



# *Matter*

{Environmental Chemistry

# What is Matter?

Nothing....What's the matter with you?



Just kidding, it is anything that occupies space and has mass

# *Well then, what is Mass?*

It is the measurement of the amount of matter an object contains.

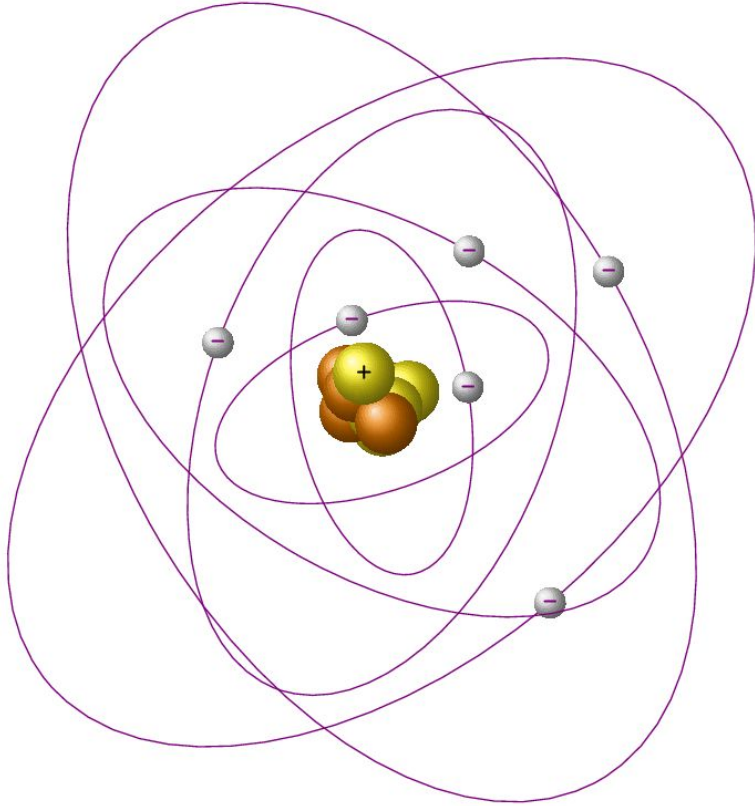


# *What is the difference between mass and weight?*

- Mass is the amount of matter in an object.
- Weight is the gravitational pull on an object.



# *What is an Atom?*

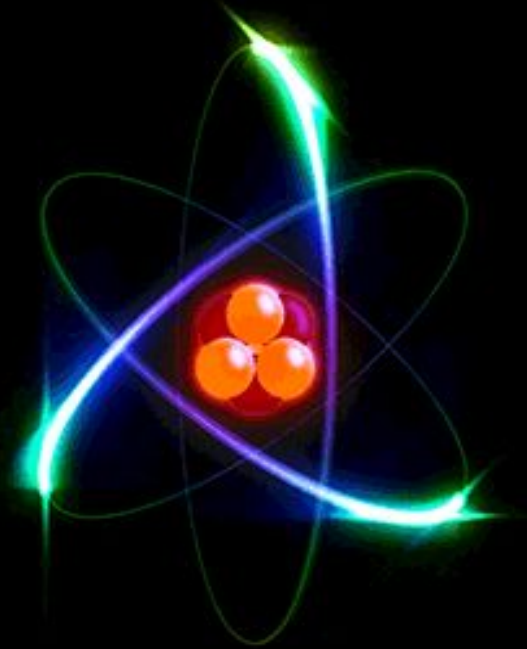


The basic building blocks of matter are known as atoms.

An atom is the smallest particle that can contain the chemical properties of an element.

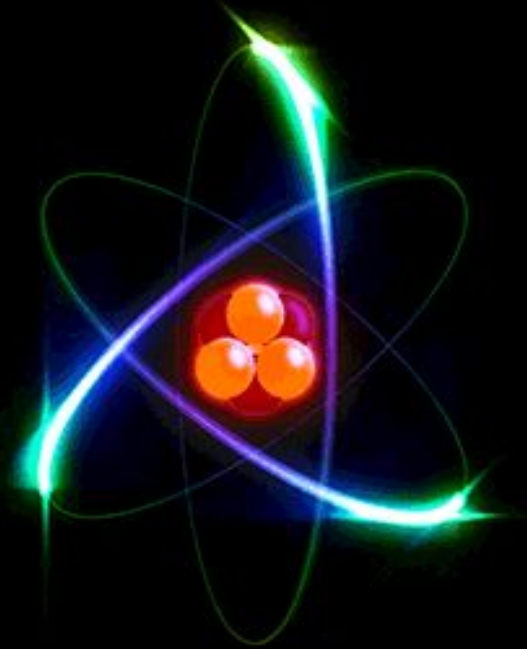
# *What Makes an Atom?*

- Protons
  - subatomic particle occurring in all atomic nuclei, with a positive electric charge equal in magnitude to that of an electron, but of opposite sign



