

UNIVERSITY OF



LA VERNE

Knowledge • Service • Vision

Life Science The Human Environment

WELCOME TO BIO 101!



42



"The role of the infinitely small in nature is infinitely large"

-Louis Pasteur



Course Website

<http://bio101f12.weebly.com>

- **1st Weekly Reflection Homework due today.**

In-Class Activity - Medical Research & Ethics

- The enormous cost of conducting medical research can be a barrier to the development of effective drugs and medical procedures for the treatment of disease. To bridge this barrier, private drug companies are currently funding approximately two-thirds of the research conducted at the nation's medical schools. However, many ethicists feel that such partnerships between industry and medical schools may create conflicts of interest that could endanger the lives of patients and shake public confidence in medical research.
- A recent study of such collaborations resulted in some disturbing findings. Among the most troubling were instances where the results of research studies were manipulated by individual researchers to make a drug appear more effective than it actually was. In some cases, researchers were discouraged, and sometimes were contractually prohibited, from publishing findings that didn't support the effectiveness of a new drug/treatment.
- Work in groups of three to discuss and formulate responses to the following questions regarding collaborations between the pharmaceutical industry and medical schools. One person in the group should lead the discussion and formulate the group's response to each question. All members of the group are responsible for each answer.

- How is the repression of research counter to the purpose of the scientific endeavor?

_____ (Discussion leader, and Group members)

Group response:

- What might cause an individual researcher to manipulate his or her data, changing the conclusions to be drawn from an investigation?

_____ (Discussion leader, and Group members)

Group response:

- What guidelines could be implemented to minimize conflicts of interest, yet still allow collaborations between pharmaceutical companies and medical schools?

_____ (Discussion leader, and Group members)

Group response:

The Scientific Method Podcast

<http://www.youtube.com/watch?v=GKGtkzgKfkc>

Mr. Andersen gives
a brief description
of the scientific
method.



The Science of Biology

- Biology is the study of living things.
- Microbiology
 - Organisms seen under a microscope
- Theoretical biology
 - Evolutionary biology, animal behavior, biochemistry
- Applied biology
 - Medicine, crop science, plant breeding, wildlife management

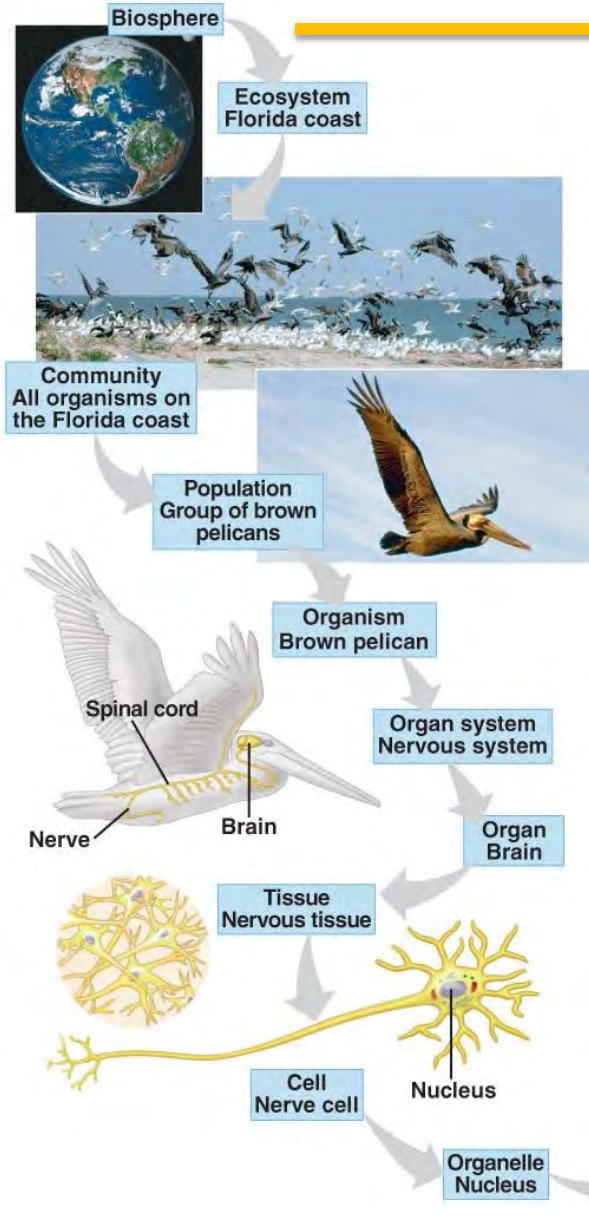
Biological Organization and Emerging Properties

- Biosphere—the worldwide ecosystem.
- Ecosystem—communities that interact with one another in a particular place.
- Communities—populations of different organisms interacting with each other in a particular place.
- Population—a group of individual organisms in a particular place.
- Organism—an independent living unit.

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Levels of Biological Organization



- Organ system—many organs that perform a particular function.
- Organ—many tissues that perform a particular function.
- Tissue—many cells that perform a particular function.
- Cell—simplest unit that shows characteristics of life.
- Molecules—specific arrangements of atoms.
- Atoms—the fundamental units of matter.

Matter, Energy, and Life

- Matter is anything that has mass and occupies space.
- Energy is the ability to do work.
 - There are two types of energy:
 - Potential energy
 - Stored energy, available to do work
 - Kinetic energy
 - Energy of motion
 - Potential energy can be converted to kinetic energy to do work.

