

Chemical and physical properties



Matter

- Every element/compound is unique in some way from all others.
- If you know enough about a substance, you can figure out what it is.
- If you know what a substance is, you can know all types of things about it.



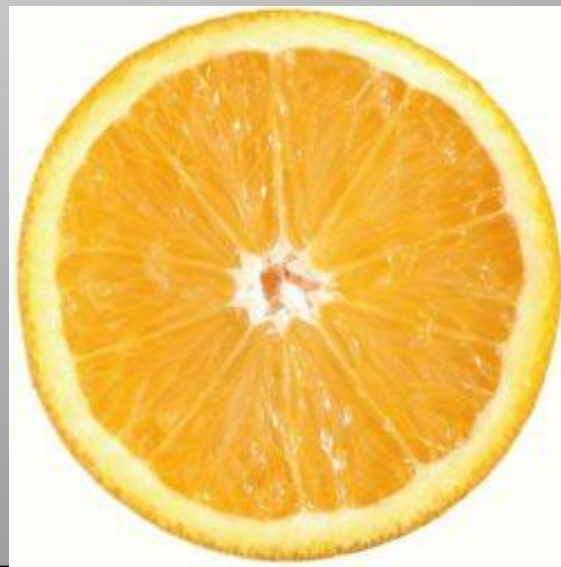
Matter

- All matter has 2 types of properties: Physical properties and chemical properties.



Physical properties

- A **physical property** is a characteristic of a substance that can be observed without changing the substance into another substance.
 - (You can see it without changing what you're looking at into something else.)



Physical Properties

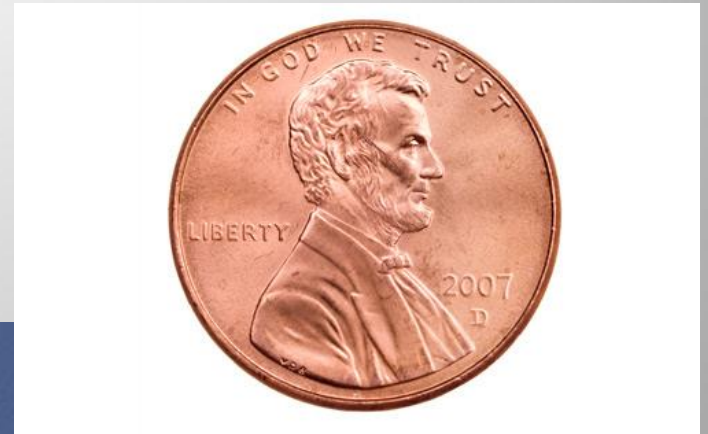
- Physical properties can be extensive or intensive:
 - **Extensive properties** depend on the amount of a substance that you have.
 - **Intensive properties** don't depend on how much you have.



Physical Properties - Examples

- **Examples** of extensive physical properties include:

- Volume
- Mass
- Weight
- Size



Physical Properties - Examples

- **Examples** of intensive physical properties include:
 - Density
 - Melting point
 - Boiling point



Physical Properties - Examples

- **Other physical properties include:**
 - Color
 - Hardness
 - Odor
 - Taste
 - State of matter
 - Texture
 - Luster (shine)
 - Flexibility
 - Heat conductivity
 - Electrical conductivity
 - Solubility (ability to dissolve in water.)
 - Shape
 - Viscosity
 - Ductility
 - Malleability



Physical properties

- List as many physical properties as you can for this item



Chemical properties

- A **Chemical property** is a characteristic of a substance that can only be observed by changing it into a different substance.



Chemical properties - Examples

- **Examples** of chemical properties include:
 - The ability to burn
 - Ability to tarnish
 - Ability to rust
 - Ability to decompose
 - Ability to react with other chemicals
 - Instability
 - Ability to do acid/base reactions



Chemical properties

- List as many chemical properties as you can for this item.



Chemical and physical properties – So what?

- Titanium is very strong and doesn't rust, so it is often used in jet engines.
- Titanium is also nonallergenic. This, combined with the fact that it is rust proof makes it great for artificial joints as well as piercings.



Chemical and physical properties – So what?

- Tungsten is usually used as the filament in lightbulbs because it has the highest melting point of any metal.
- It glows red hot when electricity runs through it, and it gives off both heat and light.