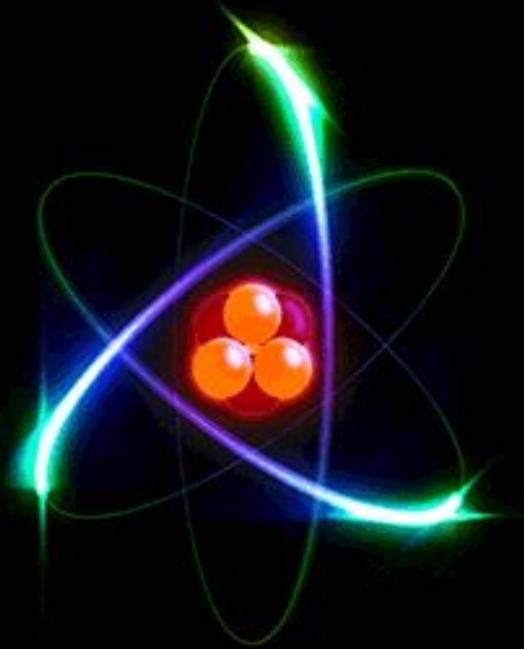
# *What Makes an Atom?*

- Electrons
  - Subatomic particle with a negative charge.
  - Electrons orbit the nucleus of an atom.



# *What Makes an Atom?*

- Neutrons
  - subatomic particle that has a neutral charge
  - Found in the nucleus of an atom



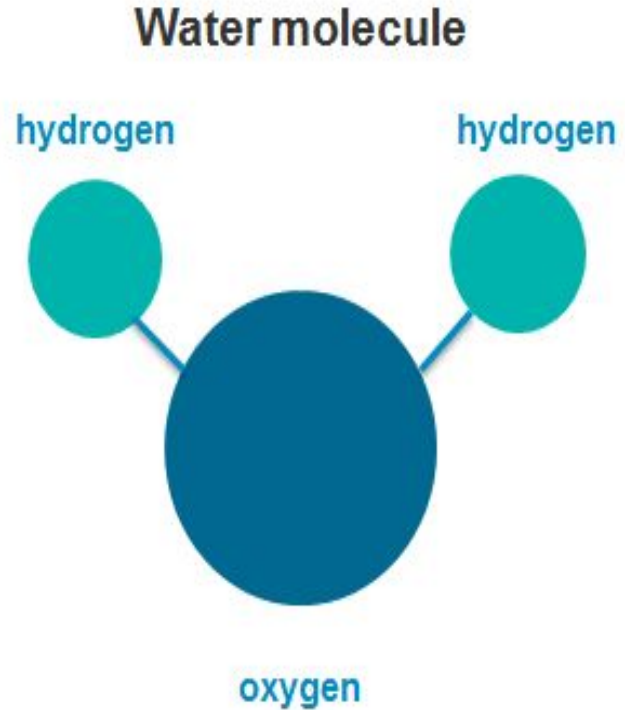


# *What is a Molecule?*

A particle that contains more than 1 atom of a single element. Ex:  $O_2$ ,  $H_2$

# *Then what is a compound?*

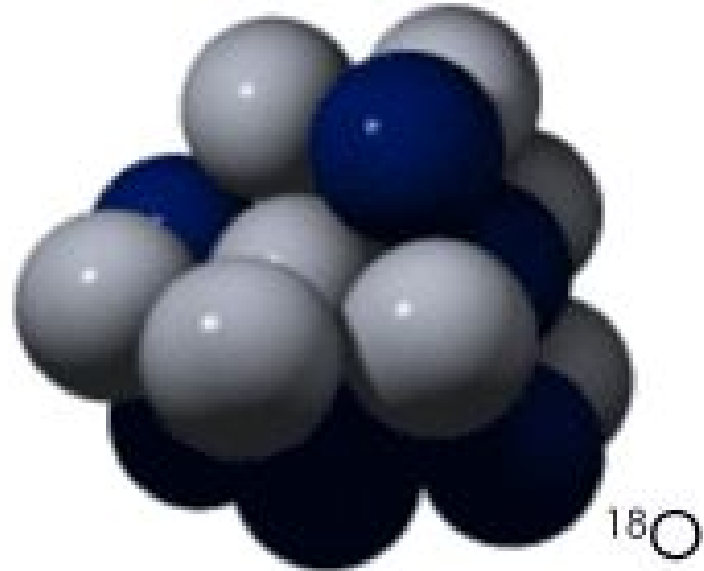
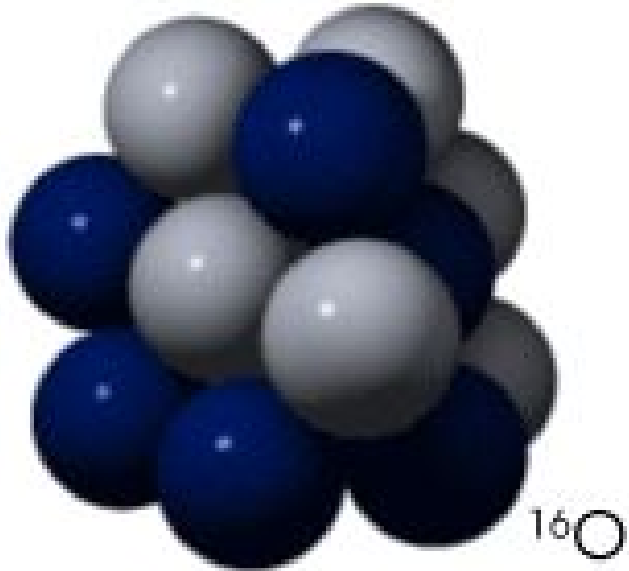
A compound is a molecule containing more than one element. Ex: NaCl (Salt)