First Law of Thermodynamics

Energy can not be created or destroyed. It can only be converted from one form or the other

Energy

Potential energy



Energy in



Energy out



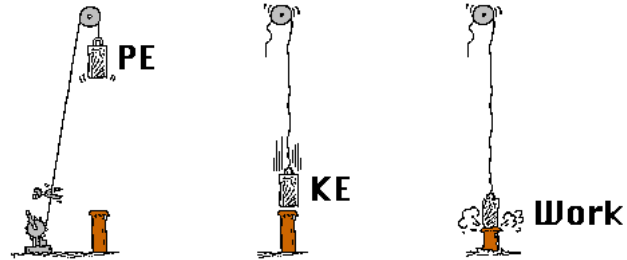
Kinetic energy

Kinetic energy

Forms of Energy

- **Mechanical**

- Energy of movement
- The ability to do work



The ram of a pile-driver possesses mechanical energy – the ability to do work. When held at a height, it possesses mechanical energy in the form of potential energy. As it falls it possesses mechanical energy in the form of kinetic energy. As it strikes the spike, it applies a force to displace the spike – i.e., it does work on the spike.

- **Nuclear**

- Energy from reactions involving the nucleus of an atom



- **Chemical**

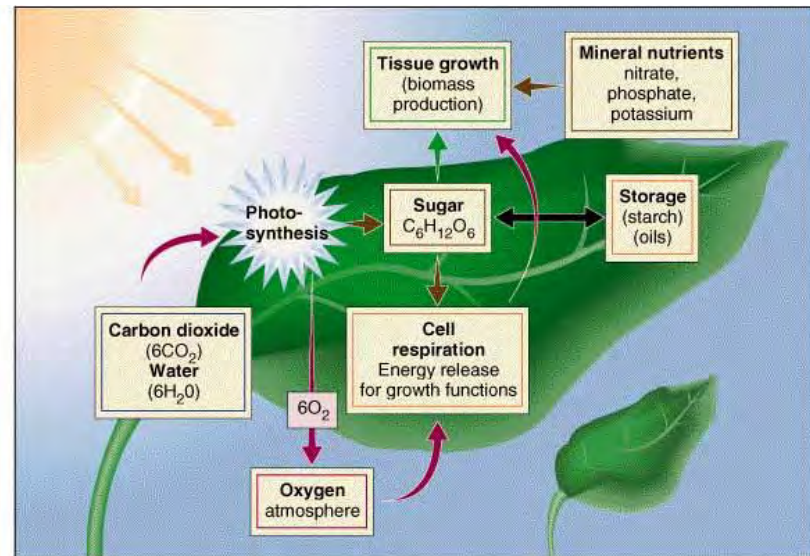
- Energy in chemical bonds

- **Electrical**

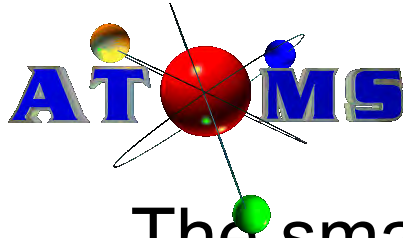
- Flow of charged particles

- **Radiant**

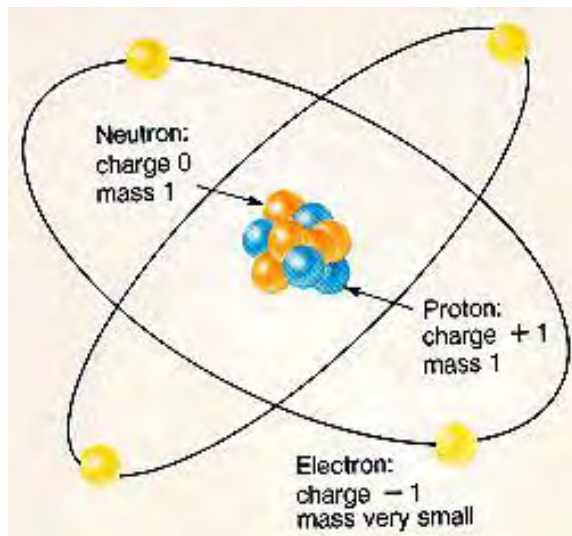
- Energy in heat, light, x-rays, and microwaves



What Is the Nature of Matter?



- The smallest units of matter that can exist separately



P Large with a positive charge

N Large with no charge

e Small with a negative charge

What Is the Nature of Matter?

- Elements
 - Chemical substances composed of same kind of atoms
 - Listed on periodic table
 - Each element represented by a symbol
 - The principal elements that comprise living things are:
 - C, H, O, P, K, I, N, S, Ca, Fe, and Mg.

Representative Elements (s Series)

Atomic Number – Number of Protons – Number of Electrons

Phase of Matter – solid, gas, liquid. An arrow should point to the symbol in the upper right hand corner of this box.

Chemical Symbol

Chemical Name

Atomic Weight – Number of Protons + Number of Neutrons

Representative Elements (p Series)

NON-METALS

METALS

Transition Metals (d Series of Transition Elements)

Inner Transition Elements (f Series)

