Introduction to Physical Science

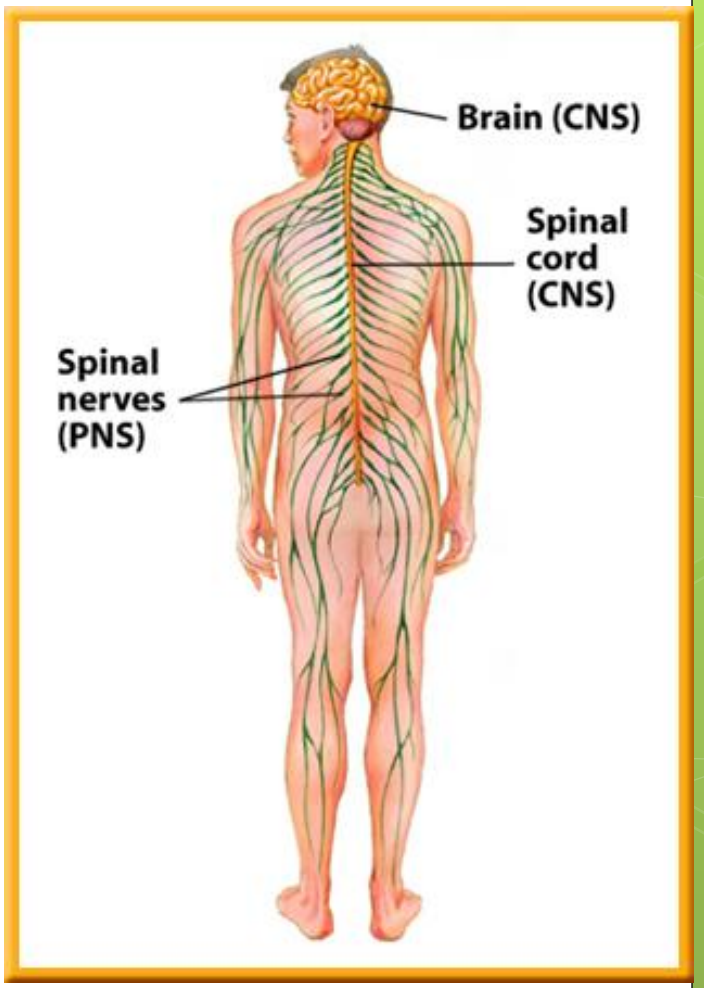
- Introduction to Physical Science
- Matter
- Chemistry
- Force and Motion
- Energy
- Waves, Sound and Light
- Electricity and Magnatism

What is Science?

- Science is a method for studying the natural world.
- It is a process that uses and to gain knowledge about events in nature

What is Science?

- Nature follows a set of rules
- many rules, such as those concerning how the human body works, are complex



What is Science?

- Other rules, such as the fact that Earth rotates about once every 24 h, are much

.

- Scientists ask questions to learn about the natural world.

Defining Science

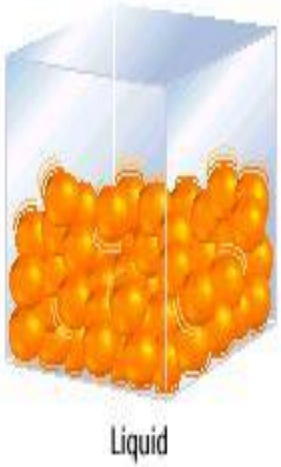
- Life Science
  - the study of living organisms
- Earth Science
  - the study of Earth and space
- Physical Science
  - the study of matter and energy
  - chemistry & physics

Defining Science

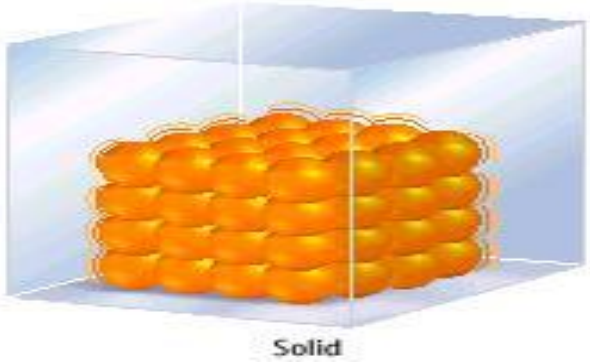
- Sometimes, a scientific study will verlap the categories.
- One scientist, for example, might study the motions of the Human body to understand how to build better artificial limbs.

States of Matter

A. The Kinetic Theory



Liquid

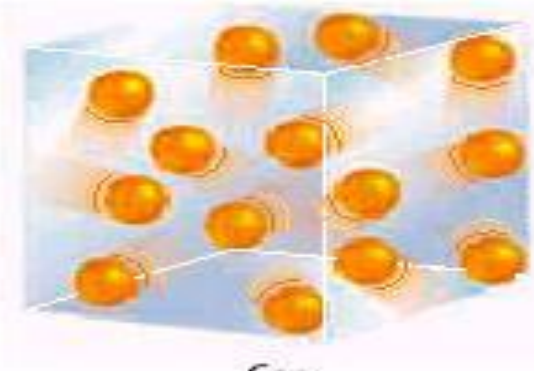


Solid

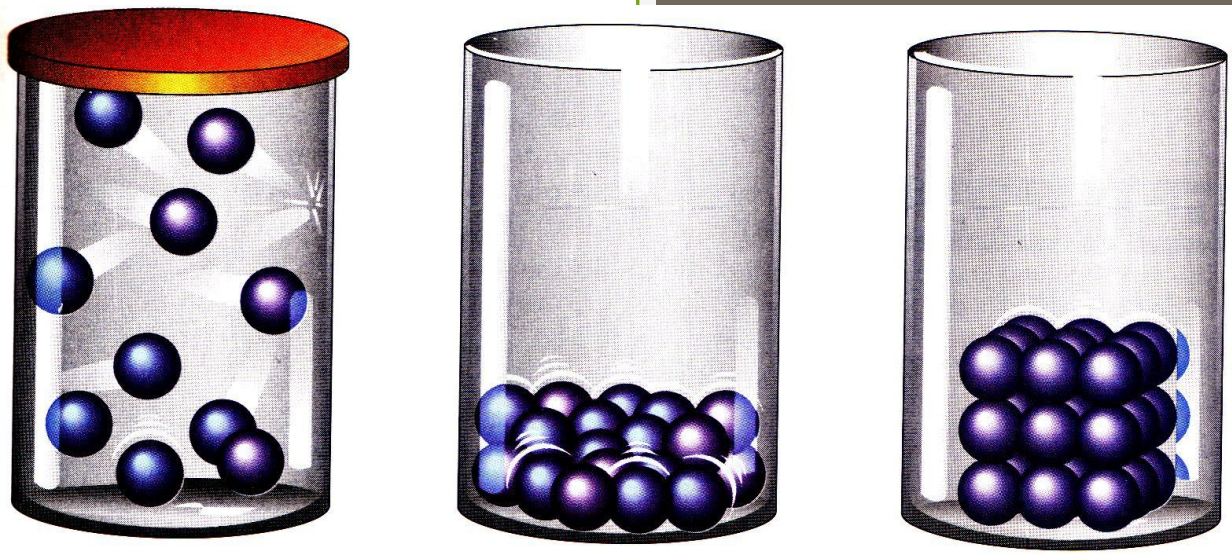
1. All matter is composed of small particles (atoms, molecules, or ions).

2. They are in constant, random motion.

3. They constantly collide with each other and with the walls of their container.



Gas



Gas Liquid Solid

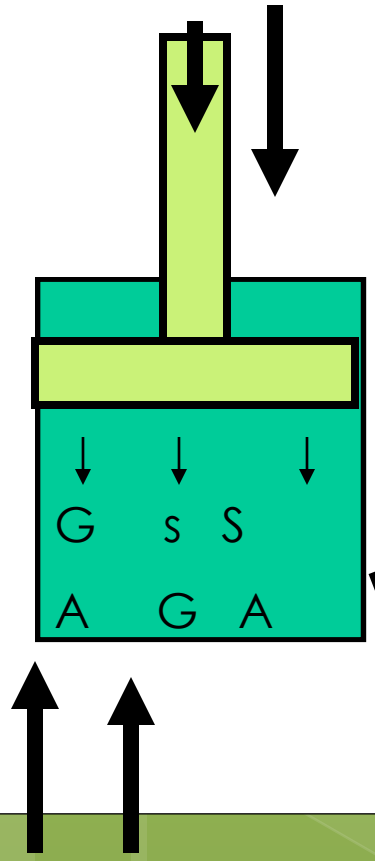
B. Phase Properties

Particle Properties					
Phase	Proximity	Energy	Motion	Volume	Shape
Solid	close	little	vibrational	definite	definite
Liquid	close	moderate	rotational	definite	indefinite
Gas	far apart	a lot	translational	indefinite	indefinite

Boyle's Law.

The volume of a gas varies inversely with its pressure if temperature remains constant

Pushing the plunger down will increase the pressure



Volume of the gas inside the cylinder will decrease

Pressure Increases inside the cylinder because the volume is smaller

Charles's Law

The volume of a gas varies directly with its temperature if pressure remains constant

A balloon shrinks when placed in cold water

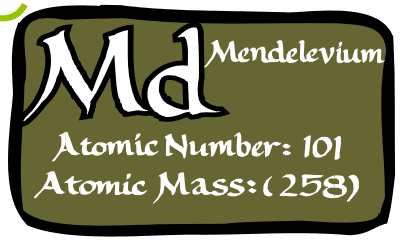
Why is the Periodic Table important to me?

