Unit D
Comparing Compounds and Mixtures

LAD D2
Law of Constant Composition

SG

slide show

The Law of Constant Composition

You don't need all 4, choose one that speaks to you.

- Separate parts combine in definite mass ratios to form compounds.
- A given chemical compound always contains the same proportion (ratio) by mass of its constituent parts.
- The relative mass of each part in a particular compound is always the same, regardless of preparation, quantity, or source.
- A given chemical compound always contains its component parts in fixed ratio (by mass) and does not depend on its source and method of preparation.

LAD D2
Law of Constant Composition

Magnesium Oxide

slide show

The Law of Constant Composition

- Elements combine in definite mass ratios to form compounds.
- A given chemical compound always contains the same proportion (ratio) by mass of its constituent elements.
- The relative mass of each element in a particular compound is always the same, regardless of preparation, quantity, or source.
- A given chemical compound always contains its component elements in fixed ratio (by mass) and does not depend on its source and method of preparation.

The Law of Constant Composition

- Colin Creavy's camera's flashbulbs

Burning Magnesium

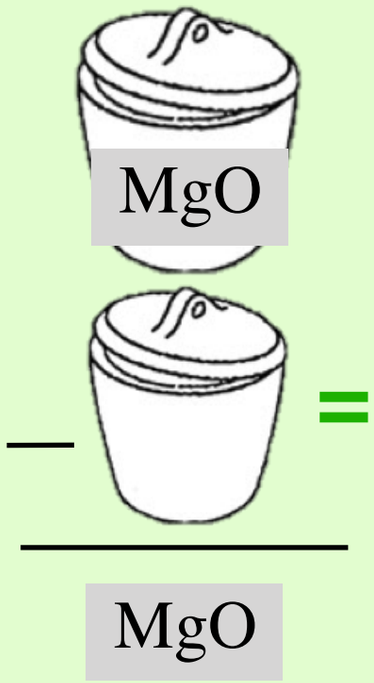
- The Kodak Magic Cube, late 1960's

Burning magnesium

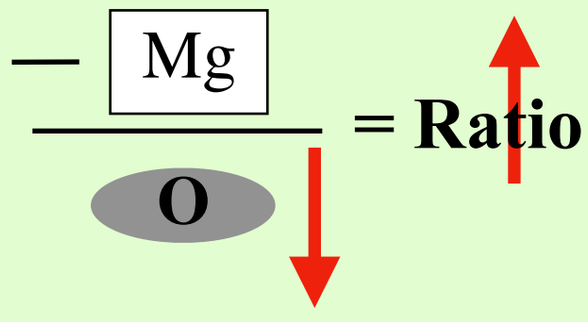
- candle snuffer
- putting out a flame by cutting off the oxygen
- Why did the flame from our magnesium go out?
- We did not run out of oxygen, all of the magnesium reacted and there was none left to burn

Error Analysis

- What if there was a coating of rust already formed on the magnesium before we weighed the magnesium at the start.