KEY

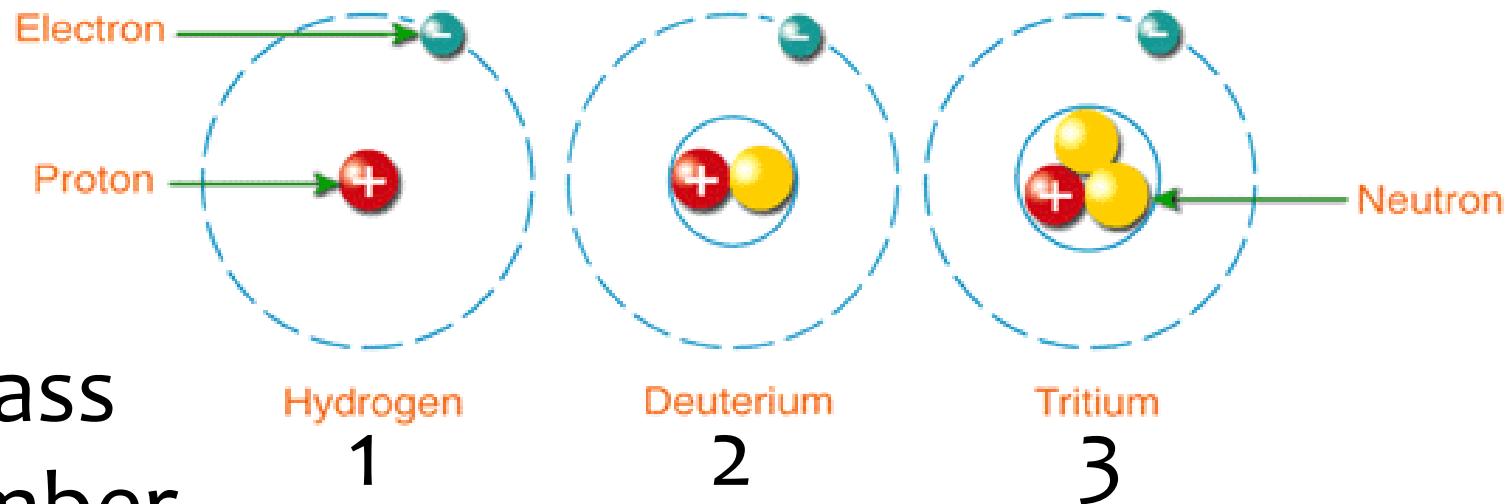
- Solid at room temperature
- Liquid
- Gas at room temperature
- Radioactive
- Artificially Made



CHOPKINS CaFé Mighty good!!!

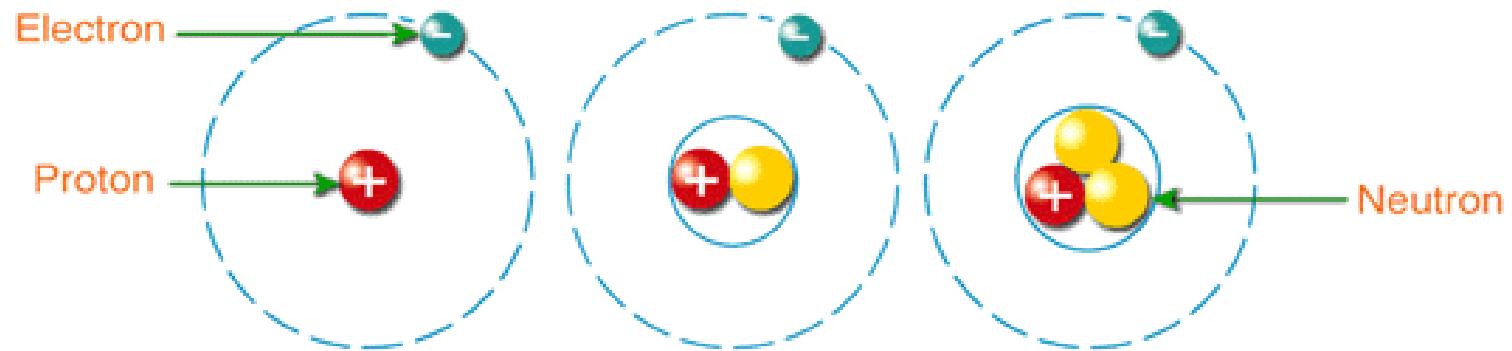
Elements

- A pure chemical substance consisting of one type of atom
- All the atoms in one element have the same atomic number
- Occur in nature as a mixture of isotopes



Elements

- A pure chemical substance consisting of one type of atom
- All the atoms in one element have the same atomic number **Stays the Same**
- Occur in nature as a mixture of isotopes



Mass
Number

Hydrogen
1

Deuterium
2

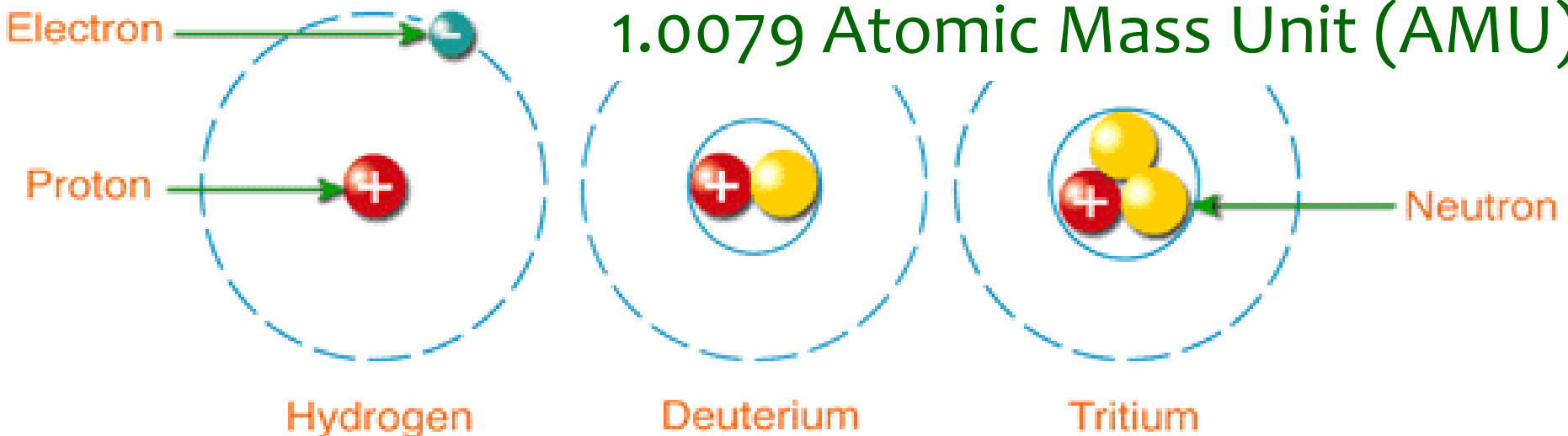
Tritium
3

Differs!