# *Did you know that...*

The same element can have different numbers of neutrons?

They are called isotopes.



# *How do Atoms Connect to one another?*

Through chemical bonds.

Covalent bonds

Ionic bonds

Hydrogen bonds



# Covalent Bonds

Bond that is formed when two atoms share electrons. Ex:  $\text{CO}_2$

Wow, we both feel so cozy and comfortable after sharing the blanket.

Sarah, I'm cold.

I'm cold too



Emily



Sarah

Emily and Sarah  
→  
share the blanket



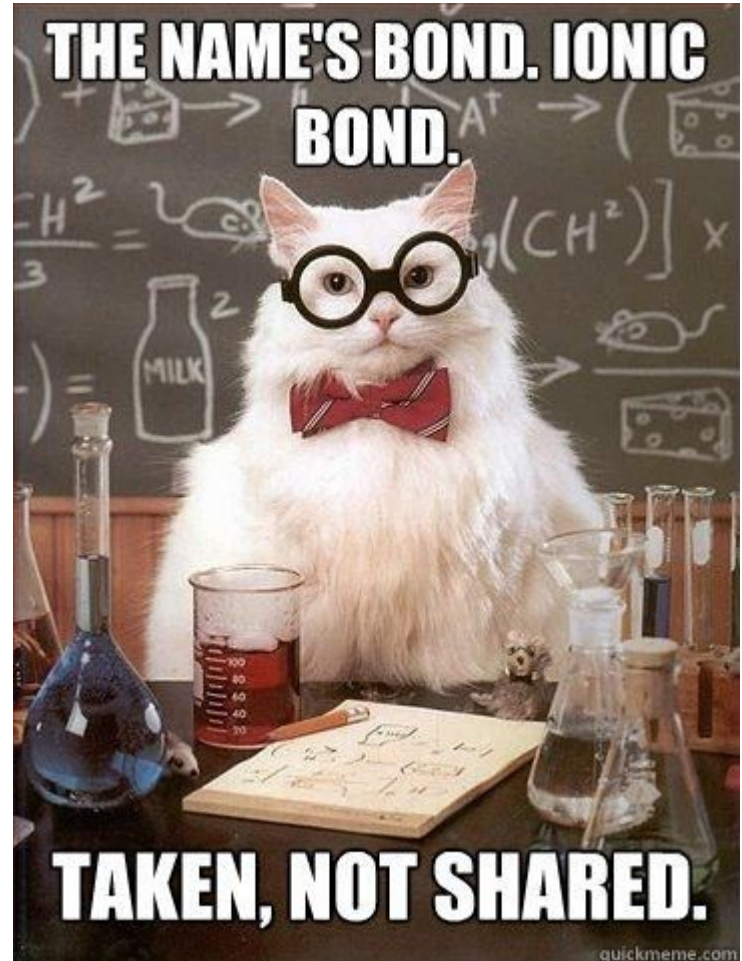
Emily

Sarah

# *Ionic Bonds*

A chemical bond between two atoms, ionic bonds form when one atom gives up one or more electrons to another atom. These bonds can form between a pair of atoms or between molecules and are the type of bond found in salts. This creates a positively charged atom and a negatively charged atom, which are then attracted to each other.