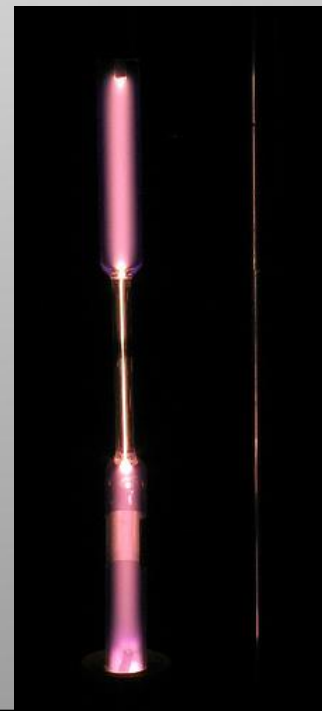
Chemical and physical properties – So what?

- Vanadium is heavier and harder than titanium, so mixing a tiny bit of vanadium with steel can make cheap tools that are still very strong.



Chemical and physical properties – So what?

- Helium is almost completely nonreactive (inert).
- It is lighter than air, so it's great for floating balloons (or making funny voices.)
- When electricity runs through helium, it glows a creamy pale peach color.



Chemical and physical properties – So what?

- In 1943, all US pennies were made of zinc plated steel because copper was being used in the war. The pennies had to be coated with zinc because steel will rust, but zinc won't.



Chemical and physical properties – So what?

- Sulfur smells awful. Rotten eggs, onions, and garlic all have sulfur in them. Stink bombs use sulfur to create a bad smell.
- Sulfur is also flammable, and it is one of the 3 main ingredients in gun powder.



Chemical and physical properties – So what?

- Chromium is famous for its intense luster. Chrome plated tools, jewellery, silverware, or car parts are very popular.



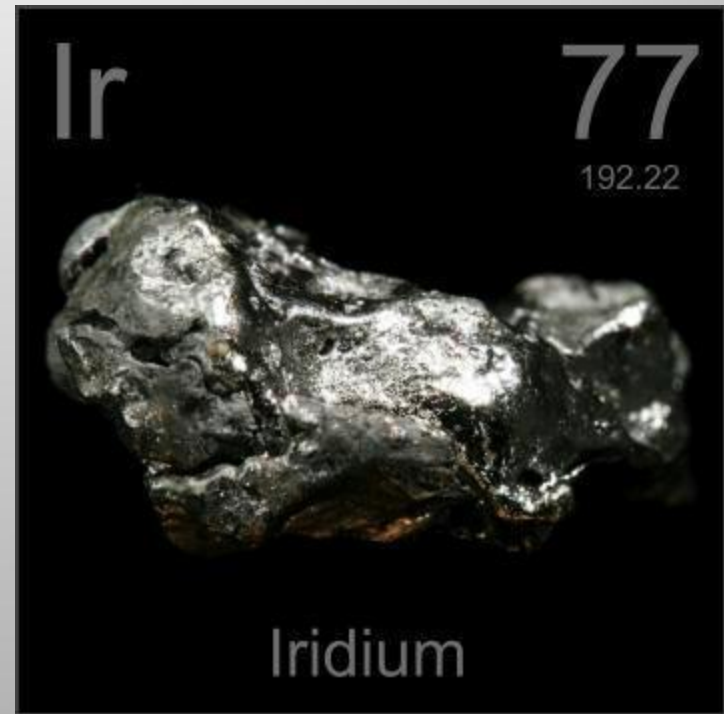
Chemical and physical properties – So what?

- Most bullets are made of lead because lead is a very dense metal. These bullets are required, by international law, to be coated with a different metal because lead has such a low melting point and is so malleable.



Chemical and physical properties – So what?

- The most dense elements are Iridium and osmium which have a density of about 22.6 g/cm³



Element abundance

- The most common element in the universe is Hydrogen (about 75%), and Helium (about 25%).
- The most common element on Earth is Oxygen (46.6%), and Silicon (27.7%).
- The most common element in your body is Oxygen (65%), and Carbon (18%)



