Quick Chemistry Demonstrations for the High School Classroom

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Course: Chemistry

Grade Level: 10 and 11

Purpose: Students will observe the excitement of electrons and the drop back down to ground state.

Objectives:
Students will be able to

1. Understand the difference between ground and excited state
2. Explain the basic principles of light emission in the form of a photon
3. Apply the knowledge to how Neon lights work.

Prior Knowledge: Students will have an understanding of the particle and wave nature of light, as well as an understanding of where electrons are located within the atom.

Burning Money (5 min)

Pre-demonstration questions:

1. What is the difference between ground state and excited state electrons?
2. Which state has more energy? How do you know? Why?
3. Can you come up with another way to explain the difference between a ground state and excited state in your own words or example (Like my student having too much sugar)?
4. Define a photon.

Procedures:

1. Make a 50%-50% ethanol solution and add salt (example: NaCl) to solution (calculate based on salt).
2. Dip dollar bill into the ethanol solution and hold with tongs.
3. Light dollar bill will portable lighter and watch flame color.
4. Drop dollar bill into the water to rinse.
5. Repeat as desired.

Post-demonstration questions:

1. What causes the color of the flame?
2. Now that you've seen this, how would you explain the way Ne lights work?

Course: Chemistry

Grade Level: 10 and 11

Purpose: Students will observe how an alloy is made.

Objectives:
Students will be able to:

1. Gain an understanding of metal solutions
2. Explain how heat is used to form alloys

Prior Knowledge: Students will understand the difference between a solution and a heterogenous mixture. They will understand the difference between the physical states of matter and the behavior of the particles of each.

Zinc Covered Penny (7-10 min)

Obtain a zinc coated penny (see attached instructions for making zinc coated penny) and place on a hot plate. After heating the penny will have a layer of brass over it.

Pre-demonstration questions:

1. What metal are pennies coated with?
2. Define an alloy.
3. What physical state are alloys in?

Procedures:

1. Coat pennies with zinc (see attached instructions)
2. Once pennies are coated, place on a hot plate at roughly a 75% setting
3. Observe the pennies changing from silver to gold.

Post-demonstration questions:

1. What color did the penny start out as and what color did it become?
2. How did the penny change colors just by heating?
3. What is another example of an alloy?

Course: Chemistry

Grade: 10 and 11

Purpose: Students will use the dry ice to make observations on the changes of state pertaining to solid to gas.

Objectives:
Students will be able to:

1. Understand the difference between melting and subliming
2. Discuss why a substance would "skip" the liquid phase
3. Discuss how the liquid phase can be obtained.

Prior Knowledge:
Students will have a basic understanding of the states of matter. They will also have and understanding of how particles behave within these different states. They will also know how to change a substances state based on the increase or decrease of energy to the system.

Dry Ice Sublimation in Balloon (5 min)

Pre-demonstration questions:

1. Define sublimation
2. In order for sublimation to occur, what must the reaction absorb from the surroundings?
3. What do you expect to see once the dry ice is placed into the balloon? Why?

Procedures:

1. Obtain a standard size balloon.
2. Place one piece of dry ice into the balloon and make observations.

Post-demonstration questions:

1. What caused the balloon to expand?
2. Can the dry ice turn into a liquid? Why? How?
3. What will happen to the balloon if we put it into liquid nitrogen?

Procedures (Part II):

1. Place balloon in liquid nitrogen and make observations.

Post-demonstration questions:

1. What caused the balloon to shrink in size? Why??

Course: Chemistry

Grade: 10 and 11

Purpose: Students will use and ethanol solution to investigate the differences between ink colors in order to determine who the "guilty" person is.

Objectives:

1. Students will understand the differences between hetrogenous and homogenous mixtures.
2. Students will apply the basic knowledge that mixtures can be separated out by physical means
3. Students will apply the knowledge of polar vs nonpolar molecules to explain why the ethanol solution works.
4. Collect and analyze the data to deduce effective conclusions
5. Present findings to the class

Prior Knowledge:

Students will have an understanding of mixtures compared to solutions. In addition, students will also use their knowledge of polar molecules to explain how the polarity of the solution effects the movement of the molecules up the chromatography paper.

Paper Chromatography (15-20 min, teachers should use time to continue class discussion of topic while waiting for results)

CSI Alternative: Mrs. Shelton's two son's Caleb and Josh went into her classroom and began to play with all of her sharpie markers. One of them took the chromatography paper and started to draw on it. Then he unscrewed the top to the ethanol solutions and started dipping it in and out. When he realized the ink was bleeding, he left the paper inside the jar and put the top back on it. Mrs. Shelton walked in her and wanted to know who was responsible for "messing" up her experiment? Neither boy admitted to it. Caleb had red, green and blue stains on his hands, and Josh had purple, green, and brown. Help Mrs. Shelton figure out who the guilty culprit is!!!