$$\frac{1.5\ ish\ gMg}{1gO}$$



Scale reads 15 g

Mg

actually
14 g Mg
+ 1 g MgO rust

+10 g oxygen

MgO
should
be 25 g

$$\frac{1.5gMg}{1gO} = \frac{14gMg}{xgO}$$

+9.3 g oxygen
+1 g MgO rust

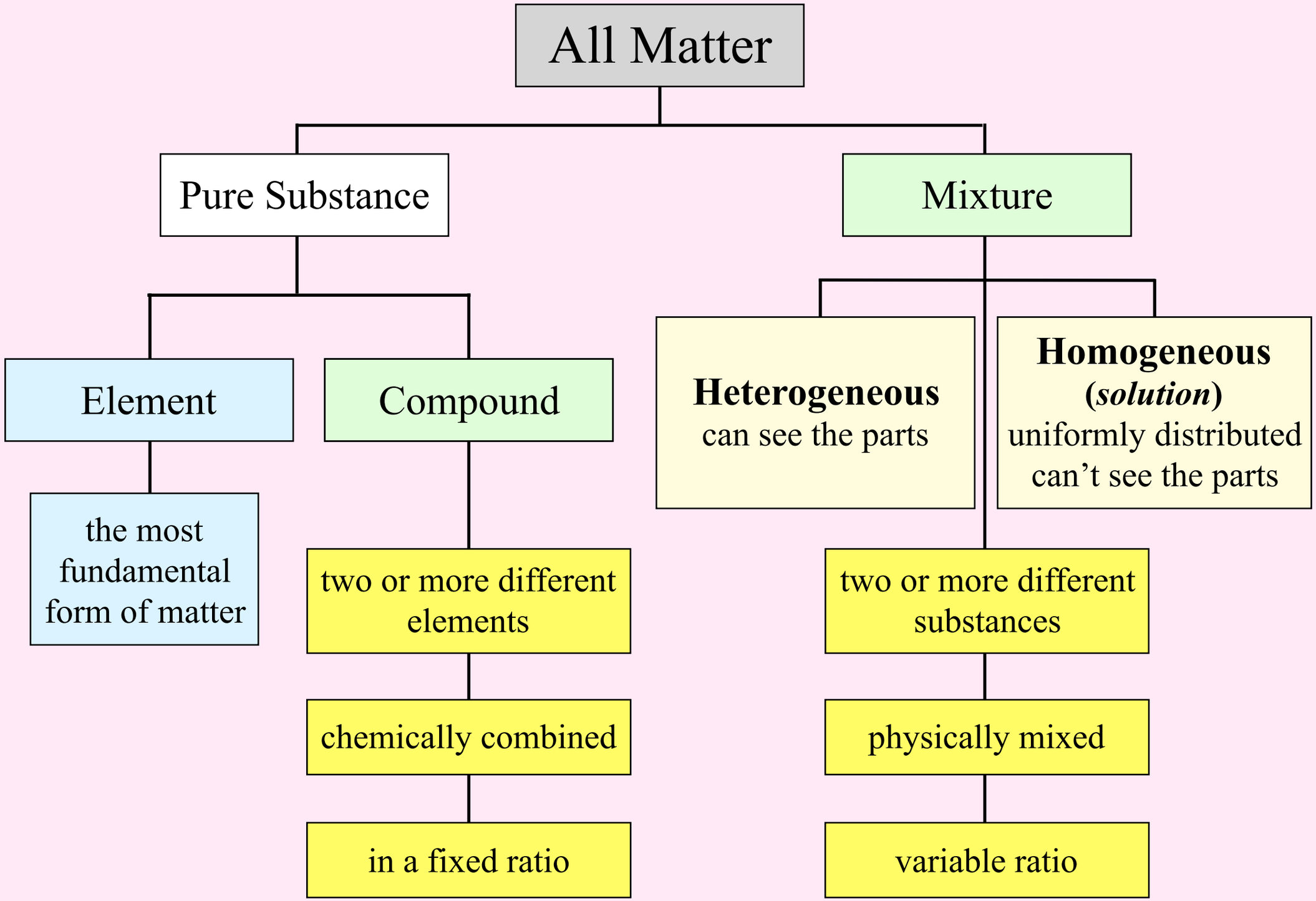
MgO
will be
24.3 g

Types of Mixtures

Two or more substances physically “swirled” together.

slide show

Classification of Matter



Two major types

- **Heterogeneous mixtures**
  - ✓ With your eyes: you can see the different parts
  - ✓ May not be mixed uniformly throughout
- **Homogeneous mixture: aka solution**
  - ✓ With your eyes: looks the same all over
  - ✓ Mixed uniformly throughout
    - For instance: Sugar in water has same sweetness throughout
  - ✓ Specific types of solutions:

✳ Solid in Liquid	✳ Solid in Gas	✳ Solid in Solid
✳ Liquid in Liquid	✳ Liquid in Gas	✳ Liquid in Solid
✳ Gas in Liquid	✳ Gas in Gas	✳ Gas in Solid

Solution: Solid in Liquid

This is what most likely comes to mind when you imagine a solution

- Ideas of Examples?

Solution: Solid in Liquid

- sugar in coffee
- salt water

What about Liquid in Liquid?