Chemical and physical changes



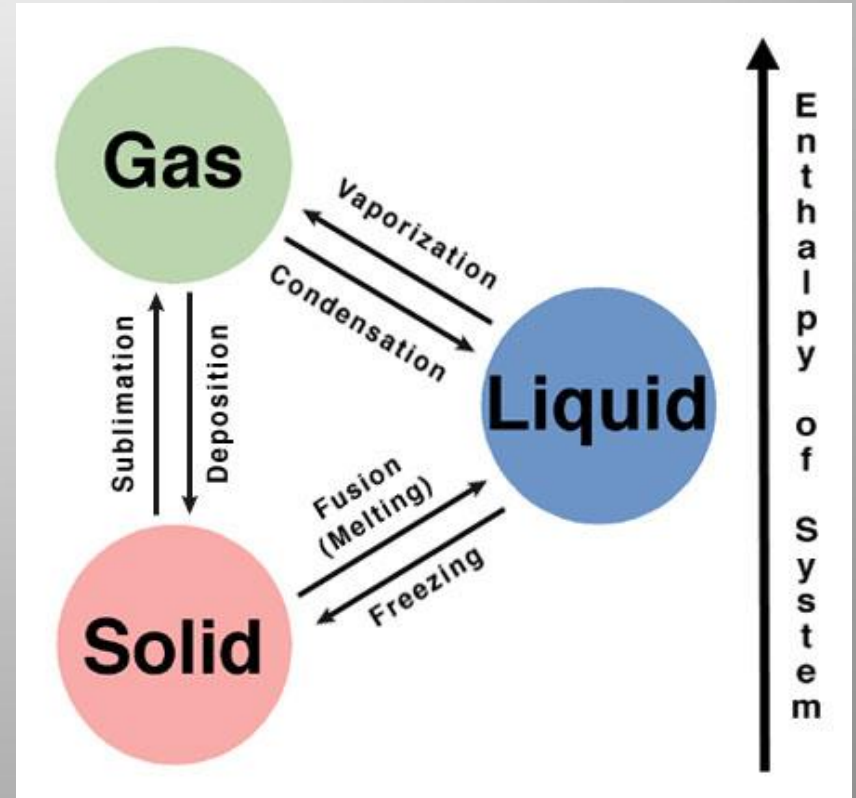
Physical Change

- A **Physical change** is a change in a substance that does not change what the substance is.



Physical Change - examples

- **Examples** of physical change include:
 - Change in shape
 - Change in size
 - Change in phase
 - Melting (solid to liquid)
 - Boiling (liquid to gas)
 - Evaporation (liquid to gas)
 - Condensation (gas to liquid)
 - Freezing (liquid to solid)
 - Sublimation (solid to gas)
 - Deposition (gas to solid)



Physical Change

- Physical changes might be caused by:
 - Grinding
 - Cutting
 - Crushing
 - Bending
 - Breaking
 - Heating/cooling
 - (change in phase)
 - squishing



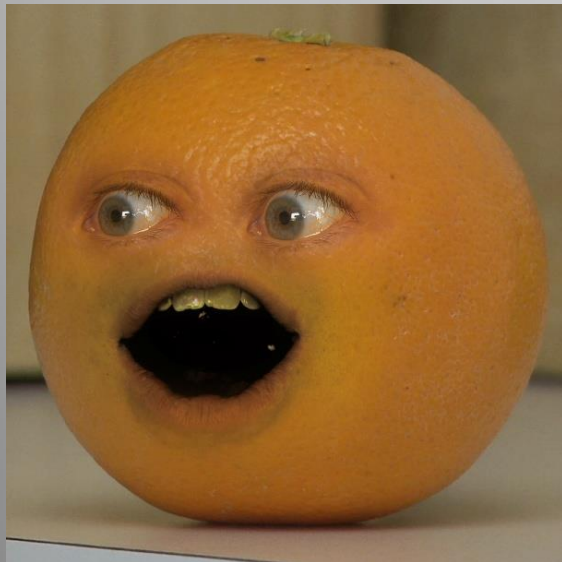
Physical Change

- Evidence that a physical change has occurred might include:
 - Change in shape
 - Change in form
 - Change in size
 - Change in **phase** (This is always a physical change!)
 - Physical changes are usually reversible



Physical change

- What could you do to these items to cause a physical change to occur?



Chemical change

- A **chemical change** is a change in which a substance is changed into a different substance. (You've changed what it **is**.)