Elements

- A pure chemical substance consisting of one type of atom
- All the atoms in one element have the same atomic number
- Occur in nature as a mixture of isotopes
 - Atomic weight is an average of all the isotopes, of a given element, in a mixture

Atomic Weight of Hydrogen:
1.0079 Atomic Mass Unit (AMU)



What is an atom?

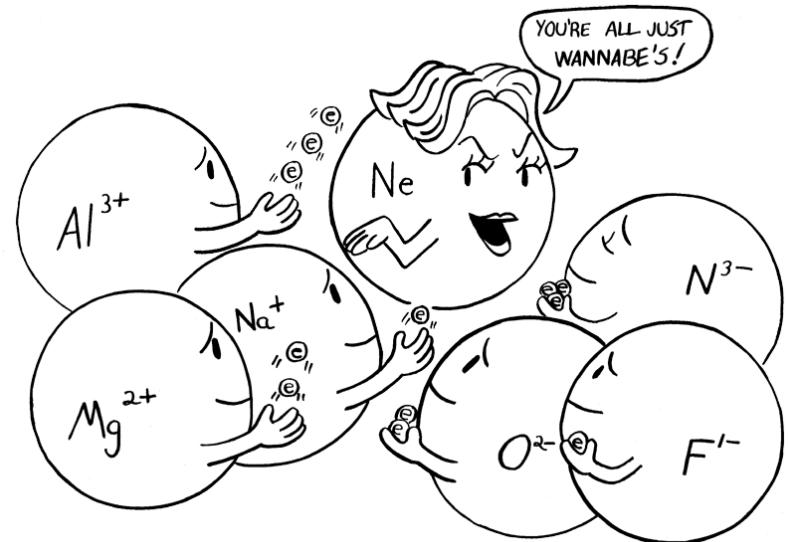
- Fundamental unit of a cell
- Fundamental unit of life
- Fundamental unit of matter
- Fundamental unit of a neutron
- Fundamental unit of an element

What is an atom?

- Fundamental unit of a cell
- Fundamental unit of life
- Fundamental unit of matter
- Fundamental unit of a neutron
- Fundamental unit of an element

Electrons

- Electrons occupy specific energy levels around the nucleus.
 - Electrons closest to the nucleus have the lowest energy.
- Energy levels hold specific numbers of electrons.
 - The first energy level can have up to 2 electrons.
 - All other energy levels can have up to 8 electrons.
- Atoms seek to have a full outer energy level.
 - Atoms that have full outer energy levels are inert.
 - Other atoms seek to fill their outer energy levels through chemical bonds.



A periodic table of elements with various annotations and a key. The table is color-coded by groups: IA (yellow), IIA (orange), IIIA (green), IVA (blue), VA (purple), VIA (pink), VIIA (light blue), and VIIIA (dark blue). The table is divided into sections: Representative Elements (p Series), Transition Metals (d Series of Transition Elements), and Inner Transition Elements (f Series). A callout box for Hydrogen (H) provides the following information:

- Phase of Matter – solid, gas, liquid. An arrow should point to the symbol in the upper right hand corner of this box.
- Chemical Symbol
- Chemical Name
- Atomic Weight – Number of Protons + Number of Neutrons

The key at the bottom left includes:

- Solid at room temperature
- Liquid
- Gas at room temperature
- Radioactive
- Artificially Made

Molecules

- Atoms combine to form molecules


Monatomic Molecules

Helium (He)
Neon (Ne)

Diatomic Molecules

H_2 , O_2 , N_2 , Cl_2



 **Compounds – a chemical substance made of two types of atoms**



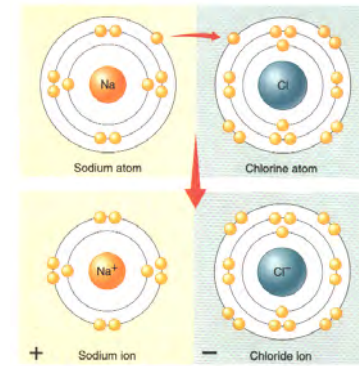
Chemical Bonds

- The attractive forces that hold the atoms of a molecule together
- There are three MAJOR types:

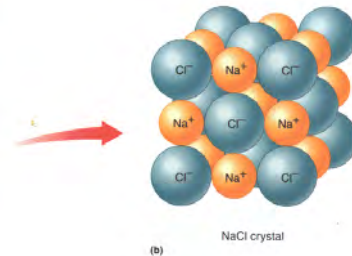
– Ionic Bonds

– Covalent Bonds

– Hydrogen

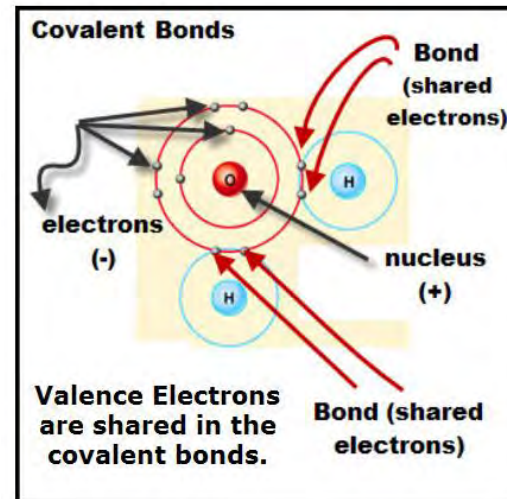
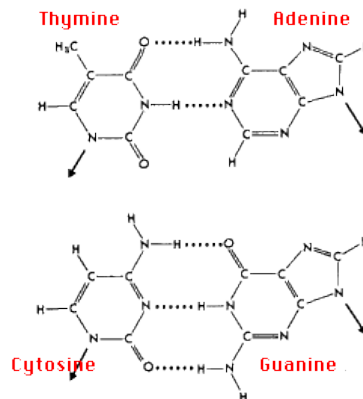
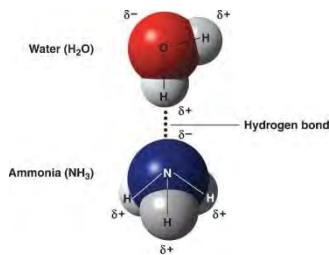