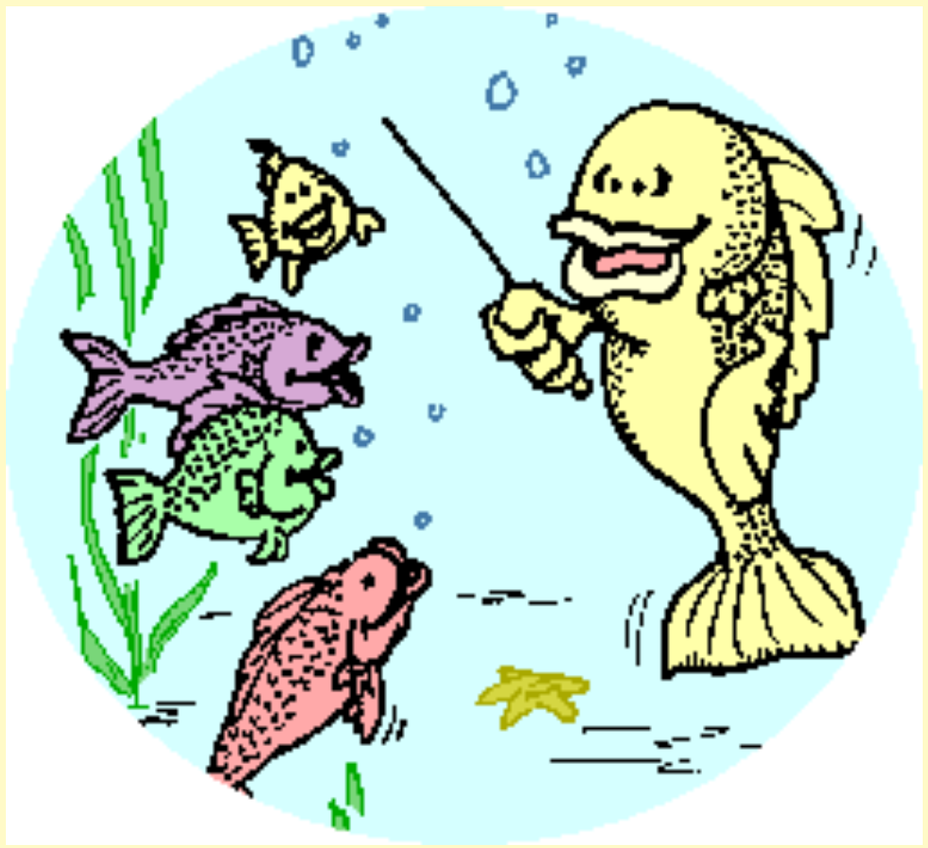
Solution: Liquid in Liquid

- Shirley Temple
  - ✓ Pomegranate juice and ginger ale
- Juice and Seltzer
  - ✓ cranberry juice and seltzer
- coffee and cream
  - ✓ after you mix together

What about
Gas in Liquid?

Solution: Gas in Liquid

- Seltzer
  - ✓ CO_2 and water
- "Air" for fish
  - ✓ O_2 in water



What about Gas in Gas?

Solution: Gas in Gas

- Air
  - ✓ nitrogen and oxygen

What about Solid in Solid?

