemistry.net

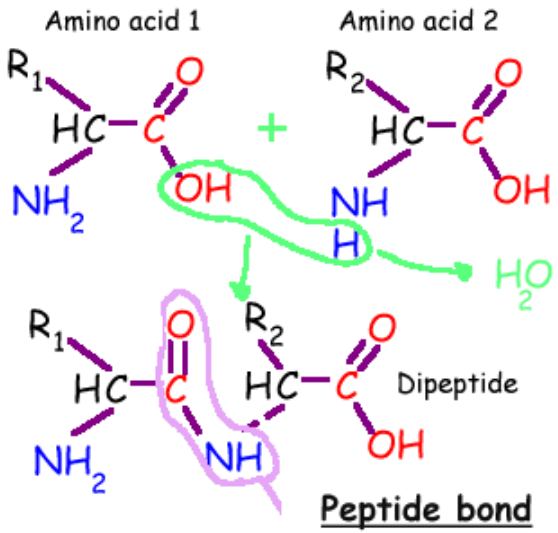


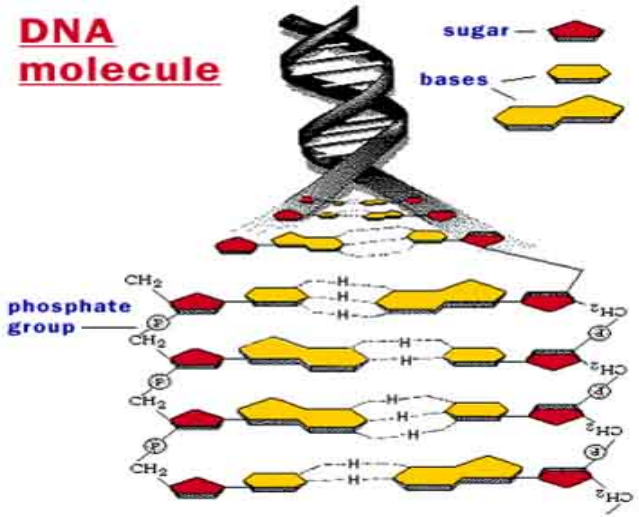
REVIEW!



Animated lessons on

Organic Macromolecules



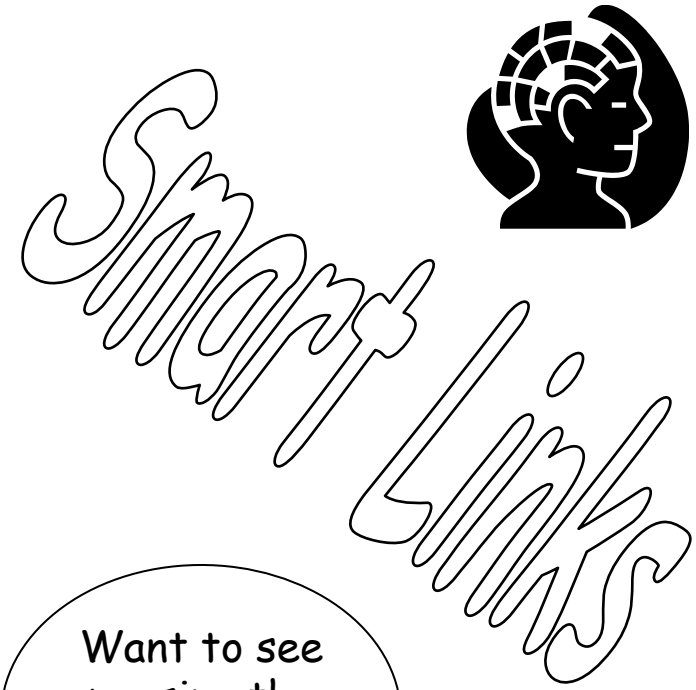


From the Virtual Biology Classroom on ScienceProfOnline.com

Images: Cholesterol, Wiki; Chilesterol; Amino Acids & Peptide Bonds; DNA Molecule, National Science Foundation

Confused?

Here are some links to fun resources that further explain Chemistry:



- Inorganic Chemistry Main Page on the Virtual Cell Biology Classroom of Science Prof Online.
- "What Kind of Bonds AreThese?" song and slide show by Mark Rosengarten.
- Ionic vs. Covalent Bonding animated science tutorial.
- Chemical Structures & Bonding animated science tutorial.
- "Meet the Elements" music video by They Might Be Giants.
- Redox Reactions video lecture by Kahnacademy.
- Chem4Kids website by Rader.
- Acid & Bases, an Introduction by Vision Learning
- Buffer System YouTube video.
- Organic Chemistry Main Page on the Virtual Cell Biology Classroom of Science Prof Online.
- Macromolecules interactive science tutorial.
- DNA Structure Cell Biology Animation from John Kyrk.

(You must be in PPT slideshow view to click on links.)

Image: Daniel Radcliff by Joella Marano