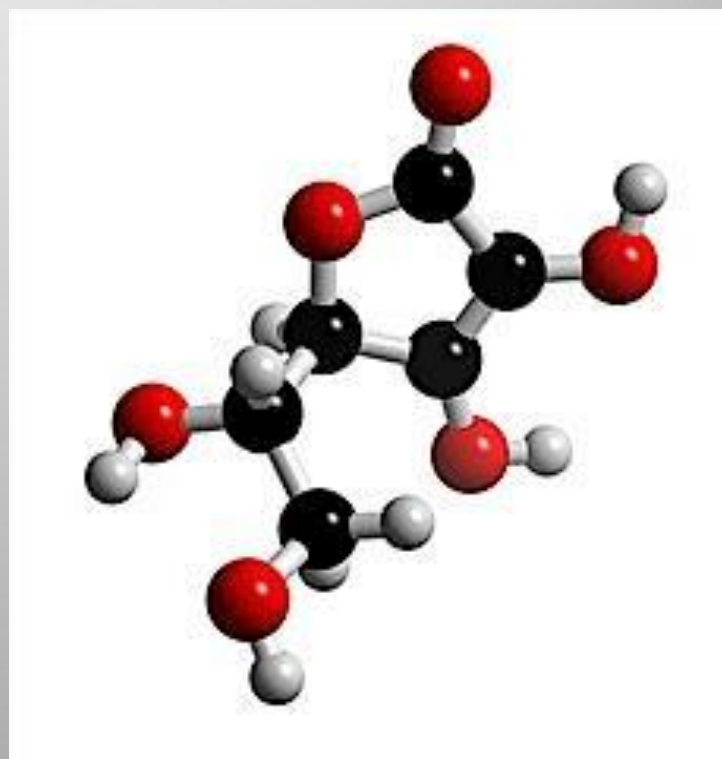
Chemical change

- **Examples** of chemical changes include:
 - Burning
 - Rusting
 - Tarnishing
 - Decomposing
 - Polymerization



Chemical change

- Chemical changes occur when a **chemical reaction** causes bonds between atoms to break or to form.



Chemical change – Chemical reactions

- There are **5 types of chemical reactions** that cause chemical changes to occur.



Chemical change – Chemical reactions

- 1- Composition reactions
 - Two things come together to form something new
 - $A + B = AB$
 - $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$



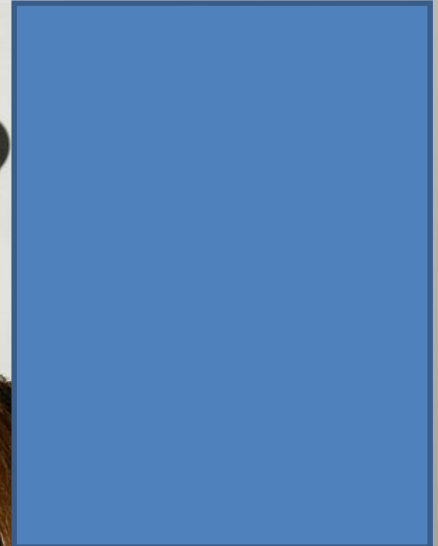
Chemical change – Chemical reactions

- 2- Decomposition reactions
 - 1 thing breaks apart to form 2 or more things.
 - $AB = A + B$
 - $2H_2O \rightarrow 2H_2 + O_2$



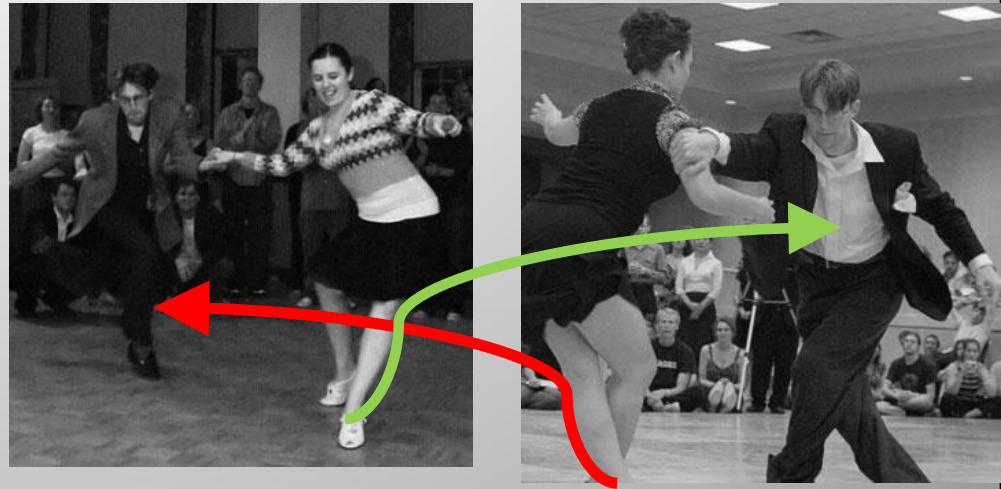
Chemical change – Chemical reactions

- 3- Single replacement reactions
 - One atom replaces another atom
 - $A + BC = AC + B$
or
 $A + BC = AB + C$
 - $Mg + 2HCl \rightarrow H_2 + MgCl_2$