(a)



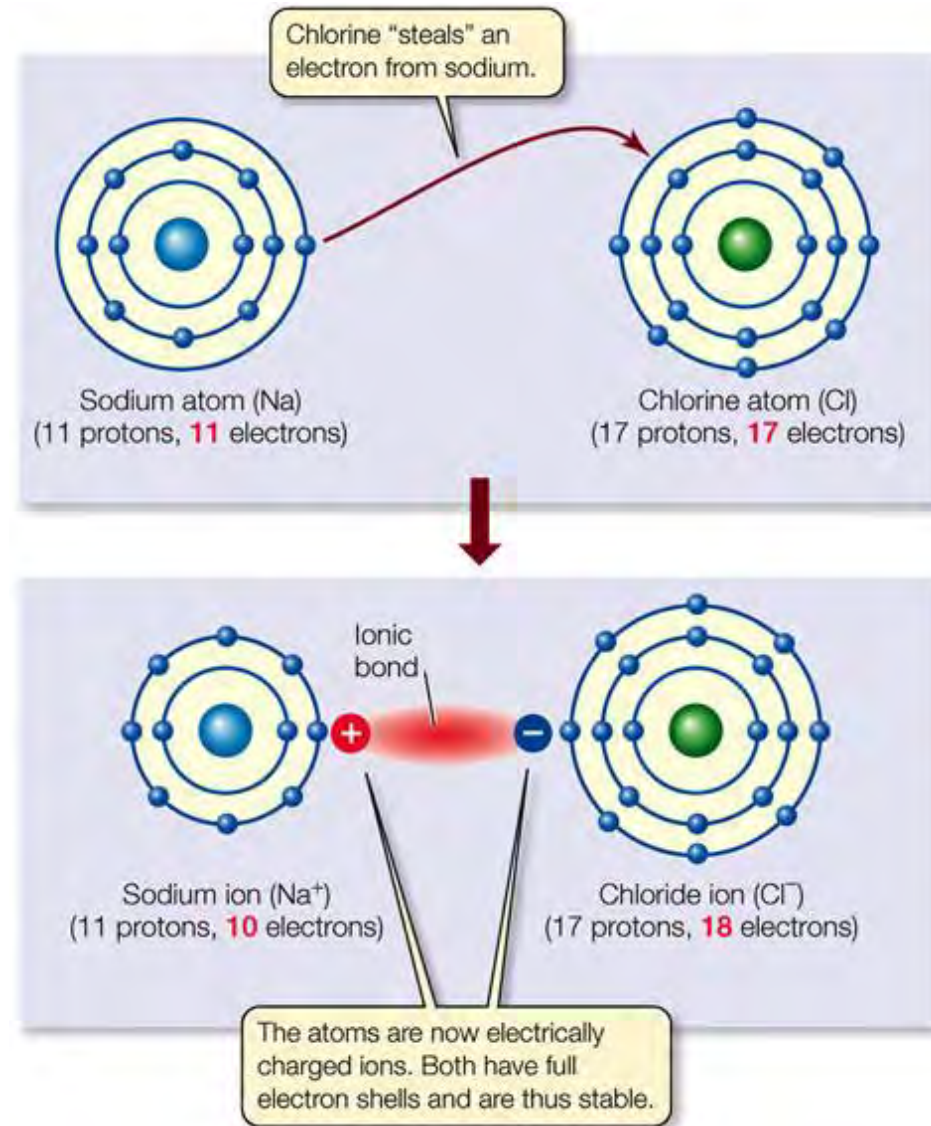
(b)

