Mark ⬭ ⇒ I do these on a regular basis.

▱ ⇒ Others do these, or I do once ~~occasion~~ in a while.

GENERAL CHEMISTRY DEMONSTRATIONS

Grouped by topic

Properties of matter:

kinetics and/or thermo

Properties of gases and liquids:

H2 and O2 balloons:
Large balloons filled with H2, O2 or a mixture of the gases are exploded in the classroom.

O2 and CO2 balloons in CO2:
Dry ice is sublimed in a container to show the difference in density of O2 and CO2 gases.

CO2 staircase:
A candle is set at the bottom of a staircase and dry ice is added to the top. The CO2 gas "walks" down the stairs and extinguishes the flame.

Magnesium:
Burn a wood splint and place into a beaker with dry ice that is subliming to extinguish the flame. Do the same after igniting a strip of magnesium to show that it does not extinguish the

Balloon Full of Carbon Dioxide:
Dry ice is put into a balloon, and the balloon inflates.

put balloon in liq N_2, and $CO_2(s)$ returns.

Playing with liquid nitrogen:
Freeze stuff and break it! Shrink balloons!

Great individual demo w/ small groups of students, especially K-12

Crystallization of Sodium Acetate:
A supersaturated solution of sodium acetate is crystallized by pouring it onto a seed crystal, forming a stalagmite-like solid.

Properties of metals and solids:

Natural Crystalline Structures:
A hands on display of natural crystals of various shapes and sizes

Flame colors:
Various metal salts are sprayed onto a flame to show different colors.

Alkali metals in water:
Lithium, sodium and potassium metals are thrown into water with a phenolphthalein indicator.

Magnetic and Electric Properties:

Ferrofluid:
Show the properties of a magnetic fluid by creating a metal hedgehog!

Superconductor:
YBCO superconductor, liquid nitrogen, and levitating magnet.

Discharge of gases:
Tubes filled with different gases are discharged by a Tesla coil.

Cathode ray tube:
The beam from a cathode ray tube is deflected by a magnet.

a few!

* **Liquid oxygen:**
Liquid oxygen levitates between the poles of a magnet.

Stoichiometry, mole-mass relationships, density and balancing equations:

H2 and O2 balloons:
Large balloons filled with H2, O2, or a mixture of the gases are exploded in the classroom.

O2 and CO2 balloons in CO2:
Dry ice is sublimed in a container to show the difference in density of O2 and CO2 gases.

The mole:
A display of molar quantities of various compounds to show differences in volume and weight. 1 mole of water, 1 mole of lead, 1 mole aluminum, and 1 mole of salt

Density of gases:
Balloons are filled with various gases and passed around the classroom. Hydrogen, Oxygen, Air and SF6.

1032 especially

Diet vs. Regular:
A can of Diet Coke floats in water and a can of Classic Coke sinks.

Density demo

Electrolysis of water:
A Hoffman apparatus is hooked to a power supply to show the electrolysis of water and the ratio of oxygen to hydrogen gas. An indicator is added to show the cathode and anode.

typically end of 1046/1051, time permitting

Limiting Reagent - reaction of Mg and HCl:

Equal quantities of magnesium are reacted with unequal quantities of acid to see how the reaction is affected.

Limiting Reagent 2:
Magnesium is added to equal volumes of 2 M hydrochloric and acetic acid to elvolve gas into balloons. The balloon with the strong acid blows up faster, but both are the same eventual size.

Density of liquids:
Water, isopropyl, Karo syrup, and Vegetable Oil are put in a column.

More density demos:
An egg sinks in water, but floats in salt water. A bar of soap floats in water, but not in ethanol (same with an ice cube).

* **Equilibrium Between Nitrogen Dioxide and Dinitrogen Tetroxide:**
Heating or cooling flasks of NO2 and N2O4 shifts the equilibrium between these two species. When more NO2 is produced, the color of the gas inside the flask becomes darker.

equilibrium!

Intermolecular forces and types of solutions:

Properties of gases and liquids:

Combustion of a candle in air:
The gas products of a burning candle are collected to show that they contain CO2 by CaCO3 precipitation by Ca(OH)2. The same reaction consumes a volume of air when a graduated cylinder is inverted over a candle in a Petri dish full of water. Water rises to extinguish the flame. Please note that this demo is a little tricky

Facilitated transport of CO2 through a soap film:
Soap bubbles grow and change color when immersed in CO2 gas. Please note that this demo is a little tricky.