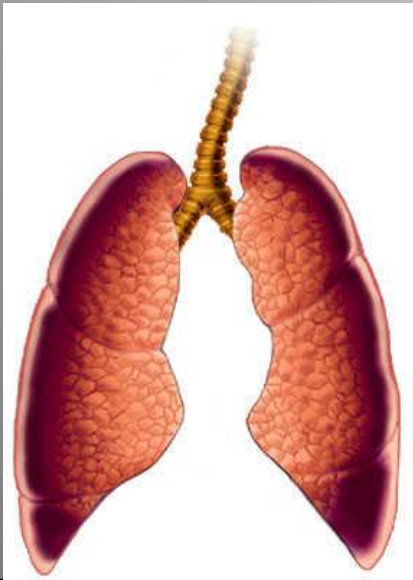
Chemical change – Chemical reactions

- Double replacement reactions
 - Two chemicals switch places
 - $AX + BY = AY + BX$
 - $2KI + Pb(NO_3)_2 \rightarrow PbI_2 + 2KNO_3$



Chemical change – Chemical reactions

- Combustion reaction
 - A substance combines with oxygen and releases energy.
 - C_3H_8 (propane) + $5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$



Chemical Change: Evidence

- **Evidence that a chemical change has occurred might include:**
 - A color change
 - An odor change
 - Formation of a precipitate (you mix two liquids and make a solid)
 - Gas is formed (bubbles)
 - Changes in physical properties.



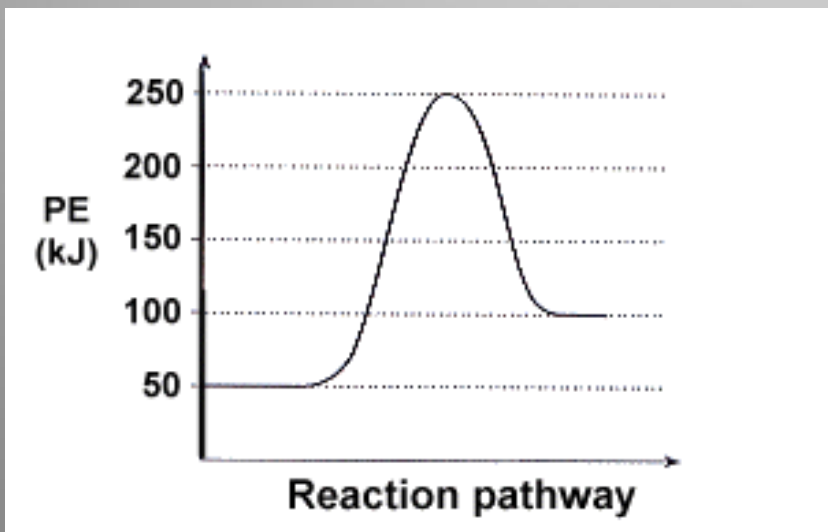
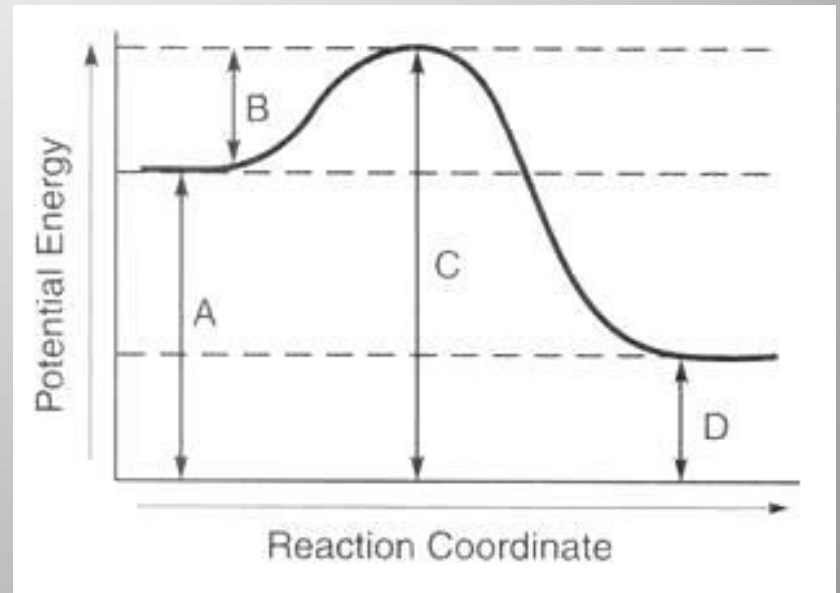
Physical and Chemical change