- The periodic table is the most useful tool to a chemist.
- You get to use it on every test.
- It organizes lots of information about all the known elements.

Pre-Periodic Table Chemistry …

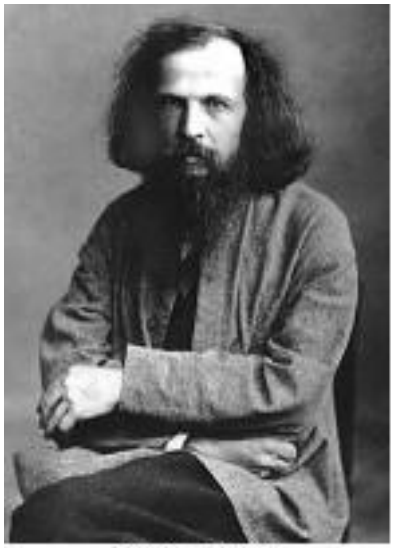
- …was a mess!!!
- No organization of elements.
- Imagine going to a grocery store with no organization!!
- Difficult to find information.
- Chemistry didn't make sense.

Dmitri Mendeleev: Father of the Table



HOW HIS WORKED…

- Put elements in rows by increasing atomic weight.
- Put elements in columns by the way they reacted.



1834-1907

SOME PROBLEMS…

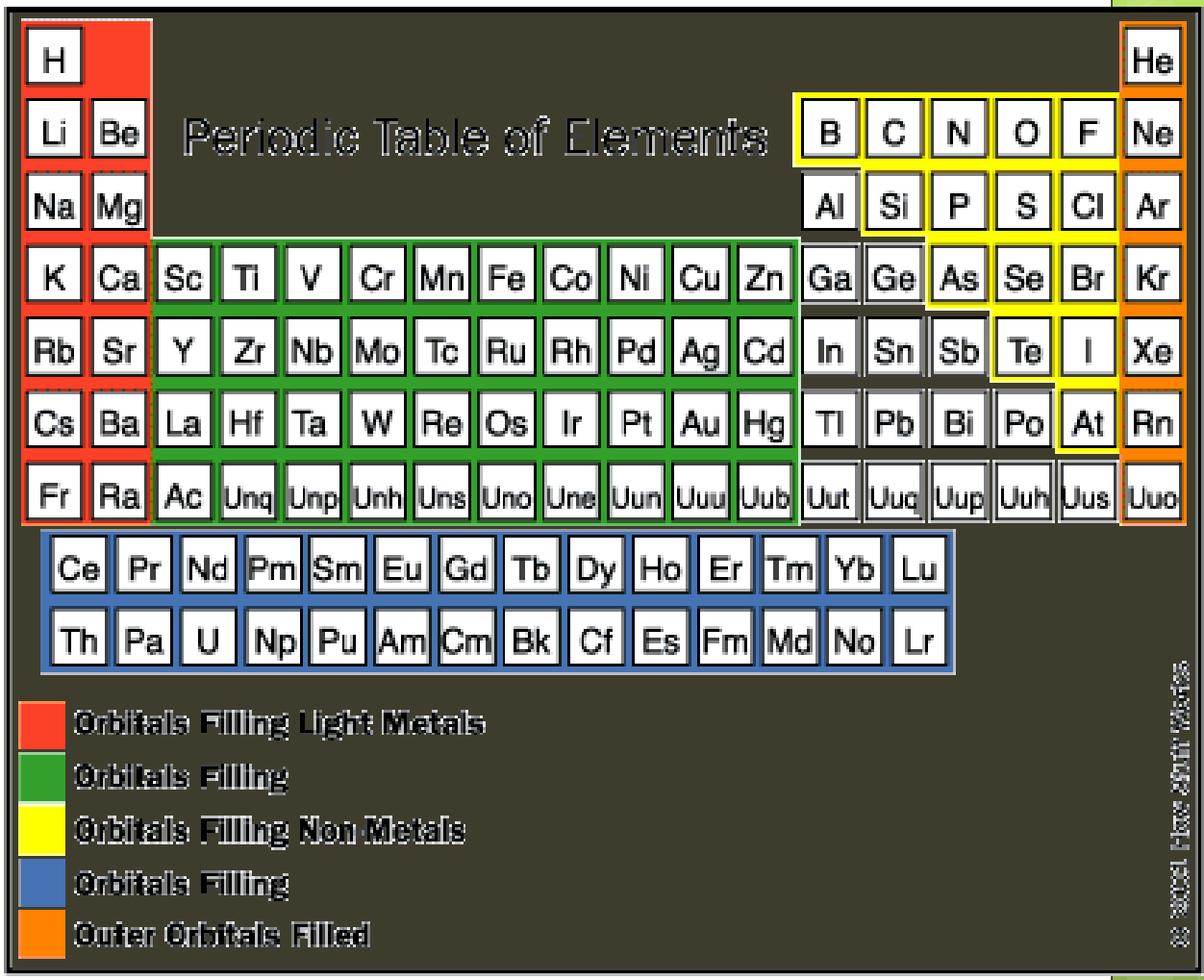
- He left blank spaces for what he said were undiscovered elements. (Turned out he was right!)
- He broke the pattern of increasing atomic weight to keep similar reacting elements together.

The Periodic Law

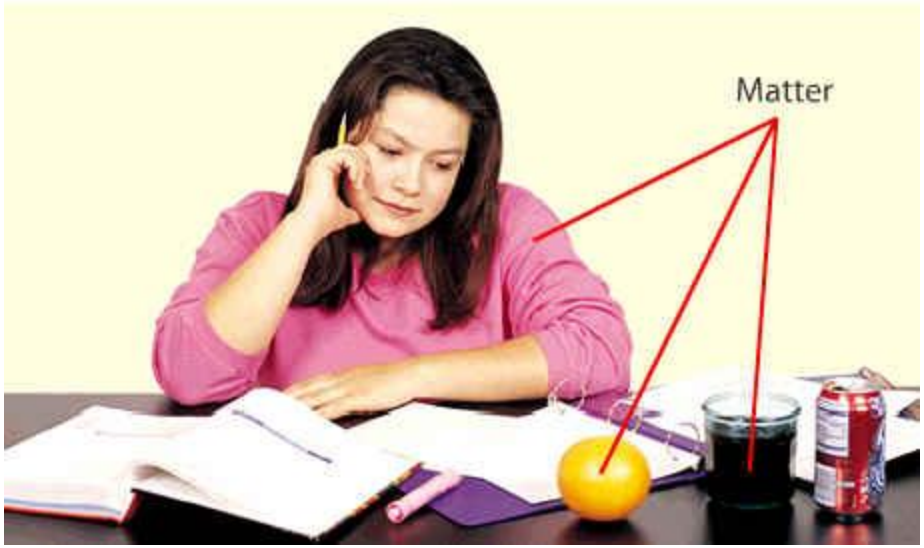
- Properties of elements are a periodic function of their Atomic Numbers.
- So…this means that when you arrange the elements according to their atomic numbers, you see a repetition of their physical and chemical properties.

Relation to elements….

- Chemical elements are arranged in groups that have similar chemical and physical properties.



CHEMISTRY

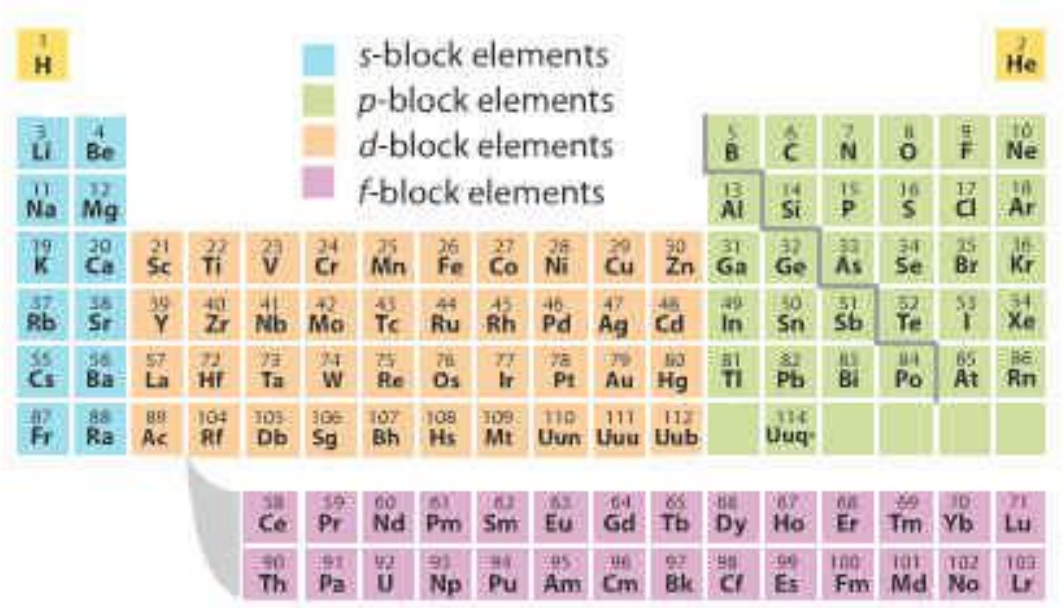


Composition of Matter

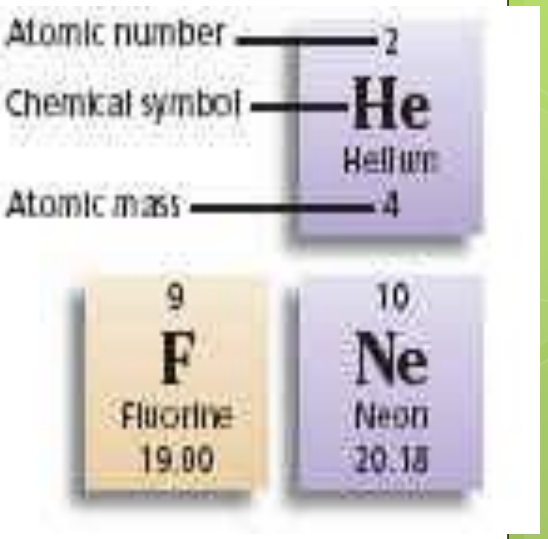
- **Matter** - Everything in universe is composed of matter
  - Matter is anything that occupies space or has mass
    - **Mass** – quantity of matter an object has
    - **Weight** – pull of gravity on an object