Surface Spreading and Surface Tension:
Drops of mineral oil and olive oil placed on water are compared for their spreading properties.

Surface Tension of Water:
A paper clip is carefully placed on the water surface. It sinks when detergent is added to the water surface.

Will a tissue hold water? :
Scotchguard is sprayed on a piece of facial tissue and allowed to dry. Water is poured into the tissue and the tissue holds the water. Water is poured onto another facial tissue that has not been treated and the tissue breaks.

Dielectric properties of liquids:
A stream of water is deflected in the electric field of a charged rubber rod, or a charged glass rod.

Compounds, mixtures, solutions and properties of them:

Volume decrease of mixtures:
100mls of water plus 100mls ethanol doesn't equal 200mls

if the topic of "volume %" comes up

Volume increase of mixtures:
Upon neutralization of HCl by NaOH, the volume of the resulting solution is greater than the mathematical addition of each individual volume.

Making Liquids Immiscible (Salting Out):
Potassium carbonate added to a solution of methanol in water produces 2 liquid phases.

Wow! I did not know that?

* **Osmosis through an egg membrane:**
An egg that has had its shell dissolved by vinegar can be soaked in water and sugar solutions to show osmosis.

Freezing Point Depression:
When salt is added to ice-water, the temperature drops below the freezing point of water.

Boiling Point Elevation:
The boiling point of a solution is higher than that of the pure solvent.

a few. Great to do when starting acid/base eq chapter

*** **Conductivity of solutions:**
A rack of light bulbs of various wattages shows how well certain solutions conduct electricity (weak/strong acids and bases, salt solutions, tap water, organic solvents, etc.)

Reverse Solubility:
Lead iodide is soluble in hot water, but forms a precipitate when the container is placed into ice water.

Making Liquids Immiscible:
Hexane and ethanol are mixed in equal portions (with a little iodine to increase visibility). A few drops of water are added to the solution and 2 liquid phases are produced.

Soap Emulsifies Hydrocarbons:
Kerosene and water are shaken together and separate rapidly. Adding liquid soap to the mixture produces a temporary emulsion when the flask is shaken again. The emulsion separates slowly.

Cholesterol Emulsifies Hydrocarbons:
Food coloring, water and vegetable oil are emulsified by cholesterol

Temperature dependent diffusion:
Food coloring is dropped into a beaker with hot water, and a beaker of cold water.

Alcohol Gels:
Alcohol is gelled with a saturated calcium acetate solution to make a "sterno". The sterno is light with a match.

Magnetic Properties:

Ferrofluid:
Show the properties of a magnetic fluid by creating a metal hedgehog!

Superconductor:
YBCO superconductor, liquid nitrogen, and levitating magnet.

Polymers:

young kids

illustrates osmosis (sort of)

* **Slime:**
Borax + Polyvinyl alcohol = slime polymer.

* **"Diaper" polymer:**
Add Sodium Polyacrylate to water to make "diaper" and dissolve again with NaCl.

Nylon:
Nylon thread is made from the polymerization of an amine and an acid chloride. Please note that this demo is a little tricky.

In 1020, the only course where I actually get to polymers

Polyurethane Foam:
Polyurethane foam is produced by mixing two liquids, a polyether polyol and a polyfunctional isocyanate. A rigid foam is produced which is many times larger than the original volume.

Types of Chemical reactions:

Acid base reactions:

Oxidation of metals by acid:
HCl will dissolve zinc, but not copper. HNO3 will dissolve both.

Properties of acids:
A plain piece of paper is dipped into solutions of HCl, HNO3, and H2SO4. HCl does nothing, HNO3 turns the paper yellow and H2SO4 chars it.

Acidic and Basic Properties of Salts:

The pH of salt solutions is estimated using universal indicator. A pH meter can also be used.

Acidic and Basic Properties of oxides:
Acid and base oxides when dissolved in water change the color of universal indicator. A pH meter can also be used.

Amphoteric Properties of Hydroxides:
Precipitates of aluminum hydroxide dissolve in either strong acid or base.

End Point of an Acid-Base Titration Determined by Electrical Conductivity:
Barium hydroxide is titrated with sulfuric acid while the conductivity of the mixture is monitored. At the equivalence point, the solution is nonconductive and the light goes out.

very cool way to illustrate neutral, even if class knows the light bulb apparat

Buffering action of Alka-Seltzer:
The amount of acid necessary to change universal indicator's color in water is dramatically increased when AlkaSeltzer is dissolved in the water.