NaCl crystal



Ionic Bonds

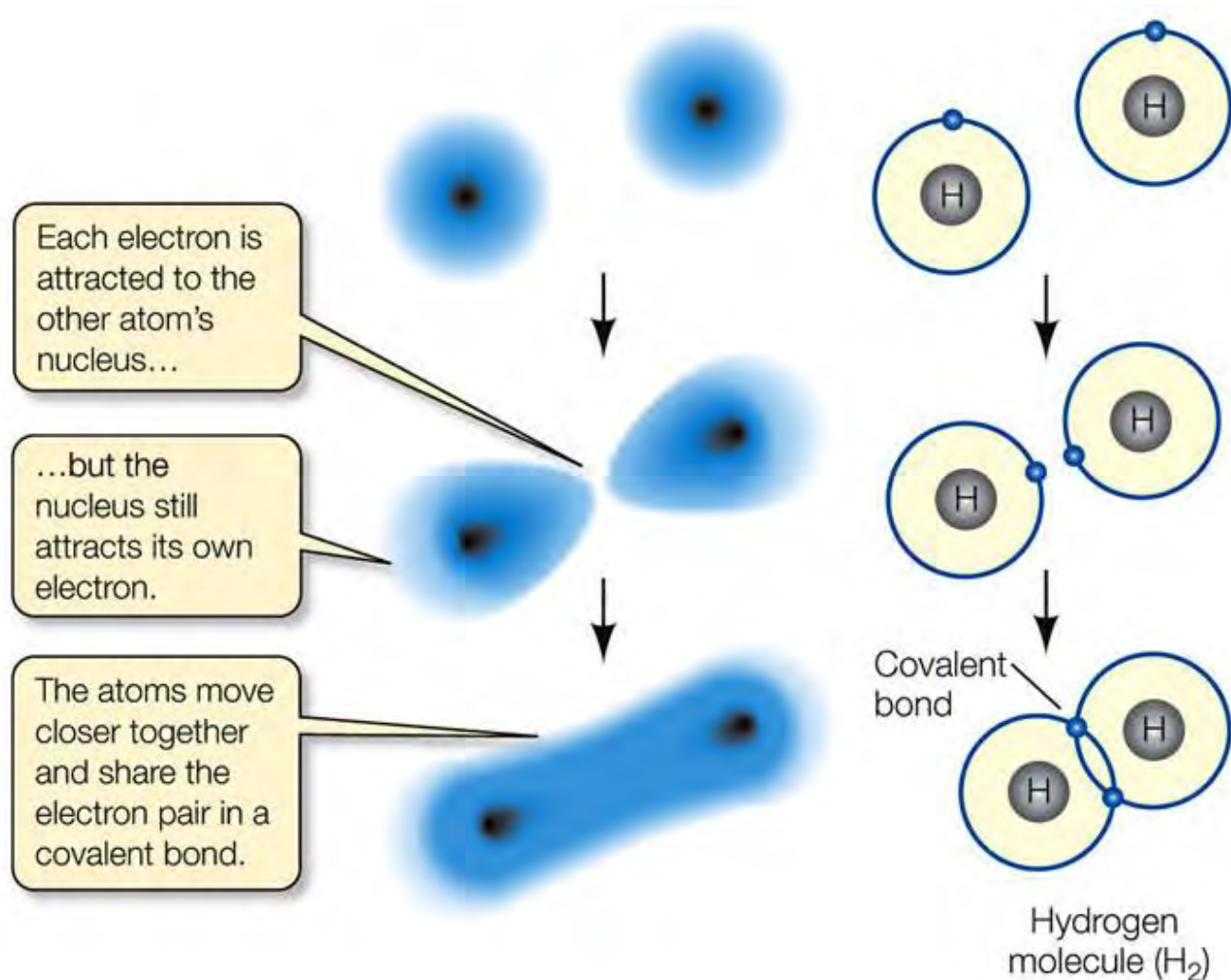
- Formed by the attraction of opposite charges
- Strong in solids but weak in solution
- Form electrolytes