Elements

- Pure substances that cannot be broken down chemically into simpler kinds of matter
- More than 100 elements (92 naturally occurring)

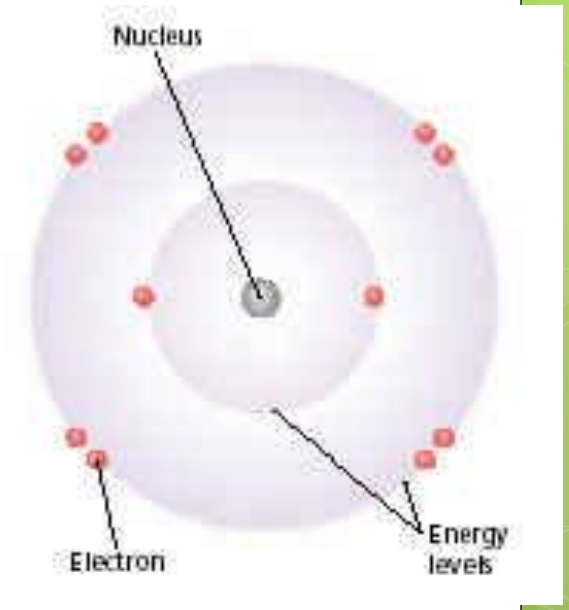


- 90% of the mass of an organism is composed of 4 elements (oxygen, carbon, hydrogen and nitrogen)
- Each element unique chemical symbol
  - Consists of 1-2 letters
  - First letter is always capitalized



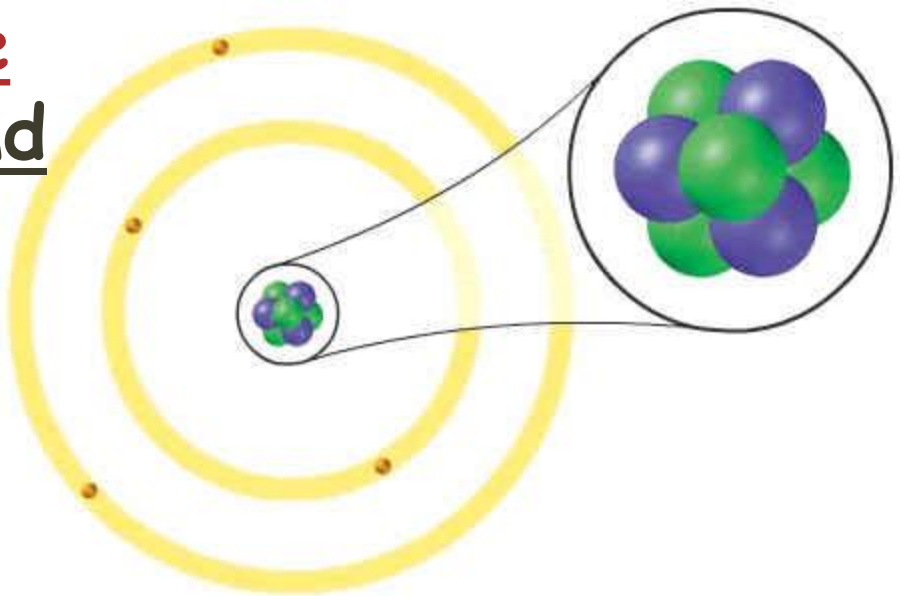
Atoms

- The simplest particle of an element that retains all the properties of that element
- Properties of atoms determine the structure and properties of the matter they compose
- Our understanding of the structure of atoms based on scientific models, not observation



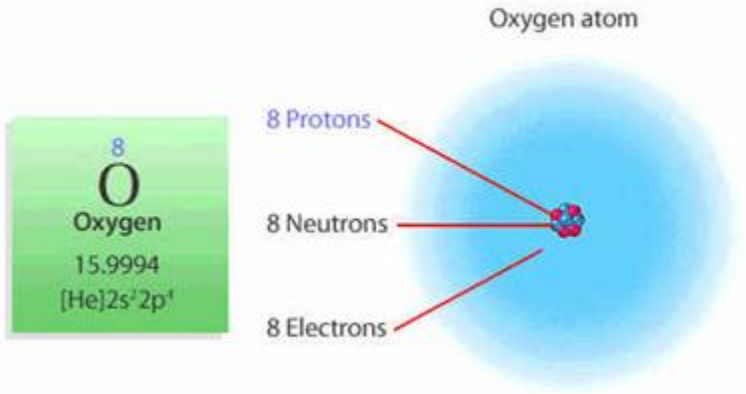
The Nucleus

- Central core
- Consists of positive charged protons and neutral neutrons
- Positively charged
- Contains most of the mass of the atom



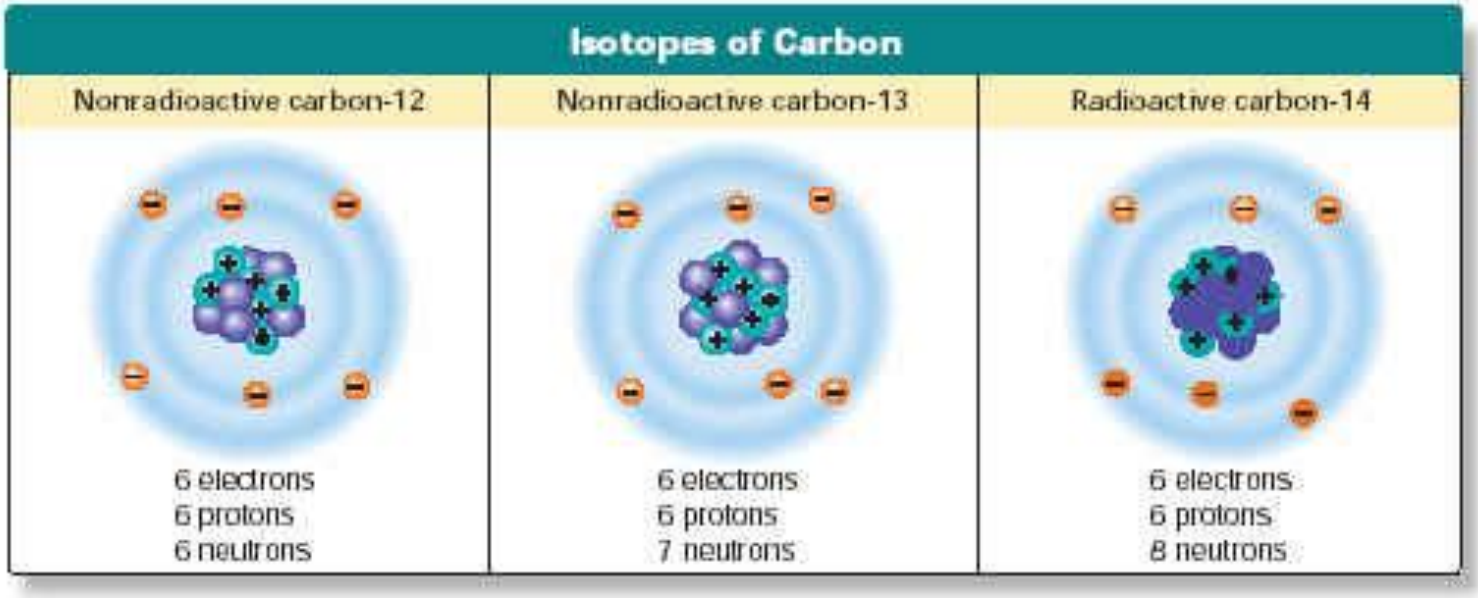
The Protons

- All atoms of a given element have the same number of protons
- Number of protons called the atomic number
- Number of protons balanced by an equal number of negatively charged electrons