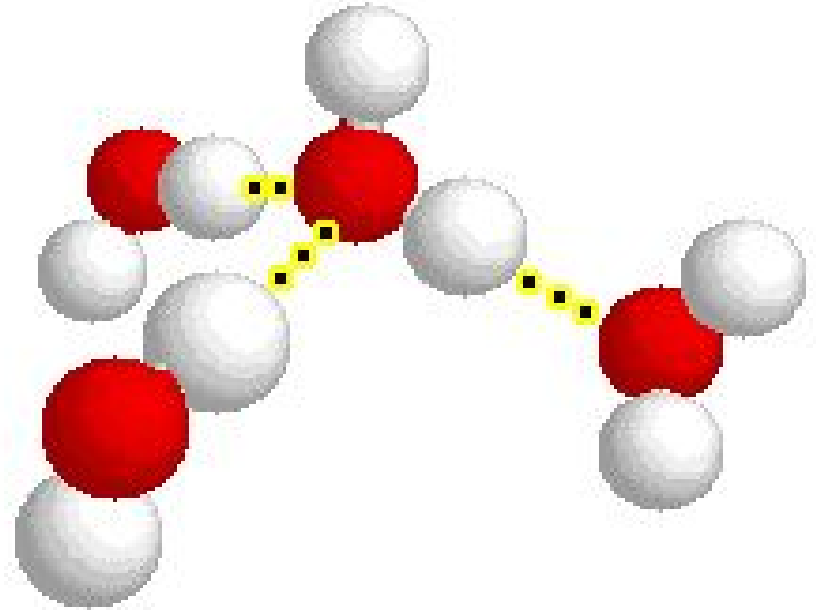
Ex: NaCl



# *Hydrogen Bonds*

This is a weak bond. This occurs when a atoms are covalently bonded to one atom and are attracted to an atom on another molecule.

Ex: H<sub>2</sub>O



# *Why is water special?*

- It occurs in all three states naturally on Earth making it a mineral
- Makes up 70% of the Earth
- Scientific evidence suggests that life originated in water and stayed there for 3 billion years before moving to land.
- Every organism, even if it lives on land, relies on water for survival

# Why is water special?

- It has cohesive nature.
  - Cohesion is when the molecules stick to themselves. Water molecules are attracted to other water molecules. Cohesion between water molecules are so strong that some animals and bugs can walk on water! This is also referred to as surface tension.
  - Adhesion is when water molecules are attracted to other substances. Ex: meniscus in a test tube, water climbing to leaves of trees



# Why water is special

- Density of ice vs. water
  - Water molecules in ice are farther apart than liquid water making ice less dense than water
  - This is why ice floats in water

- Density of

- Ice =  $0.9167 \text{ g/cm}^3$

water =  $1 \text{ g/cm}^3$

# *Why is water special?*

- It resists to temperature change
  - Heating weakens the hydrogen bonds in water, but does not increase the molecular motion, because of this, water can absorb large amounts of energy with only small changes in temperature. This will help stabilize aquatic environmental systems and climates. It takes larger bodies of water longer to heat up and cool down, making them ideal vacation spots.

# *Why is water special?*

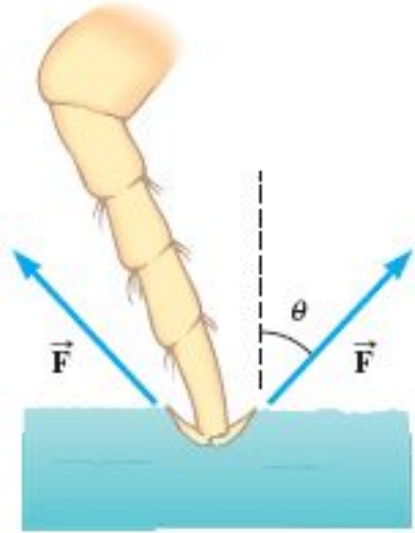
- Water is a universal solvent
  - Water molecules bond well with other polar molecules. Therefore, water can hold or dissolve many other molecules, including chemicals vital for life.

# *Boiling and Freezing*

At atmospheric pressures here on Earth....

- Water boils (turns to gas) at what temperature?
  - $100^{\circ}\text{C}$  ( $212^{\circ}\text{F}$ ) whereas Hydrogen Sulfide boils at  $-60^{\circ}\text{C}$  ( $-76^{\circ}\text{F}$ )
- Water freezes (turns to a solid) at what temperature?
  - $0^{\circ}\text{C}$  ( $32^{\circ}\text{F}$ )

# How insects walk on water



(a)

Herman Eisenbeis/Photo  
Research, Inc.



(b)

**SURFACE TENSION!**

This *water strider* resting on the surface of a lake remains on the surface, rather than sinking, because an upward surface tension force acts on each leg, balancing the force of gravity on the insect.

# *How water moves through trees*

