Physical

CHANGE

Chemical

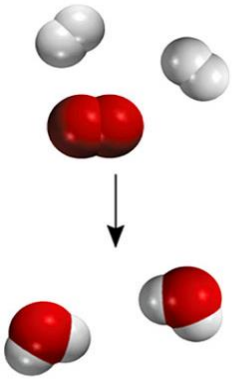
A ***physical change*** **does NOT alter** the composition or identity of a substance.

sugar dissolving in water

ice melting

VS

A ***chemical change*** **does alter** the composition or identity of the substance(s) involved.



hydrogen burns in air to form water

Chemical Change -

matter changes chemically **into an entirely different substance** with **different properties**

Color Change

Solid Formation

Gas Formation

Odor

Temperature Change

Chemical reactions (change) can be used to **separate a compound** into its pure components.

Chemical Reaction Examples

Chemical reaction can be often recognized by an appearance of a different state of matter.

When vinegar (liquid) and baking soda (solid) combine, they form carbon dioxide (gas).

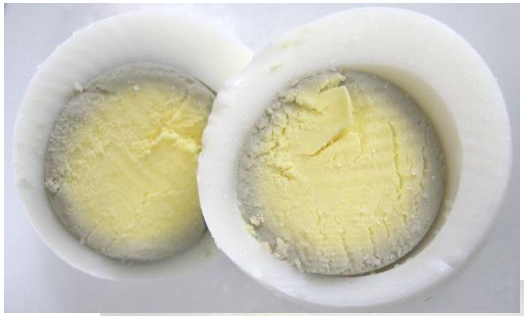
Chemical change is often *difficult or impossible to reverse*.

Silver *tarnishes*. The solid silver reacts with sulfur in the air to make solid silver sulfide, the black material we call tarnish.

Chemical Reaction Examples

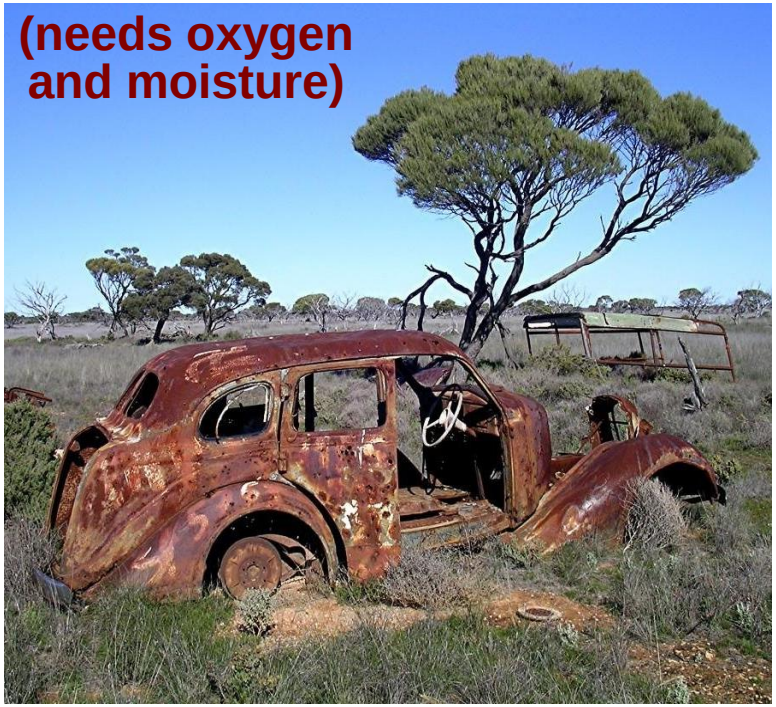
Cleaning with soap:

soap *emulsifies* grime, which means oily stains bind to the soap so they can be lifted away with water.

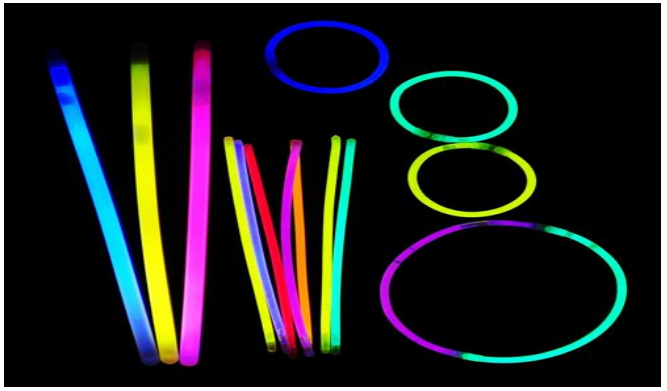


Boiling the egg: when you use high heat to boil an egg, it causes a chemical reaction between the yolk and the white that leaves a green film around the yolk. That film is iron sulfide, caused by iron in the yolk reacting with hydrogen sulfide in the white (it won't hurt you to eat it, and the egg will taste the same).