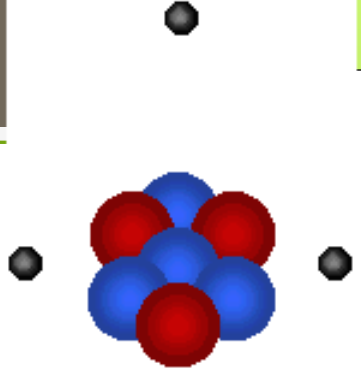
The Neutrons

- The number varies slightly among atoms of the same element
- Different number of neutrons produces isotopes of the same element



Atomic Mass

- Protons & neutrons are found in the nucleus of an atom
- Protons and neutrons each have a mass of 1 amu (atomic mass unit)
- The atomic mass of an atom is found by adding the number of protons & neutrons in an atom
- # of protons + # of neutrons =atomic mass



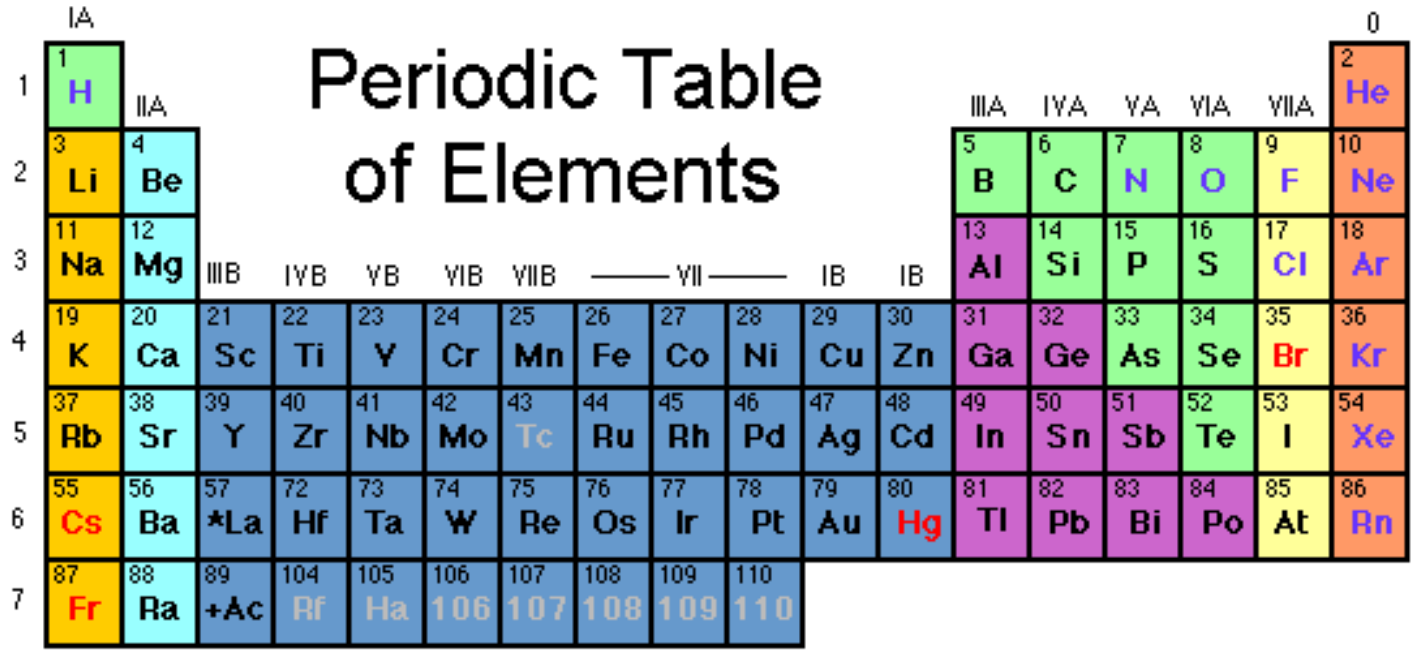
The Electrons

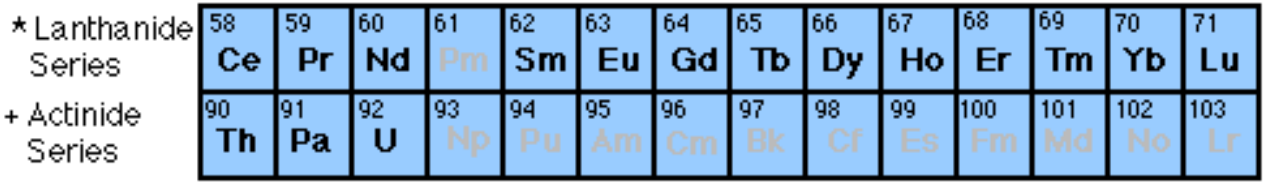
- Negatively charged high energy particles with little or no mass
- Travel at very high speeds at various distances (energy levels) from the nucleus
- Are located around the nucleus

Periodic Table

- Elements are arranged by their atomic number on the **Periodic Table**
- The horizontal rows are called **Periods** & **tell the number of energy levels**
- Vertical groups are called **Families & tell the outermost number of electrons**

Periodic Table of Elements





Legend - click to find out more...

H - gas

Li - solid

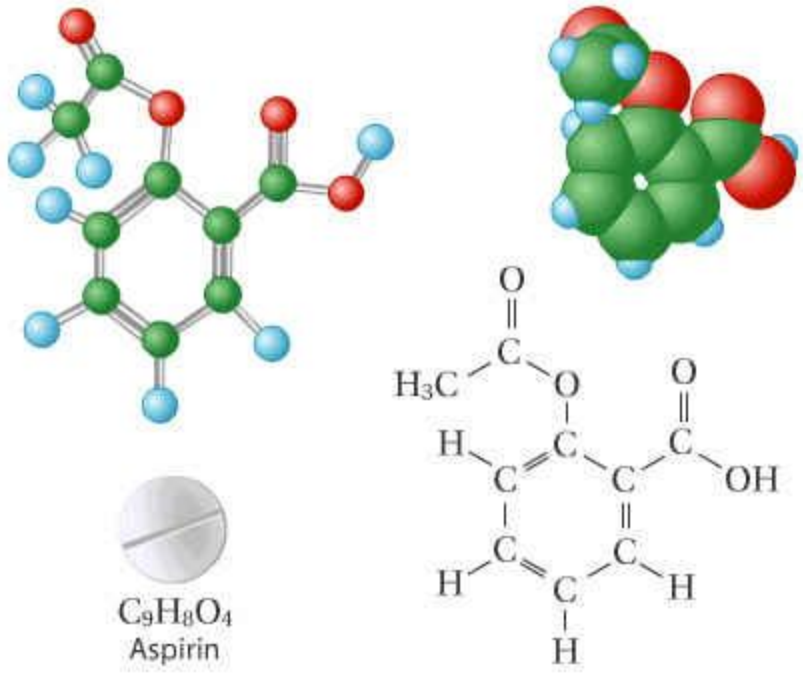
Br - liquid

Tc - synthetic

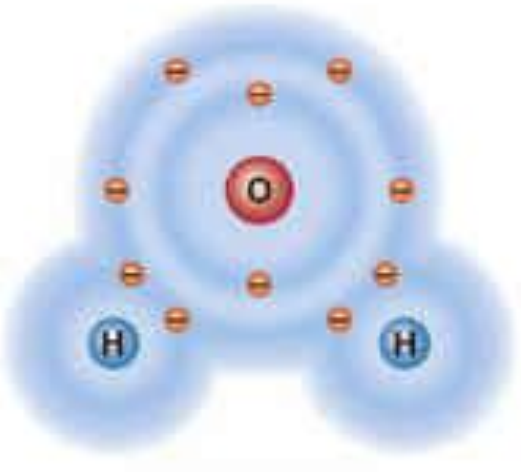
- Non-Metals
- Transition Metals
- Rare Earth Metals
- Halogens
- Alkali Metals
- Alkali Earth Metals
- Other Metals
- Inert Elements

Compounds

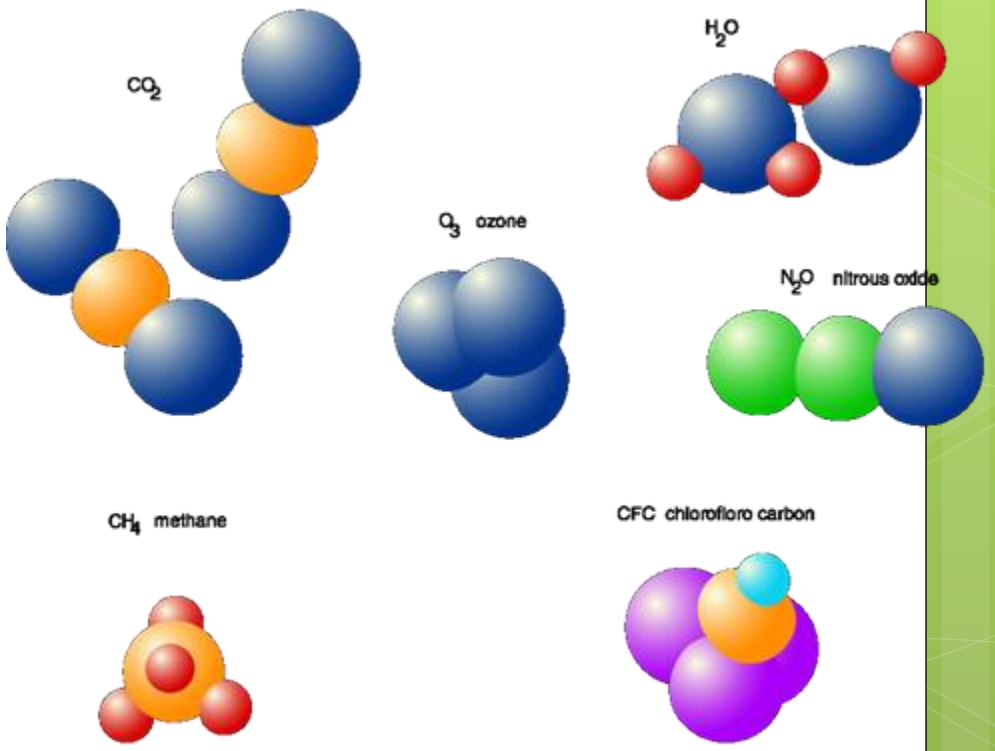
- Most elements do not exist by themselves
- Readily combine with other elements in a predictable fashion