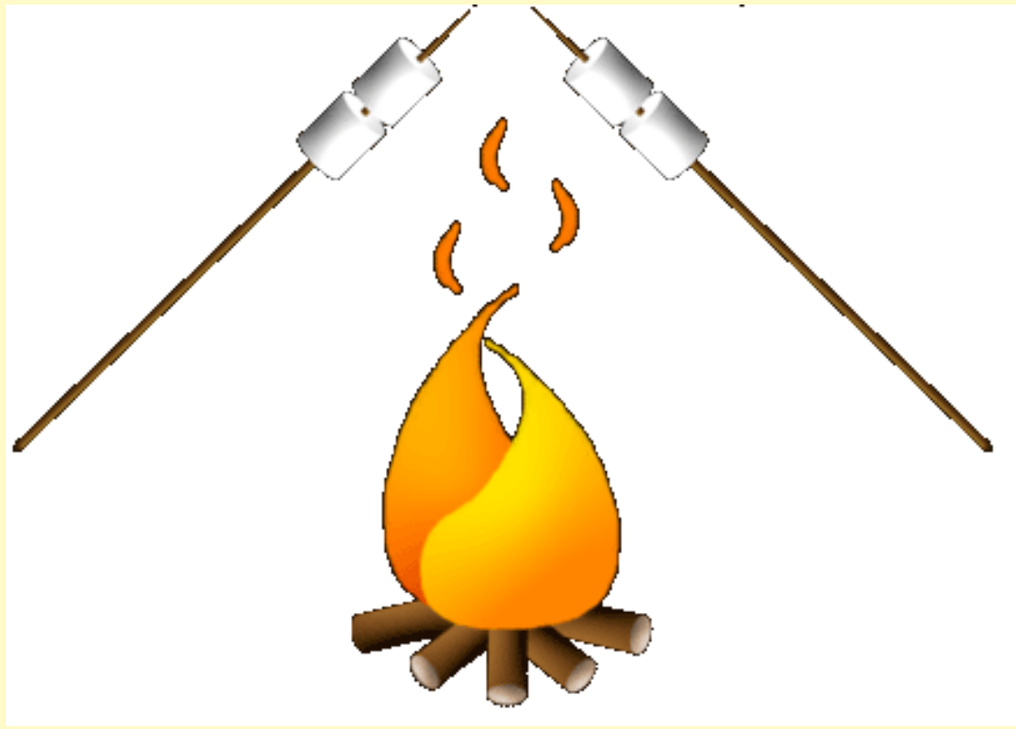
Solution: Solid in Solid

- Alloys
  - ✓ Brass
  - ✓ Stainless steel
- Gems
  - ✓ Ruby: red chromium compounds in aluminum oxide
  - ✓ Sapphire: blue titanium in aluminum oxide

What about Gas in Solid?

Solution: Gas in Solid

- Marshmallows
  - ✓ air in sugar puff
- Canned whip cream
  - ✓ N_2O in cream
- Meringue (air in whipped egg whites)

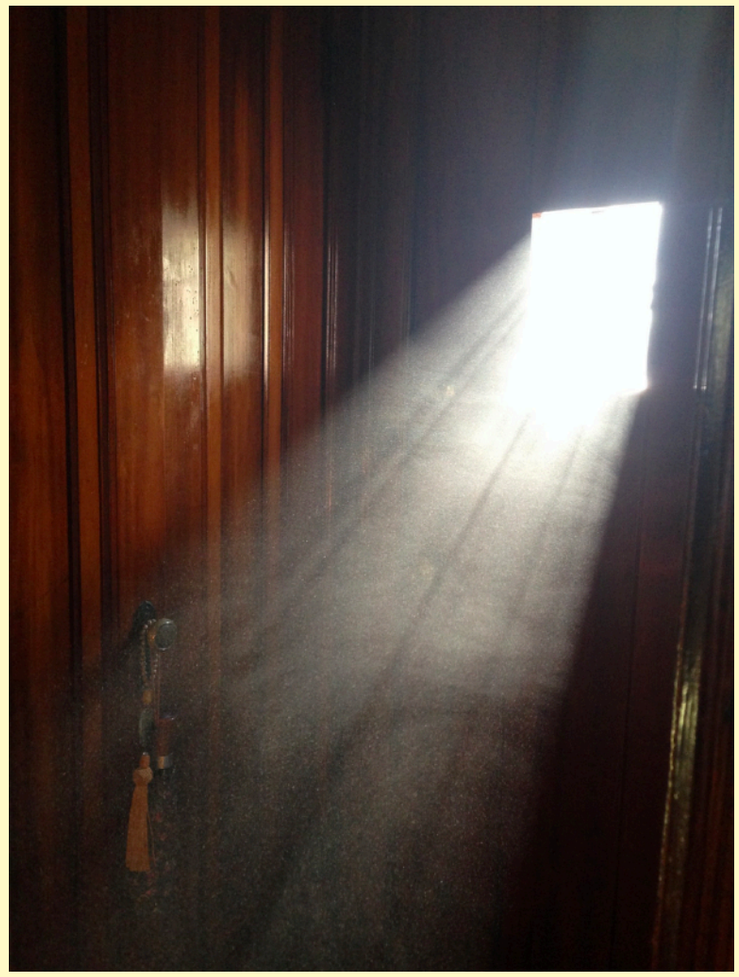


What about Solid in Gas?