- During a chemical change **energy can be released** in the form of:
 - Heat
 - Light



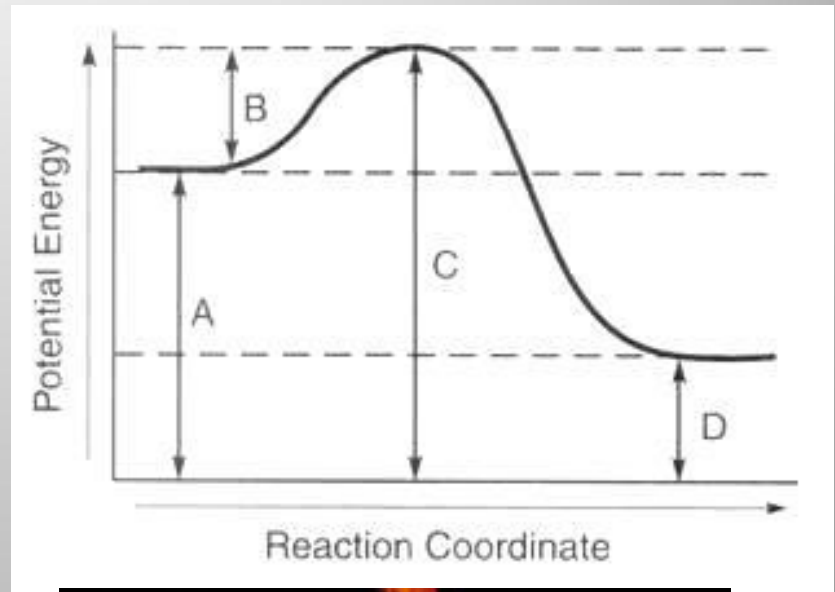
Chemical change – Chemical reactions

- When a chemical change occurs, energy is either released or absorbed.



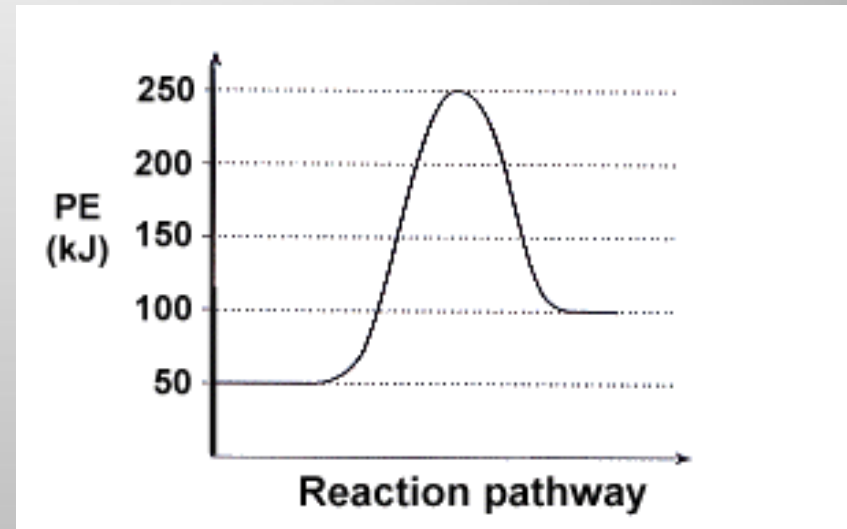
Physical and Chemical change - heat

- A chemical reaction that releases energy in the form of heat is called **exothermic**.
 - Heat comes OUT
 - Exo = out
 - Thermic = heat
 - It will feel HOT.



Physical and Chemical change - heat

- A chemical reaction that absorbs energy in the form of heat is called **endothermic**.
 - Heat goes IN
 - Endo = in
 - Thermic = heat
 - It will feel COLD



Quiz time!

- Which life cycle is most similar to a chemical change?
- Why?



Grasshopper =
Egg → nymph → adult

Butterfly =
egg → larva → pupa → adult

Quiz time!

- What type of reaction is most likely occurring here?
- How do you know?



Quiz time!

- What type of reaction is most likely occurring here?
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Quiz time!

- What type of reaction is most likely occurring here?
- How do you know?