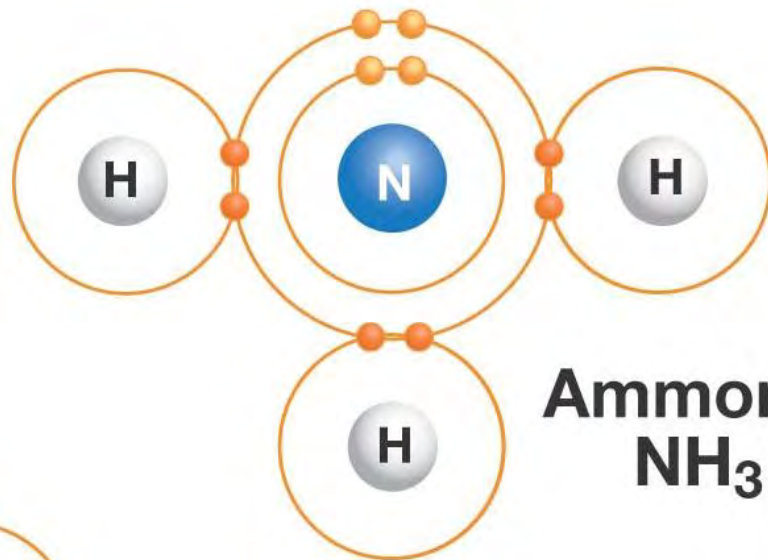
Covalent Bonds

- Formed by sharing of a pair of electrons

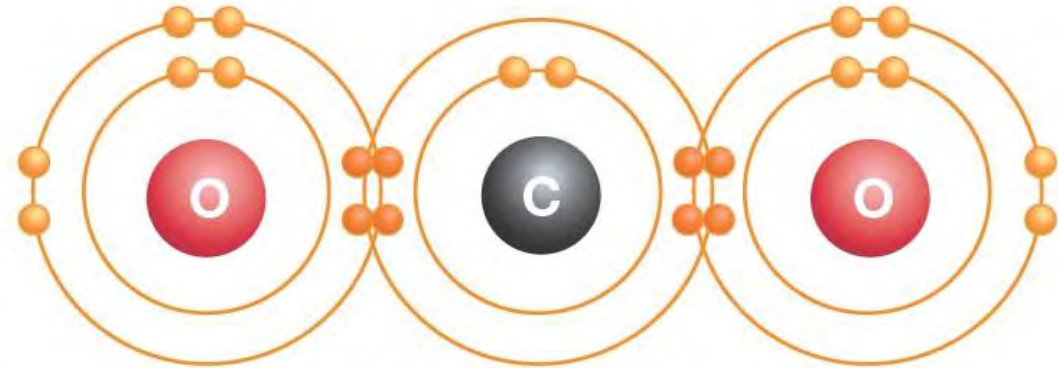
- Strong bonds



Covalent Bonds



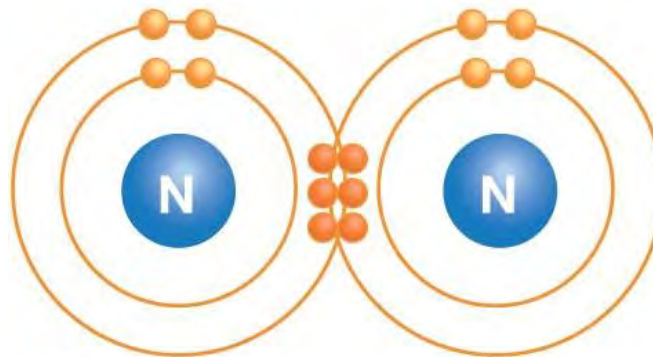
Ammonia
NH₃



Carbon dioxide
CO₂

Single Bond

Double Bond

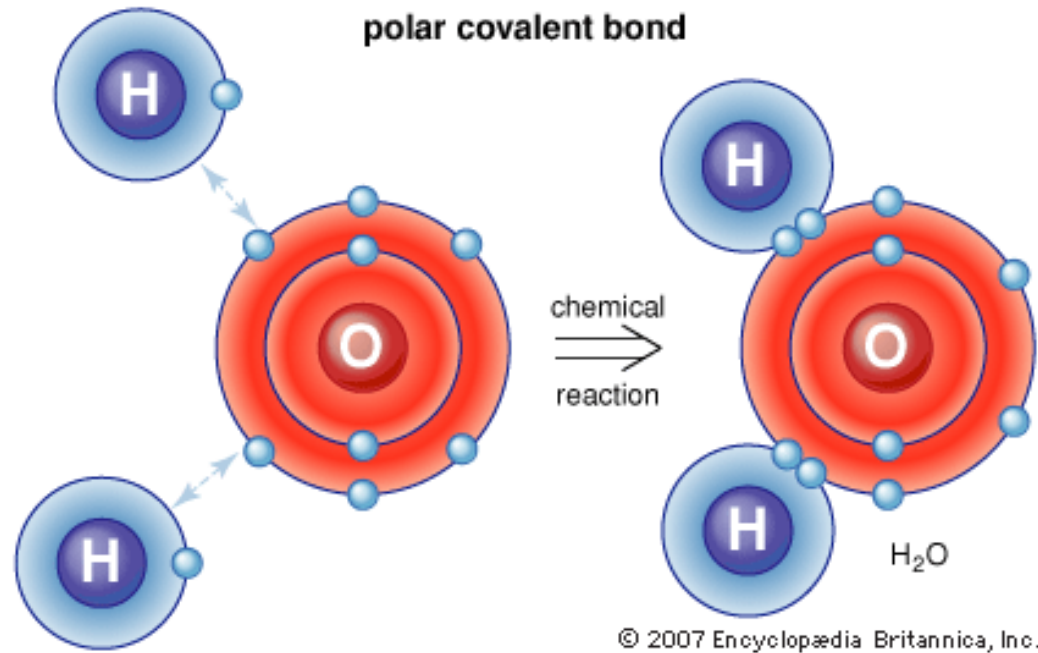


Molecular nitrogen
N₂

Triple Bond

Polar Covalent Bonds

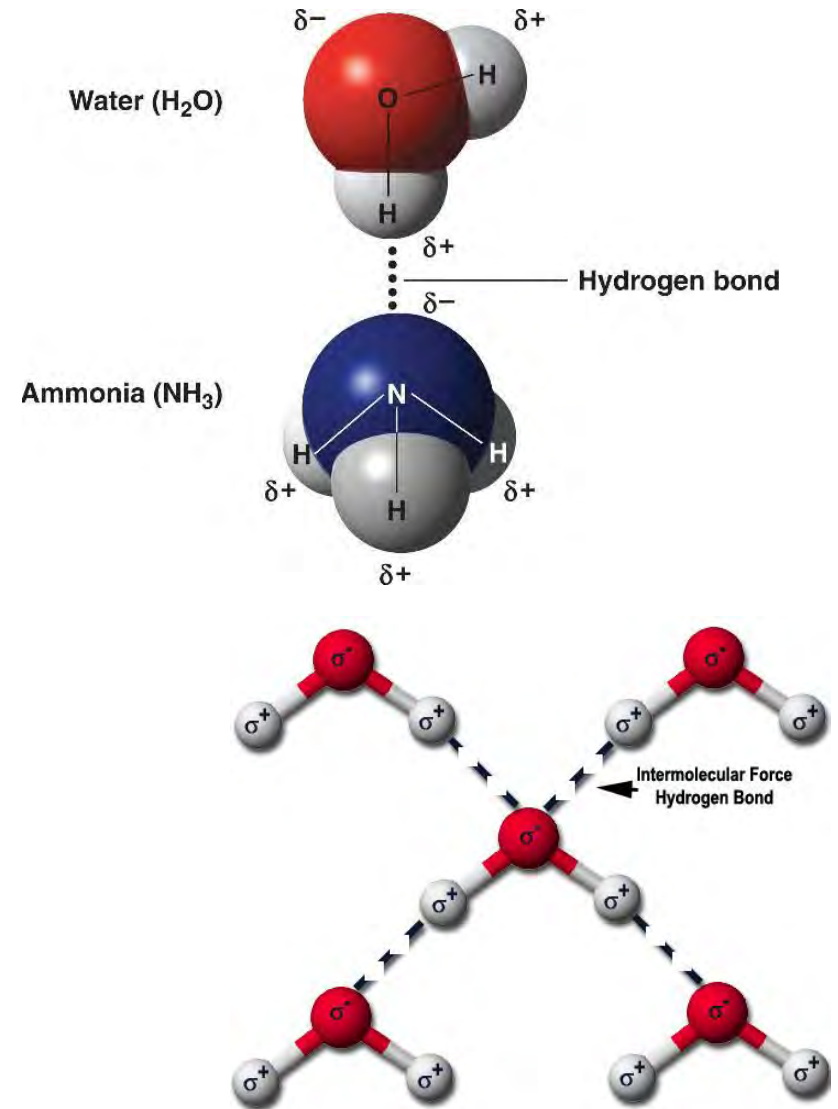
- Sometimes shared electrons are NOT shared equally
 - Creates a dipole
- Polar bonds formed when a negative end of a molecule is semi-attached to the positive end of another