- A compound is a pure substance made up of atoms of two or more elements
  - The proportion of atoms are always fixed
- Chemical formula shows the kind and proportion of atoms of each element that occurs in a particular compound



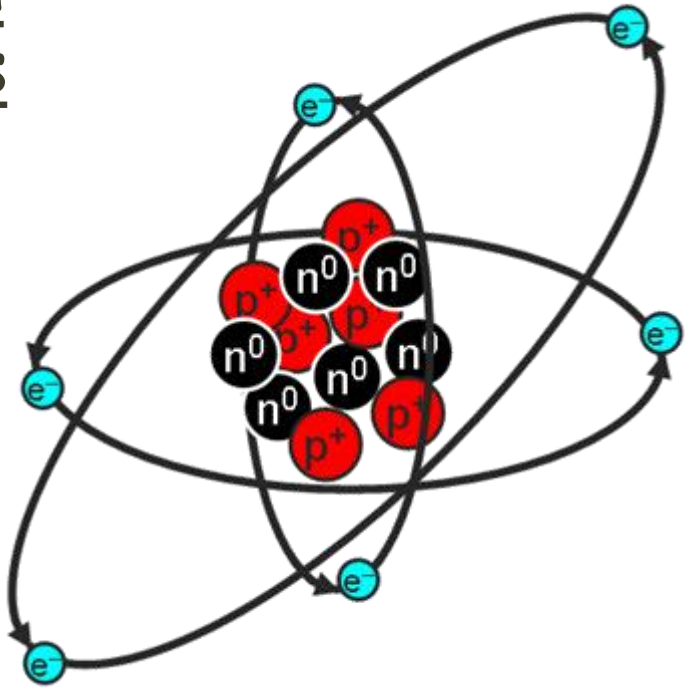
- **Molecules** are the simplest part of a substance that retains all of the properties of the substance and exists in a free state
- Some molecules are large and complex



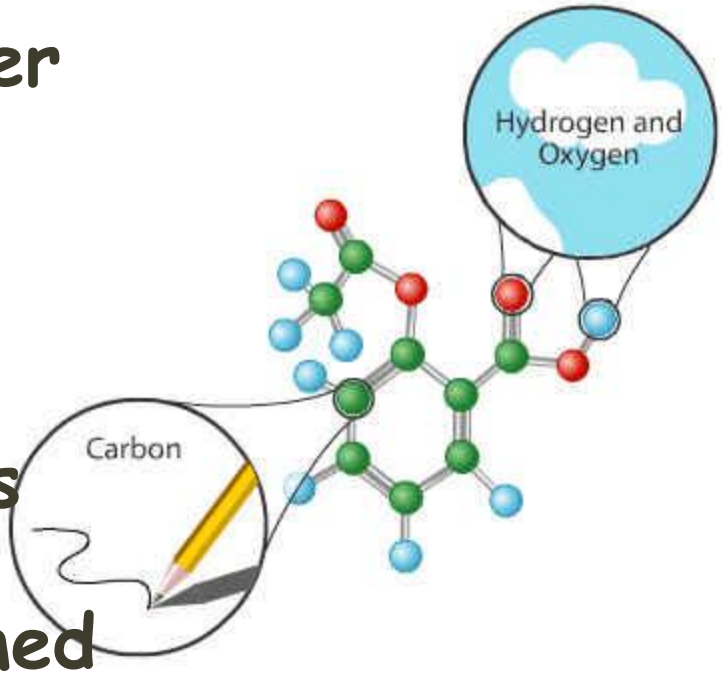
Chemical Formulas

- Subscript after a symbol tell the number of atoms of each element
- H_2O has 2 atoms of hydrogen & 1 atom of oxygen
- Coefficients before a formula tell the number of molecules
- $3O_2$ represents 3 molecules of oxygen or (3x2) or 6 atoms of oxygen

- The tendency of elements to combine and form compounds depends on the number and arrangement of electrons in their outermost energy level
- Atoms are most stable when their outer most energy level is filled (when it has 8 electrons)

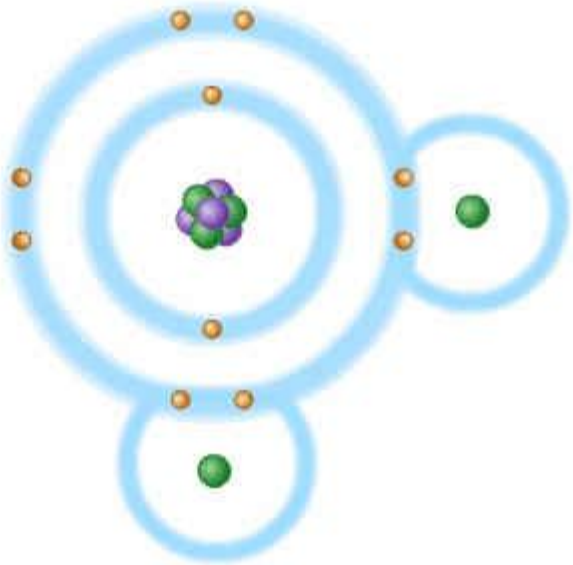


- Most atoms are not stable in their natural state
- Tend to react (combine) with other atoms in order to become more stable (undergo chemical reactions)
- In chemical reactions bonds are broken; atoms rearranged and new chemical bonds are formed that store energy



Covalent Bonds

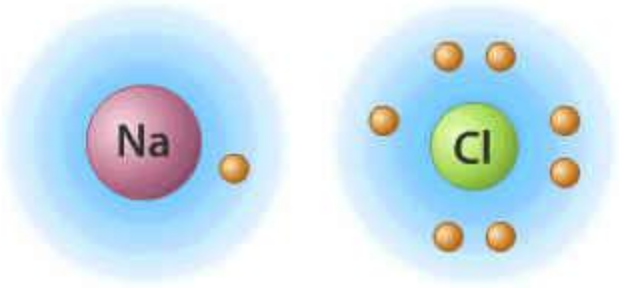
- Formed when two atoms share one or more pairs of electrons



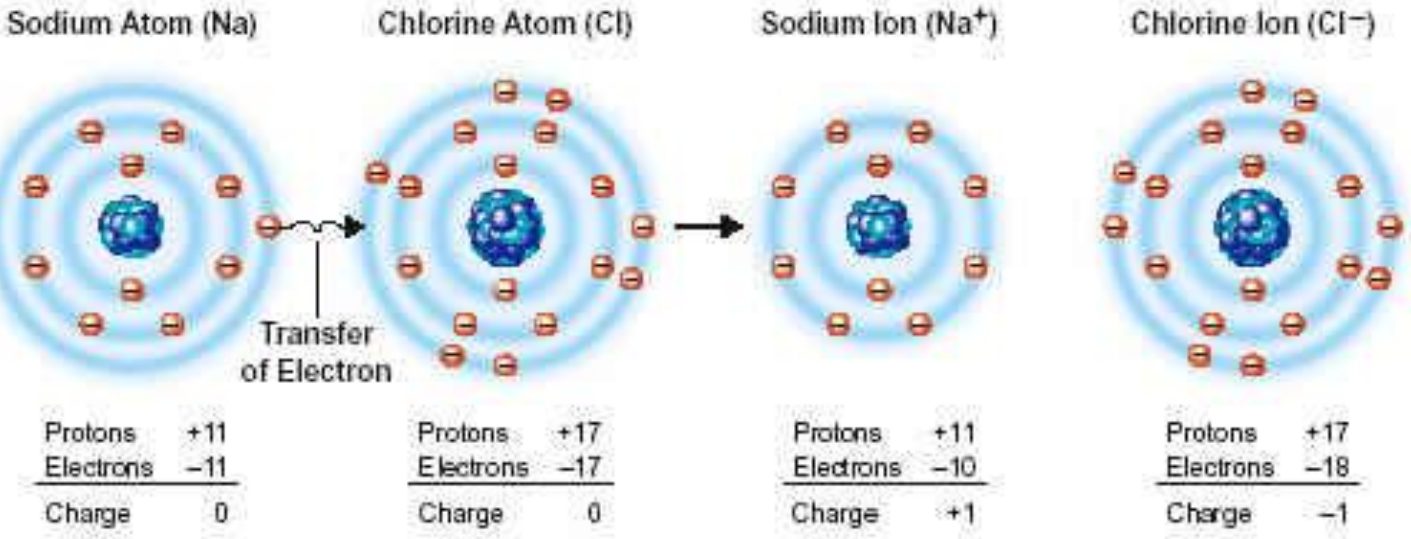
Water (H_2O)