Chemical Reaction Examples



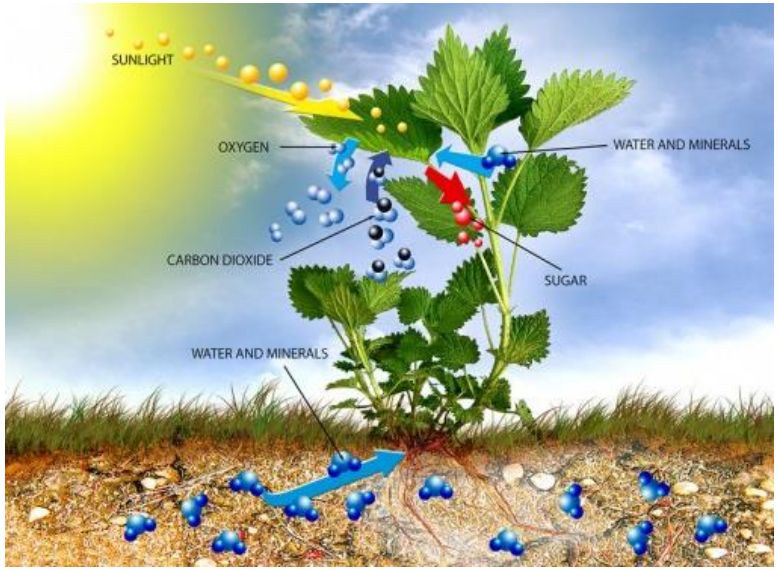
Rust: when exposed to elements, iron develops a red, flaky coating called rust, which is an example of an oxidation reaction.



Glow stick is a plastic tube with a glass vial inside. When you bend it, the glass vial breaks allowing the chemicals that were inside the glass to mix with the chemicals in the plastic tube. Once these substances combine, a light-releasing reaction starts taking place.

Chemical Reaction Examples

Combustion: every time you strike a match, burn a candle, build a fire, or light a grill, you see the combustion reaction; it combines energetic molecules of fuel with oxygen to produce carbon dioxide and water.



Photosynthesis: plants apply a chemical reaction called photosynthesis to convert carbon dioxide and water into food (glucose sugar) and oxygen.


ENERGY

What is Energy?

Energy is defined as the ability to do work, that is, *produce certain changes* within a system.

Types (forms) of energy:

- **Mechanical**
- **Chemical**
- **Electromagnetic**
- **Heat (Thermal)**
- **Nuclear**

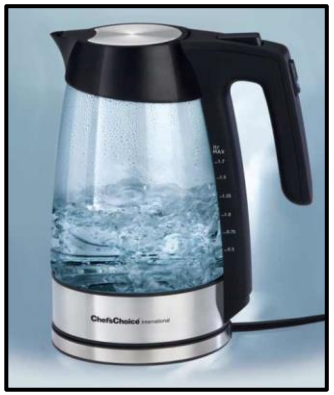
- **We cannot actually see energy ☺**
- **We can observe how *energy makes matter change* in numerous ways (for example, change of physical properties, change of state, change of position etc.)**
- **We can observe how energy changes its *form*.**

Law of Conservation of Energy

Total energy of an isolated system is conserved over time: energy can be neither created nor destroyed, but can be transferred, or converted from one form or place to another.

Electrical energy is transported to your house through power lines…

…and is converted into…



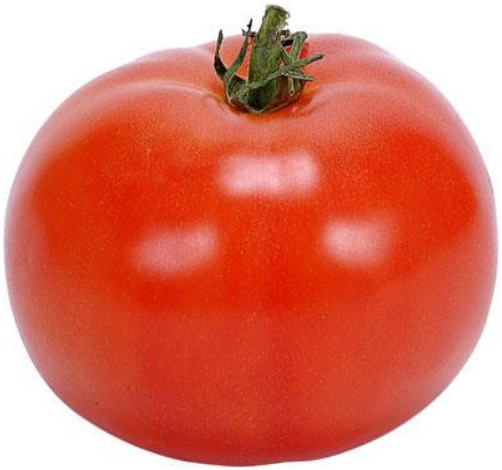
Mechanical Energy

Energy due to an object's motion (kinetic) or position (potential).

Chemical Energy

Chemical energy is an inherent energy of a substance due to its chemical composition:

- **All compounds are held together by chemical bonds.**
- **All types of chemical bonds have specific stored energy that can be released (transferred to another form, for example, heat or light) when the bonds are broken in a chemical reaction.**



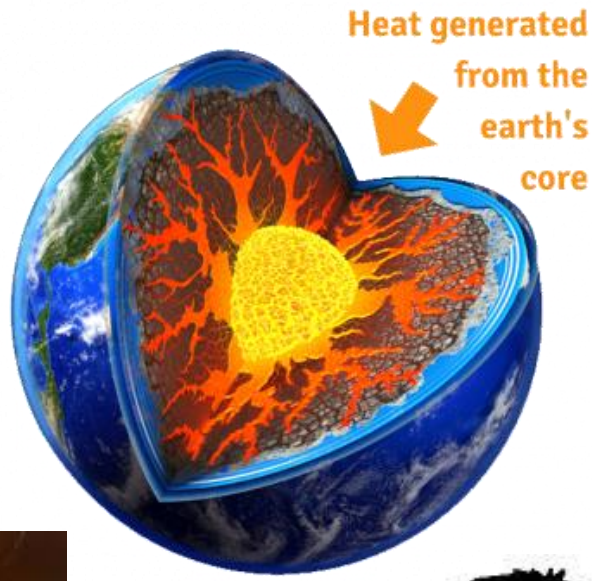
Electromagnetic Energy

<u>Electrical</u> (from electric fields), <u>Magnetic</u> (from magnetic fields), <u>Radiant</u> (from electromagnetic radiation including *light*)