Acid Strength vs. concentration:
Using 0.1M solutions of HCl, H2SO4 and acetic acid, neutralization of HCl requires only half as much NaOH as H2SO4, even though they are near the same pH and acetic acid requires the same amount even though it is at a different pH.

Ammonia fountain:
Water with an indicator is squirted into a large round bottom flask filled with ammonia gas to make a colored fountain.

Acid/Base titration with universal indicator:
HCl with universal indicator is titrated with NaOH to show the various color changes at different pH.

Invisible Painting:
A design or picture is painted on absorbent paper with a colorless indicator. When it is sprayed with base, the picture appears.

Dry Ice and pH:
Adding dry ice to a solution with universal indicator changes the pH.

Oxidation Reduction reactions:

Copper to Silver to Gold (not really):
A copper penny is zinc plated, resembling silver. When the penny is heated it becomes yellow in color, resembling gold.

Thermite:

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Thermite

Ferric Oxide and Aluminum powder with a fuse set off by H2SO4 make fireworks and molten iron.

Energy of food:
An M&M is added to liquid potassium chlorate to oxidize the sugar in an explosive reaction.

Silver mirror:
Tollen's reagent: deposits silver on the outside of a flask.

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Growing Silver Crystals on Copper wire:
A copper wire in a solution of silver nitrate will grow silver crystals after a few minutes.

Reaction of Iron and Oxygen:
When a red-hot wad of steel wool is placed in oxygen, the steel wool glows more brightly, and many sparks are produced. ← supposed to be very cool

Reaction of Zinc and Iodine:
The addition of a few mL of water to a mixture of elemental zinc and iodine results in evolution of purple vapor and heat.

Blue Bottle experiment:
A bottle half-full of a colorless liquid is shaken and turns blue. On standing undisturbed, the blue color fades.

Precipitation reactions and gas evolving reactions:

Evolving CO2:
Sodium bicarbonate and HCl are combined to fill a balloon with CO2 gas/

Evolving H2:
HCl and mossy zinc are combined to fill a balloon with H2 gas, which can then be ignited.

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$Pb(NO_3)_2(aq) + 2KI(aq) \longrightarrow PbI_2(s) + 2KNO_3(aq)$

↑ striking yellow ppt

↑ a classic!

Precipitation rxns:
Various solutions are mixed to yield colored precipitants.

Snowflakes:
BaOH and H2SO4 precipitates snowflakes!

Silver mirror:
Tollen's reagent: deposits silver on the outside of a flask.

Equilibrium reactions:

Chloro and Thiocyanato complexes of cobalt:

The pink complex of cobalt is converted to the blue chloro complex by addition of concentrated hydrochloric acid. The blue chloro complex is converted back to the pink complex by adding more water.

Equilibrium Between Nitrogen Dioxide and Dinitrogen Tetroxide:
Heating or cooling flasks of NO2 and N2O4 shifts the equilibrium between these two species. When more NO2 is produced, the color of the gas inside the flask becomes darker.

iodine I_2 & $Cu^{2+/+}$

* **Le Chatlier's Principle:**
Equilibrium shifts between organic and inorganic layers in a colorful display

Kinetic-Molecular Theory, Ideal Gas Law and Thermodynamics:

Gas mole volume box:
A visual representation showing the volume that one mole of a perfect gas would occupy.

Collapsing can:
A can filled with a small amount of water is heated and thrown into ice water to collapse it.

never did it, but others did it always seemed kind of elem. school to me

Egg through a flask:
A flask is heated and a hard boiled egg is placed on top. The flask is put into a bucket of dry ice and the egg is sucked into the flask.

"Boyled" Whip Cream:
Whipped cream swells as the external pressure is reduced.

Balloon Inside a Flask:
A flask containing a small amount of boiling water is sealed with a balloon over its mouth. As the flask cools, the balloon is drawn into the flask.

Boyle's Law and the Monster Marshmallow:
The marshmallow swells as the external pressure is reduced.

Balloon Full of Carbon Dioxide:
Dry ice is put into a balloon, and the balloon inflates.

Variation of Volume of Water with Temperature:
A volumetric flask is filled with water exactly to the mark at room temperature. This flask is placed in a hot water bath until the volume increases.

* **Volume variation with temperature of gas:**
An air filled balloon shrinks when placed into liquid nitrogen.

Freezing Point Depression:
When salt is added to ice-water, the temperature drops below the freezing point of water.

Boiling Point Elevation:
The boiling point of a solution is higher than that of the pure solvent.