Ionic Bonds

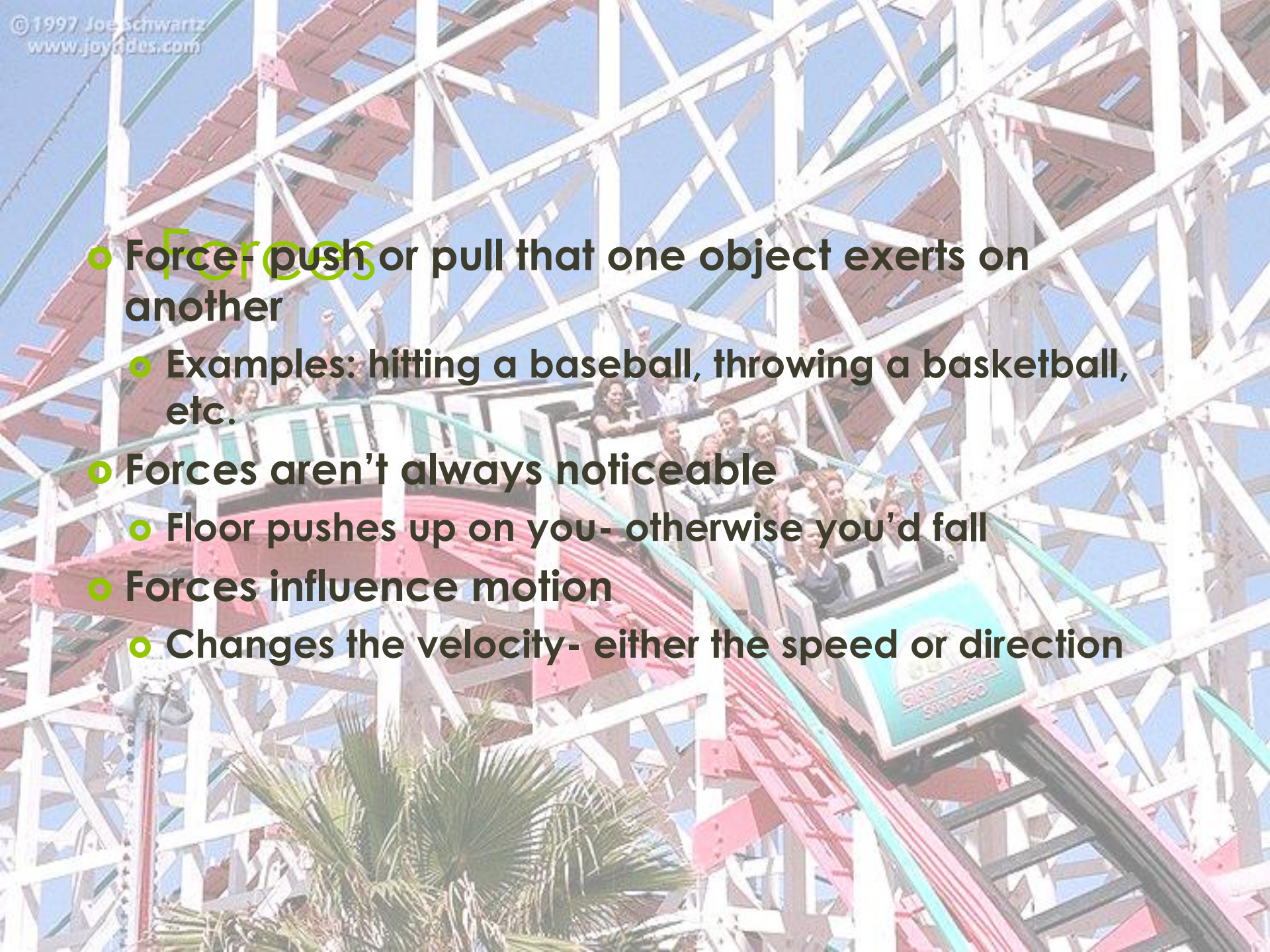
- Some atoms become stable by losing or gaining electrons
- Atoms that lose electrons are called positive ions



- Atoms that gain electrons are called negative ions
- Because positive and negative electrical charges attract each other ionic bonds form



Motion and Forces



Forces

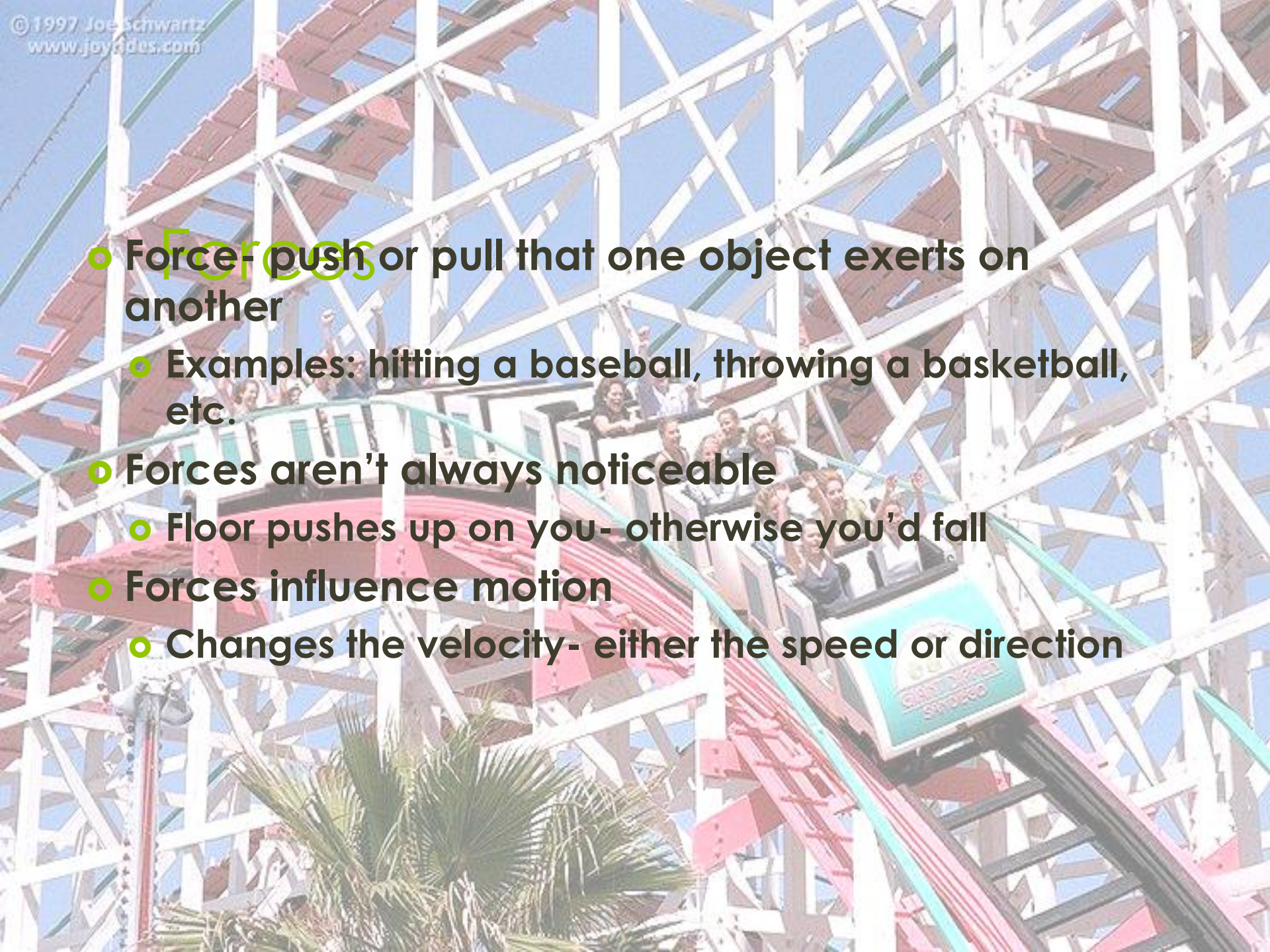
- Force- push or pull that one object exerts on another
  - Examples: hitting a baseball, throwing a basketball, etc.
- Forces aren't always noticeable
  - Floor pushes up on you- otherwise you'd fall
- Forces influence motion
  - Changes the velocity- either the speed or direction

Forces

- Net Force- Total force on an object
  - If forces are balanced, no movement occurs- net force is zero
  - Balanced forces- forces equal in size but opposite in direction
  - Why don't you fall through the floor?? http://www.teachersdomain.org/resources/phy03/sci/phys/mfw/goalstring/index.html
- Unbalanced force- force that is not balanced by another force
  - Results in movement