Thermal Energy

Thermal energy originates from the individually random, or disordered, motion of particles in a substance:

- **All objects constantly give off or gain thermal energy.**
- **Heat is an amount of thermal energy being transferred in a given process in the direction of decreasing temperature.**

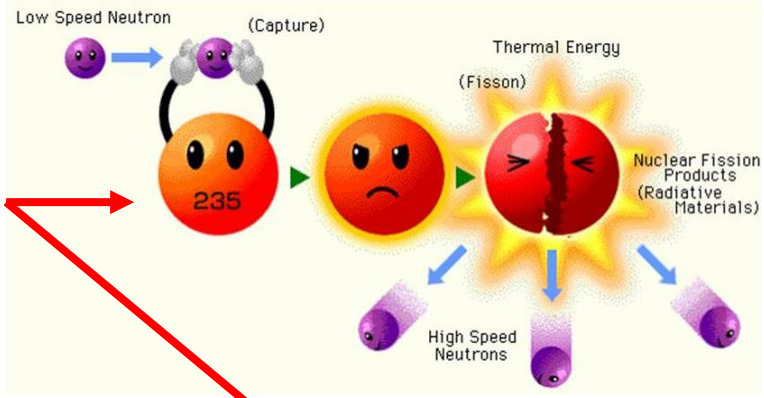


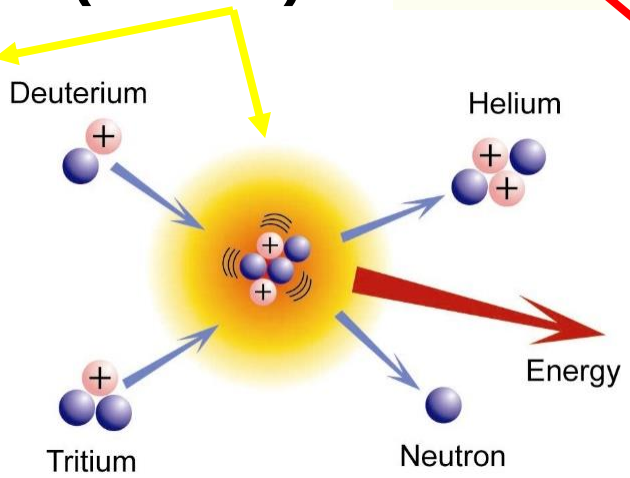
Nuclear Energy

Energy stored in the nucleus of an atom.

Nuclear energy is *released in the form of heat and light* when:

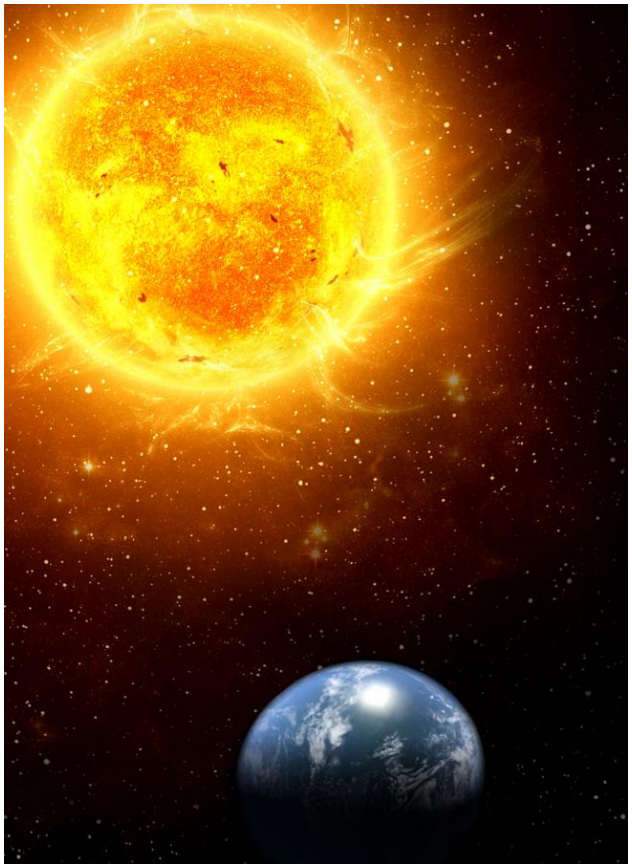
- **the nucleus splits (fission)**
- **the nuclei collide at high speeds and join (fusion).**





Nuclear energy is the most concentrated form of energy.

More Energy Conversion Examples



Light from the Sun is reaching the Earth…

…and is converted into…