Solution: Solid in Gas

(perhaps this is actually a *suspension*)
(the particles will settle out eventually)

- Dust
  - ✓ Dirt in air
- Pollen
  - ✓ Pollen in air



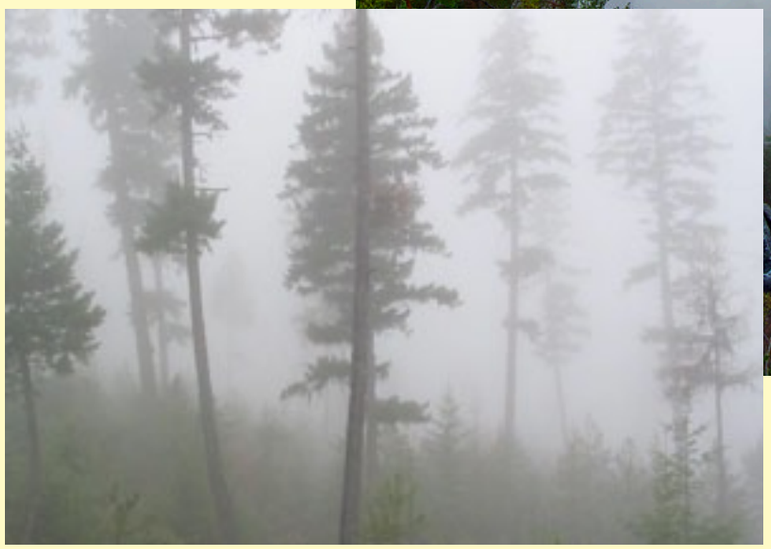
What about
Liquid in Gas?

Solution: Liquid in Gas

(This is a *colloid*)

(the particles don't usually settle out)

- Fog
  - ✓ Water in air



What about Liquid in Solid?

Solution: Liquid in Solid

(this too is actually a *colloid*)