Motion and Forces

Physical Science 2.3



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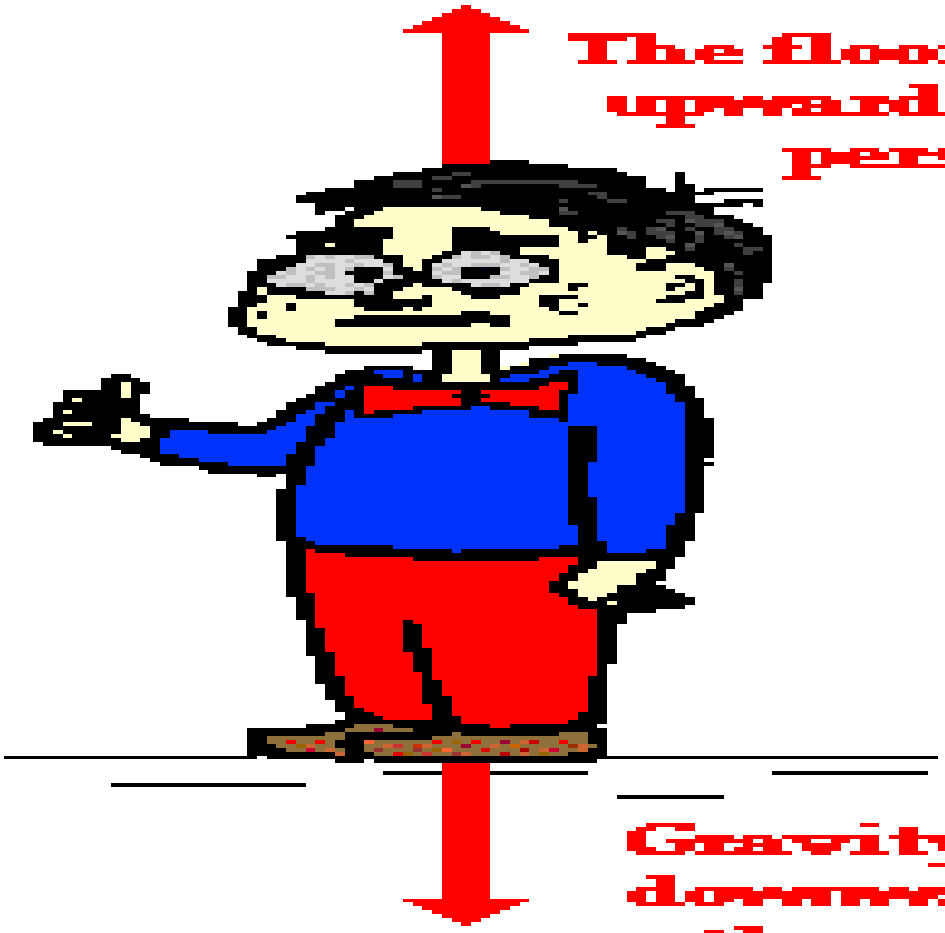
The forces on the person are balanced.



Forces

- Strong force to the right, weak force to the left = move to the right
- Inertia- the tendency of an object to resist any change in motion
  - If moving- stays moving unless acted on by unbalanced force
  - If stopped- stays stopped unless acted on by unbalanced force
  - Car should stay in motion once it starts in motion
    - Problem: friction opposes motion

Forces

- Inertia and injury
  - In car crashes, you tend to remain in motion until you are acted on by a force (until you hit something that resists you)
- Seatbelts
  - Prevents people from being thrown from the car- provides unbalanced force to stop inertia
  - Increases time over which patient slows

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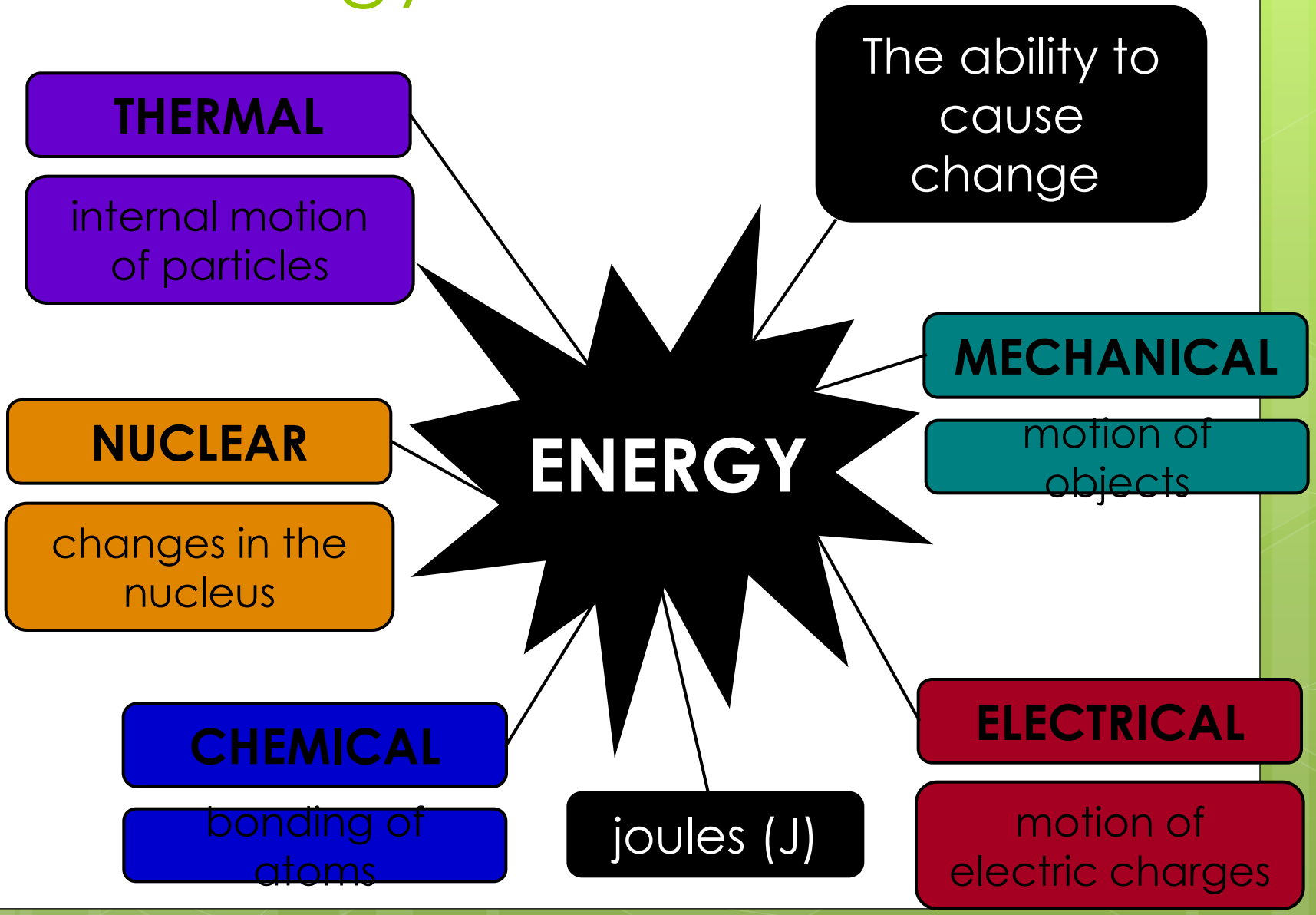
A. Energy


The ability to cause change
THERMAL
internal motion of particles
MECHANICAL
motion of objects
NUCLEAR
changes in the nucleus
ENERGY
CHEMICAL
bonding of atoms
joules (J)
ELECTRICAL
motion of electric charges

A. Energy

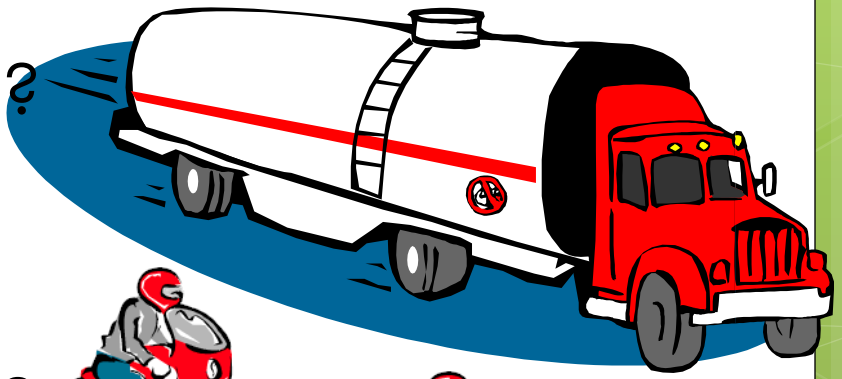
- **Kinetic Energy (KE)**
  - energy in the form of motion
  - depends on mass and velocity

- Which has the most KE?

  80 km/h truck

- Which has the least KE?

