Rutgers Day 2012

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Demonstration Goals

- Safety first and foremost when conducting demonstrations – goggles, gloves, attire.
- Perform examples of demonstrations that are integrated into first year chemistry lectures
- Integrate every day observations into each experiment performed
- Provide explanations for what happens in each experiment presented

Your Job as an Observer

- You are the observer – be attentive !
- Make a mental note of everything you see
- Be ready for the unexpected – look for energy releases in the form of light, sound, or heat, changes in state
- Think about what happens – relate what you see to common experiences or real life events
- Get a sense of how to be a scientist
- Enjoy the show !

Elephant Toothpaste

- Remember Mom treating your scraped knee or cut with hydrogen peroxide? Ever see the bubbles that form at the cut?
- Hydrogen peroxide found in stores is a 3% solution – safe to touch, but powerful enough to kill bacteria, viruses and fungi on surfaces
- When it decomposes, it breaks down to form water and oxygen – slow process (store cold)
- Solution used here is 10 times stronger – not available in stores

Elephant Toothpaste

- Catalyst is a substance that speeds up a reaction, but is not consumed in the reaction
- Potassium Iodide will serve as a catalyst
- Mix 30% hydrogen peroxide, soap, coloring
- Add potassium iodide solution and observe
- Rapid evolution of oxygen – mixes with soap – eruption of foam erupting out of containment vessel resembling a giant tube of toothpaste
- Reaction gives off heat – steam rises above foam

Carbon Dioxide Extinguisher

- How many of you have heard of carbon dioxide?
- Carbon dioxide – colorless, odorless gas at room temperature
- Dry ice – solid carbon dioxide – sublimes (solid to gas) at -79 C – density = 1.56 g/L at this temperature vs oxygen's density = 1.31 g/L at 25 C – a molecule of carbon dioxide is heavier than a molecule of oxygen
- Solid dry ice very cold – can cause frostbite – must be handled carefully
- Place dry ice pellets in pitcher – carbon dioxide gas fills up pitcher

Carbon Dioxide Extinguisher

- Four candles lit in plastic chamber – varying heights – open top – example of controlled combustion
- For combustion need fuel, oxygen, source of ignition
- Can pour gaseous carbon dioxide just like a liquid – just can’t see it
- Pour into chamber – watch candles

Carbon Dioxide Extinguisher

- What happens?
- Since carbon dioxide heavier than oxygen, displaces it out of chamber – key component of combustion eliminated
- As carbon dioxide accumulates, level gets higher, candles go out from bottom to top
- Fire extinguishers – carbon dioxide released – aim at base of flame to extinguish
- Carbon dioxide heavier than air – explains one of the strangest natural disasters of the 20th century

Lake Nyos – Cameroon – West Africa

- A “crater lake” – formed when the crater of a previous volcano fills with water
- Waters of lake very still – surrounded by hills
- August 1986 – nearly 1800 people died suddenly and quickly along with 3000 cattle and other animals for miles around
- Carbon dioxide buildup deep in lake close to volcanic activity – tremendous amount of gas suddenly released and travelled into village
- Estimated 1.2 cubic kilometers released in about 20 seconds – enough to fill ten football stadiums, smothering living creatures just like the candles that were snuffed out

Pop Bottle Demonstration

- Have you ever heard of ethanol?
- Ethanol (ethyl alcohol) – many uses – alcoholic beverages, fuel additive – relatively high vapor pressure (evaporates easily) – burns well
- Bottle construction: two metal rods inserted through sides of plastic bottle – small gap between rods inside – small amount of ethanol added – corked
- Ethanol vapor saturates the closed container at room temperature – has air inside as well

Pop Bottle Demonstration

- Tesla coil – instrument being used to generate a spark when held close to a metal surface
- Recall components needed for combustion
- Place Tesla coil near metal rod – spark jumps – electricity conducted – spark inside container
- Chemical energy converted to mechanical energy – gases generated resulting in popping of cork, along with light and sound energy
- Same thing happens in an internal combustion engine (car motor) – continuous explosions inside cylinders – pistons pushed upwards like cork – attached via a crank which drives mechanical energy to other moving parts that are connected to wheels of car to make it travel

How Milk of Magnesia Works

- How many of you have ever had acid indigestion?
- M.O.M. – one of a variety of antacids used to relieve stomach discomfort (indigestion) after a large meal
- Commonly available in stores – variety of brands – slurry of magnesium hydroxide suspended in water
- Base – neutralizes acid – relieves discomfort
- Beaker of water stirred and lit from below to aid visualization
- Add Universal Indicator – change of color when degree of acidity changes in solution

How Milk of Magnesia Works

- Add M.O.M. to water plus indicator – observe color
- Add vinegar which mimics acid in stomach
- Change in color when initial amount of dissolved magnesium hydroxide reacts with acid – more undissolved solid then goes into solution, turning color of solution back to basic form
- Can repeat addition of acid until all of M.O.M. is used up, as seen when solution becomes translucent – color will stay red until more M.O.M. is added – extra dose needed for those extra big meals !

Lighter than Air Balloons

- How many balloons do you see? What colors?
- What do you think they contain?
- Gases lighter than air include hydrogen and helium – first two elements in the periodic table
- Helium is a non combustible gas – hydrogen is
- Conduct an experiment to figure out contents of balloons
- Touch flame to balloon see what happens – repeat the experiment to confirm observations – note all observations

Lighter than Air Balloons

- Safety first – protect from possible ear damage by placing fingers in ears
- Helium does not burn – balloon pops
- Hydrogen does burn – combustion product is water – eruption of flame
- Hydrogen mixed with oxygen in a 2:1 ratio results in an enhanced, uncontrolled combustion – explosion – resulting in the release of light and sound energy
- Can you think of any practical uses for hydrogen?
- The *Hindenburg* airship exploded in 1937 as a result of a spark igniting hydrogen gas – “blimps” now use helium as lifting gas

Dry Ice / Hot Water

- Recall earlier experiment with dry ice – CO_2
- Hot water in flask is poured into basin
- A large quantity of dry ice pellets is poured in
- Fog forms when water vapor condenses into tiny suspended droplets when cooled
- Warm air over hot water is nearly saturated with water vapor, and is cooled by mixing it with the cold carbon dioxide gas that sublimes from dry ice

Dry Ice / Hot Water

- Initially the hot water heats the air above it, making it less dense, and causing the fog to rise
- Eventually, the cold carbon dioxide cools the air to the point that it becomes more dense than the air around the basin, and the fog sinks
- Used by film makers to generate cloud like effects, especially in horror movies – can fan the fog in any direction as needed
- Meteorological formation of fog – cooled condensed water vapor – low clouds on cool morning – temperature rise – fog lifts

Conclusion of Demonstration Show

- Take home messages
- Observe things around you in every day life and ask questions – but be safe !
- Expand your mind – how discoveries are made
- Hope you enjoyed the show
- Enjoy the rest of your day at Rutgers
- Thank you for coming !

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