- Jello
- Gels

Chemical Reaction

Using a to Verify Constant Composition

Electrolysis of Water

aka decomposition of water

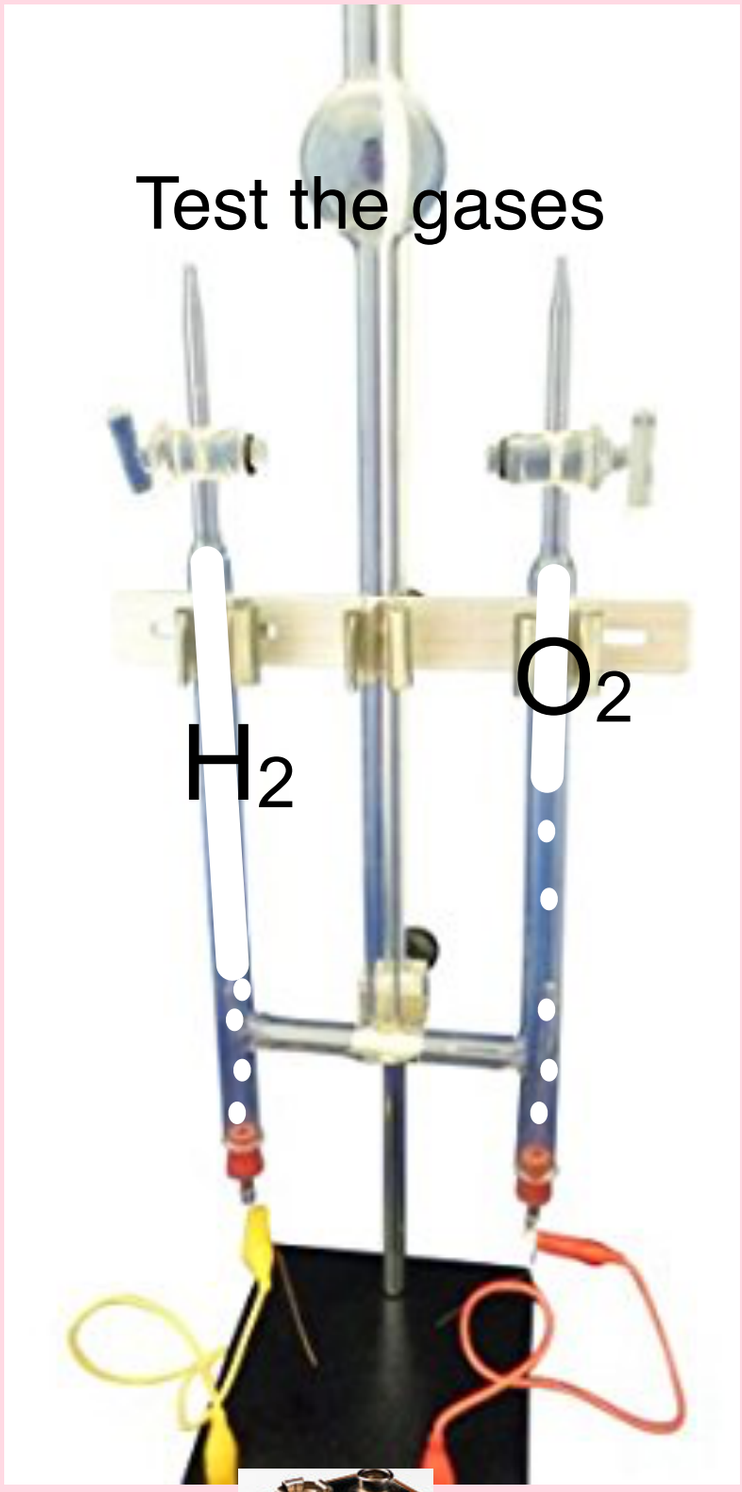
slide show

Electrolysis - Decomposition of Water

- Let's write a chemical equation to describe the reaction
- ____ → ___ + ___
- During the chemical reaction, electricity (energy) was required to break intra-molecular bonds in the liquid water molecules and then intra-molecular bonds reformed to produce hydrogen gas and oxygen gas diatomic molecules.
- How much hydrogen will formed compared to the oxygen?

Electrolysis - Decomposition of Water

- $2H_2O_{(L)} \rightarrow 2H_{2(g)} + O_{2(g)}$
- During a chemical reaction, chemical bonds are broken and new substances are formed.
- Note that twice as much hydrogen was formed as the oxygen.
- *Some of you asked, how is it that the two gases form at the two separate electrodes. If you have an inquiring mind, and want to know more - go on to the 3rd slide following.*



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Lab Tests for Gases

- Flaming splint test
  - If you think you may have produced hydrogen, place a flame in the gas and a “pop” (small explosion) will indicate the presence of hydrogen.

- Glowing splint test
  - If you think you may have produced oxygen, place a *glowing* ember in the gas, and if the ember relights, the test confirms the presence of oxygen.

- Flaming splint test
  - If you think you may have produced carbon dioxide, place a flame in the gas and if the flame is extinguished, the test confirms the will indicate the presence of carbon dioxide.

The Hindenberg

- The German blimp filled with hydrogen gas.
- Ignited while trying to dock in New Jersey in 1937

More on Electrolysis: *you are not responsible for this info*

- $2H_2O_{(L)} \rightarrow 2H_{2(g)} + O_{2(g)}$
- The reaction above is the "overall reaction, and does not accurately depict what is occurring at each metal electrode.
- At the cathode, this is the "half reaction" that occurs:
  - $4H_2O_{(L)} + 4e^- \rightarrow 2H_{2(g)} + 4OH^-_{(aq)}$ (Basic)
- At the anode, this is the "half reaction" that occurs:
  - $2H_2O_{(L)} \rightarrow O_{2(g)} + 4H^+_{(aq)} + 4e^-$ (Acidic)

From Biology you may remember…

- Bromothymol Blue (BTB) was used to indicate the presence of photosynthesis or cellular respiration of water plants such as elodea.
- The presense of acid (H^+) will make BTB yellow
- The presence of base (OH^-) will make BTB blue.
- Neutral solution will be green (equal amounts of yellow & blue).
- When your mate blew into the solution, the green turned yellow.
  - $CO_2 + H_2O \rightarrow 2H_2CO_3$ (carbonic acid)
  - This is the same reaction by which extra CO_2 in the atmosphere acidifies the ocean.

Whew!

That’s all for now.