  50 km/h motorcycle



80 km/h

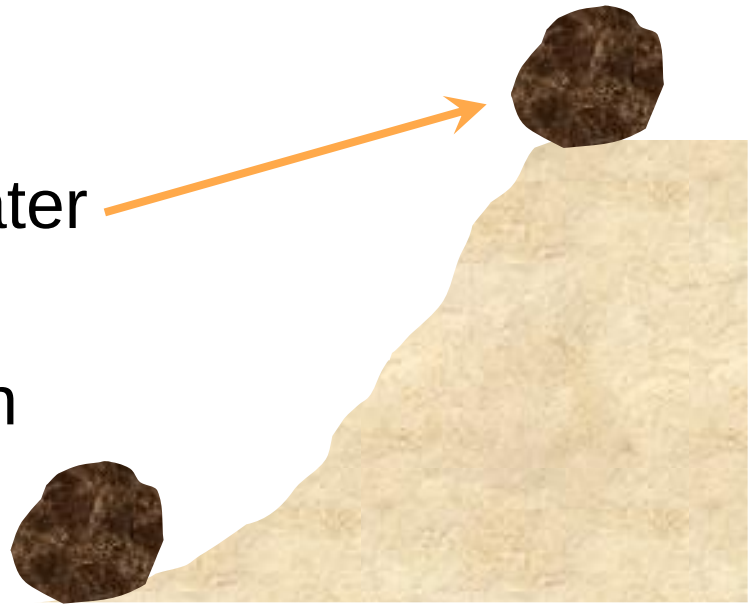
50 km/h

80 km/h

A. Energy

- **Potential Energy (PE)**
  - stored energy
  - depends on position or configuration of an object

- Which boulder has greater gravitational PE?
- What other ways can an object store energy



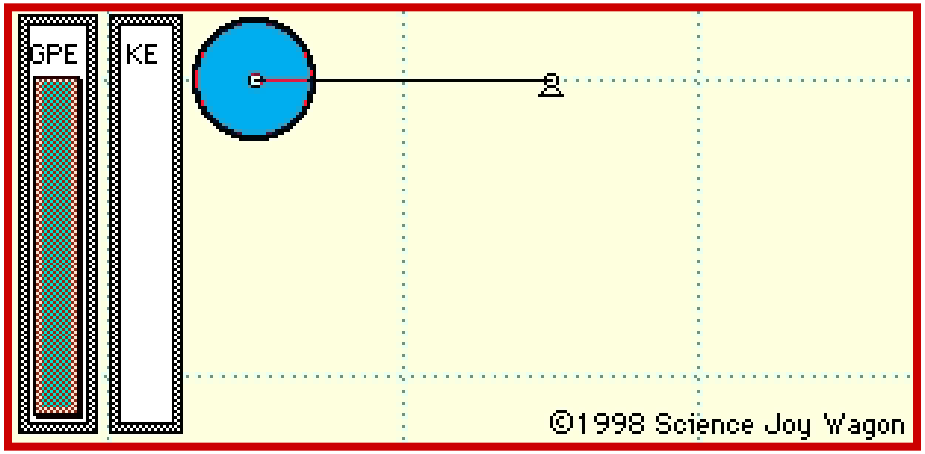
C. Conservation of Energy

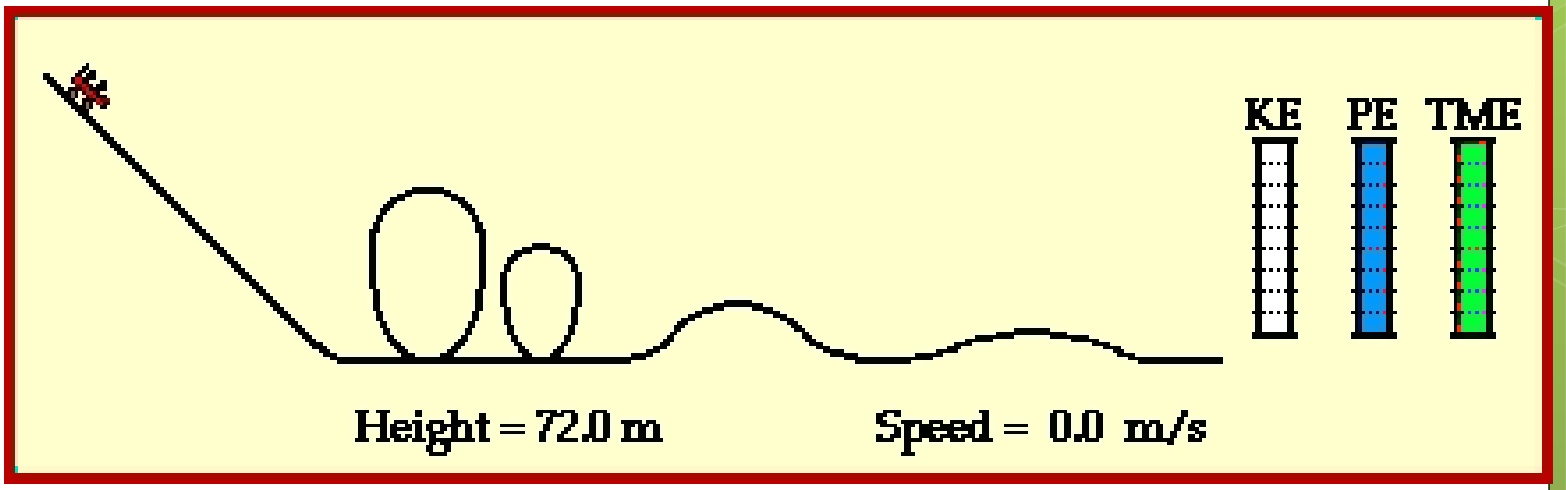
- **Law of Conservation of Energy**
  - Energy may change forms, but it cannot be created or destroyed under ordinary conditions.

- EX:
  - PE → KE
  - mechanical → thermal
  - chemical → thermal

C. Conservation of Energy

PE ⇔ KE



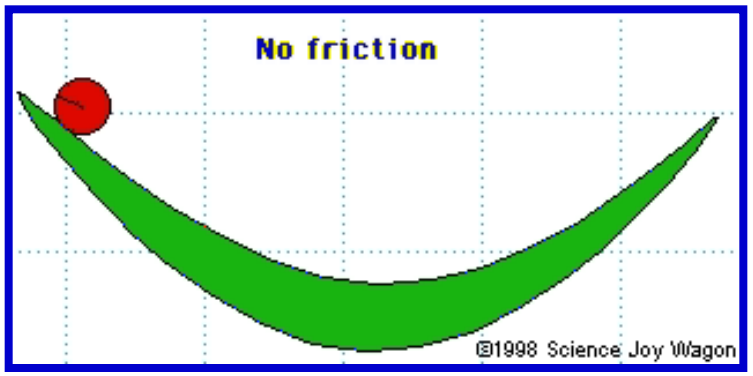


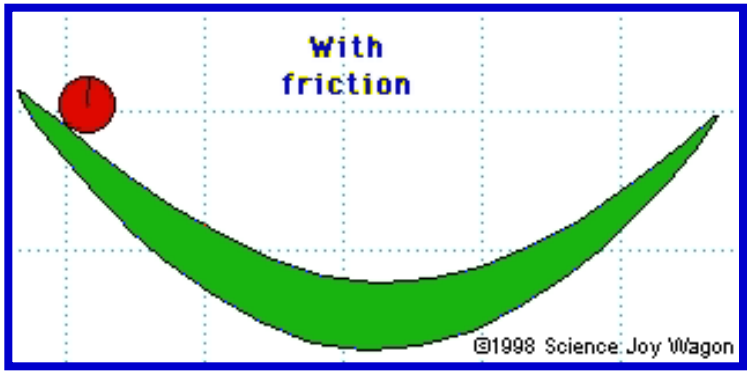
View pendulum animation.

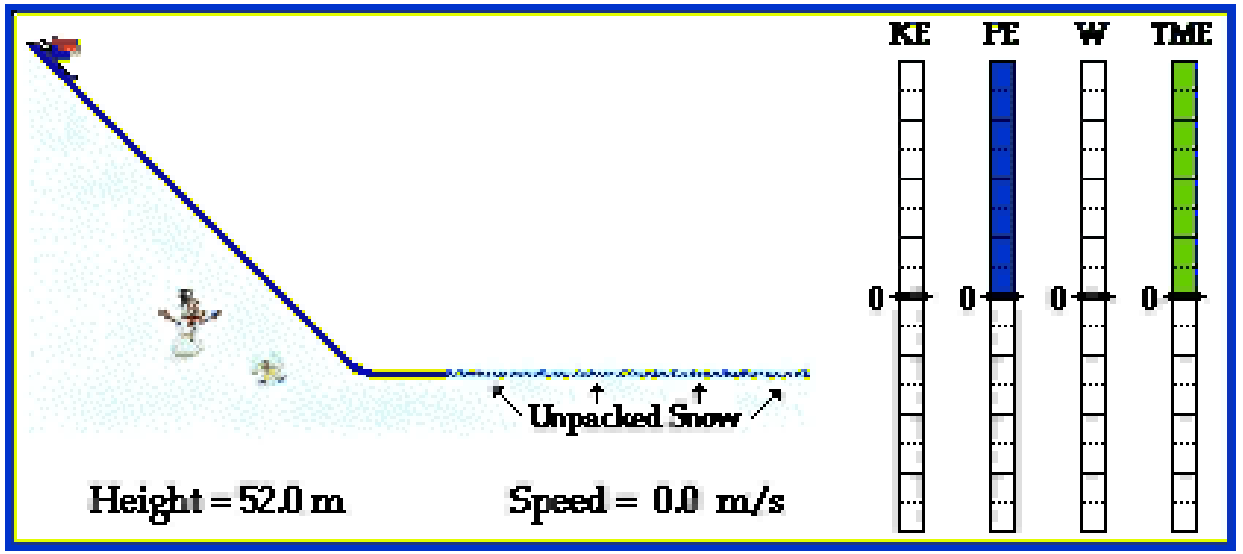
View roller coaster animation.

C. Conservation of Energy

Mechanical → Thermal







View rolling ball animations.

View skier animation.