Effect of Pressure on the size of a balloon:
A balloon inside of a flask fills as the flask is evacuated

Superheated Steam:
Steam made to be above the boiling temperature of water is capable of charring paper.

note that many of these are repeated throughout the list

Thermochemistry:

Thermite:
Ferric Oxide and Aluminum powder with a fuse set off by H2SO4 make fireworks and molten iron.

* **Lycopodium:**
Fern Spores are dispersed and ignited to blow the lid off of a milk can. — kinetics

H2 and O2 balloons:
Large balloons filled with H2, O2 or a mixture of the gases are exploded in the classroom.

Endothermic reaction:
2 solids are mixed in a flask and waters of hydration are produced and the flask cools below the freezing point of water (-20 to -40C depending on what solids are used)

Energy of food:
An M&M is added to liquid potassium chlorate to oxidize the sugar in an explosive reaction.

pretty cool, but fills room w/ "smoke"

Dehydration of Sugar by sulfuric acid:
Concentrated sulfuric acid is added to sugar in a beaker and stirred. The mixture changes color to black and expands out of the beaker, accompanied by the evolution of heat, sulfur oxides, and the smell of burned sugar and sulfur dioxide.

Nitrogen Triiodide:
It explodes when you touch it, or on its own. — a classic, but I never wanted to deal w/ the risk - but ask Ron

Magnesium:
Burn a wood splint and place into a beaker with dry ice that is subliming to extinguish the flame. Do the same after igniting a strip of magnesium to show that it does not extinguish

Reaction of Zinc and Iodine:
The addition of a few mL of water to a mixture of elemental zinc and iodine results in evolution of purple vapor and heat.

The Non-burning towel:
When dipped in an alcohol solution, a towel is ignited, but does not char. This can also be done with a dollar bill (from the student of your choice!)

Crystallization of Sodium Acetate:
A supersaturated solution of sodium acetate is crystallized by pouring it onto a seed crystal, forming a stalagmite-like solid.

Kinetics:

Lycopodium:
Fern Spores are dispersed and ignited to blow the lid off of a milk can.
(reaction rate depends on particle size)

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Oscillating Clock:
Equal volumes of three solutions are added together and stirred to produce oscillations between colors (indigo, amber and colorless).

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Reaction rate change with temperature:
Lit glow sticks are placed in hot and cold water to show which will glow brighter.

Iodine Clock:
To show that reaction rate depends on concentration. Please note that this demonstration is a little tricky. they do this in lab

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Elephant toothpaste:
A foaming reaction to show a catalyzed decomposition of H2O2.

Limiting Reagent - reaction of Mg and HCl:
Equal quantities of magnesium are reacted with unequal quantities of acid to see how the reaction is affected.

Limiting Reagent 2:
Magnesium is added to equal volumes of 2 M hydrochloric and acetic acid to evolve gas into balloons. The balloon with the strong acid blows up faster, but both are the same eventual size.

Reverse Solubility:
Lead iodide is soluble in hot water, but forms a precipitate when the container is placed into ice water. (reaction rate depends on temperature)

Equilibrium Between Nitrogen Dioxide and Dinitrogen Tetroxide:
Heating or cooling flasks of NO2 and N2O4 shifts the equilibrium between these two species. When more NO2 is produced, the color of the gas inside the flask becomes darker.

Temperature dependent diffusion:
Food coloring is dropped into a beaker with hot water, and a beaker of cold water.

Electrochemistry:

Electrolysis of water:
A Hoffman apparatus is hooked to a power supply to show the electrolysis of water and the ratio of oxygen to hydrogen gas. An indicator is added to show the cathode and anode.

Growing Metal Crystals:
Two platinum electrodes are immersed in a solution of silver nitrate. When voltage is applied, crystals grow at the cathode. When the voltage is reversed, the crystals dissolve and grow at the anode.

CuSO4/ZnSO4 battery:
A voltmeter is hooked up to a battery made from these solutions.

Orange Electrode:
A voltmeter is connected to an orange and several different salt solutions to measure the voltage difference between the solutions.

Concentration Cell:
Two identical copper solutions are connected by a salt bridge and hooked up to a voltmeter. The reading changes upon addition of sodium sulfide.

End Point of an Acid-Base Titration Determined by Electrical Conductivity:
Barium hydroxide is titrated with sulfuric acid while the conductivity of the mixture is monitored. At the equivalence point, the solution is nonconductive and the light goes out.

Its Beating Heart

very tricky, but very cool

Rob got it to work well