Since it is polar,
water can easily form
Hydrogen Bonds

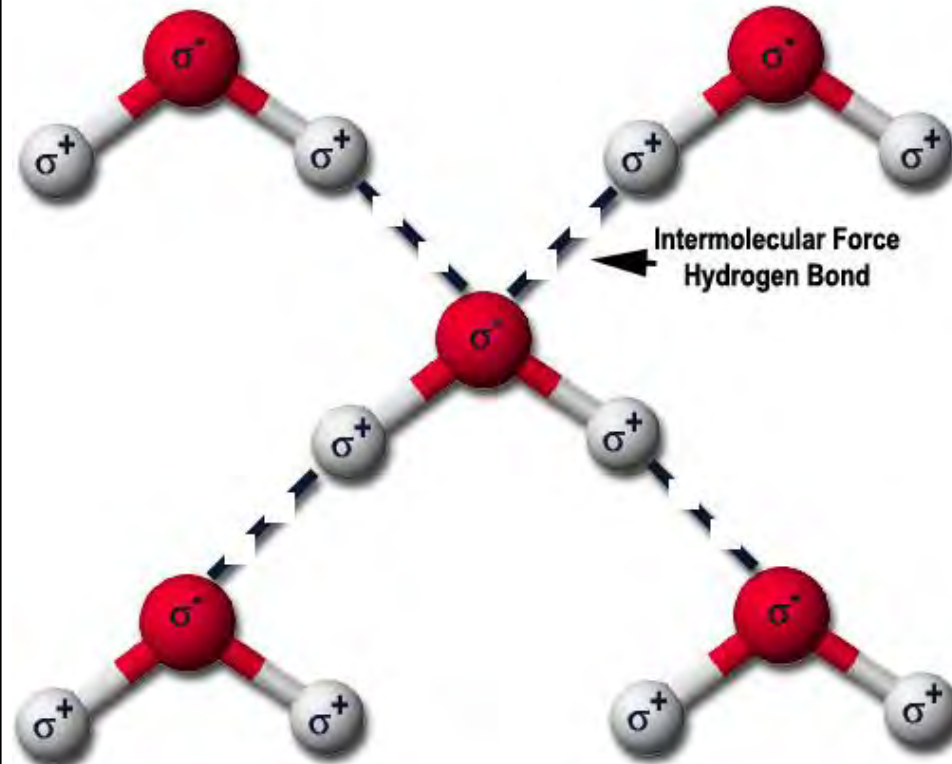
Hydrogen Bonds

- Weak association between (+) and (-) ends of polar molecules
- They hold molecules together
- Form between Hydrogen and Oxygen or Hydrogen and Nitrogen



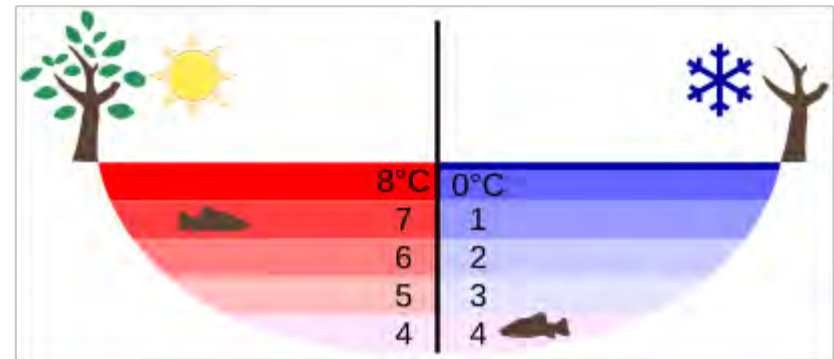
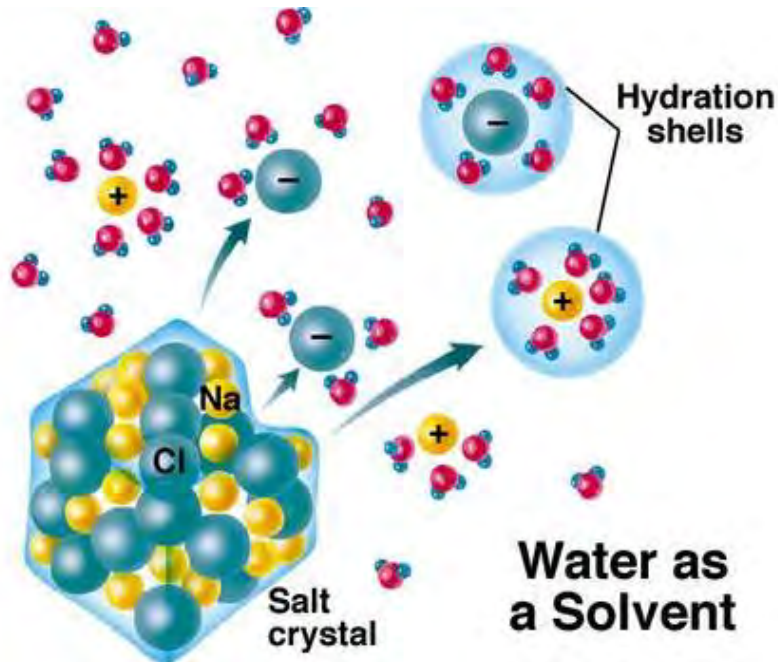
The Importance of Water

- ~60-80% of life is made of water
- Why is it such a great molecule?



Water - Hydrogen Bonds

- High Surface Tension
- Unusual Density
- Universal Solvent



Why life on Earth?



- Gravity high enough to retain an atmosphere
- **Water in liquid form**
- Organic molecules from natural energy sources (i.e. lightning)