Make three different solutions with EtOH and anything nonpolar (i.e. toluene) of 50%/50%, 80%/20% and 20%/80%

Pre-demonstration questions:

1. Using your textbook or laptop, look up an explanation of paper chromatography.
2. Explain the difference between a homogenous and heterogenous mixture.

3. Define a polar molecule.

Procedures:

1. Obtain three pieces of TLC filter paper.
2. Take each piece of filter paper and draw a line of one of three different colored sharpie markers 10 cm high for each piece of filter paper.
3. Using paper clips, suspend each piece of filter paper into one of the three solutions provided (List the colors observed for each solvent.
4. Take the unknown and determine who made the mess!

Post-demonstration questions:

1. Measure and record the distances traveled by each color within each solvent. Draw and label colors of what you observed on each strip of paper. Determine which colors that separated out are most and least polar. Explain how you figured it out.
2. What type of mixture was the black ink? Heterogenous or Homogenous and why?
3. Why did the different colors of the ink travel different distances?

Course: Chemistry

Grade Level: 10 and 11

Purpose: Students will make observations on the varying densities of multiple liquids and explain why the variation occurs.

Objectives:

1. Continue developing observational skills
2. Explain the basic principles of density
3. Explain how the particles in a liquid behave
4. Understand and explain the difference in densities based on physical states
5. Understand the relationship between volume and mass.

Prior Knowledge:

Students will have a basic understanding of the kinetic molecular theory and will apply it in explaining density. Students will also apply their understanding to the behavior of particles as well as applying the density formula: D=m/V.

Density of Liquids (5 min)

Pre-demonstration questions:

1. Explain how the particles in a liquid behave.
2. Define density
3. How does the density of a liquid compare to that of a solid and gas?

Demonstration procedures:

1. Obtain a beaker of glycerin, water, and oil.
2. Add food coloring to glycerin and water.
3. Poor 25 mL of each substance into a 100 mL graduated cylinder in a random order and make observations.

Post-demonstration questions:

1. From bottom to top, what order are the liquids in?
2. Is it the same order we poured them in?
3. What happens if we shake it?
4. What causes the order of the liquids?

Course: Chemistry

Grade level: 10 and 11

Purpose: Students will understand the difference between mass and volume. They will understand that though air doesn't have a definite volume, it does still have volume.

Objectives:

1. Develop observational skills
2. Explain the basic principles of volume
3. Understand that all physical states demonstrate volume

Prior Knowledge:

Students will have a basic understanding in the differences between solids, liquids and gases based on volume. Students will apply their knowledge of the definition of volume.

Air takes up space! (2-4 min)

Pre-demonstration questions:

1. Define volume
2. What physical states of matter demonstrate volume?

Demonstration procedures:

1. Obtain a 250 mL beaker and a 600 mL beaker.
2. Take paper and crumble it up so that it will lodge into the bottom of the 250 mL beaker.
3. Fill the 600 mL beaker with 300 mL of water.
4. While inverting the 250 mL beaker place it into the 600 mL beaker until the 250 mL beaker is completely submerged under water.
5. Pull 250 mL beaker out.

Post-demonstration questions:

1. Why was the paper not wet?
2. Using your knowledge of volume, explain what happened.

Course: Chemistry

Grade Level: 10 and 11

Purpose: Students will make use of different gases to compare the density of those gases by making observations**.**

Objectives:

1. Develop an understanding on how density applies to all states of matter, including gases.
2. Explain the basic principles of density
3. Review over the idea that air does take up space
4. Begin to use the periodic tables as it refers to atomic mass

Prior Knowledge:

Students will have an understanding of volume and will use it to apply to the density formula, D=m/V. Students will also use their basic understanding of the periodic table to determine atomic masses of elements.

Density of different gases in balloons (3-5 min)

Pre-demonstration questions:

1. Does air take up space? (Review from Chp 1 demo)
2. Define Density.
3. Do gases have density?

Demonstration procedures:

1. Obtain balloons of Helium, Argon, and Hydrogen (Propane gas as a substitute) making sure to fill each balloon to roughly the same diameter.
2. Hold each balloon up and release it.
3. Make observations

Post-demonstration questions:

1. Why did some balloons fall and some float?
2. By looking at the atomic mass of each gas, how would you explain the balloons behavior as it relates to density?

Course: Chemistry

Grade Level: 10 and 11

Purpose: Students will make observations comparing the appearance of the laser pointer in both sets of picture frames in order to understand what Rutherford expected to see and what he actually saw during his gold foil experiment.

Objectives:
Students will be able to:

1. Make observations comparing the appearance of the laser pointer in both frames
2. Explain based on the plum pudding model what Rutherford should have seen and compare it to what was actually observed
3. Describe why the scattering takes place

Prior Knowledge:

Students will have a basic understanding of the "Plum Pudding" model that was considered accurate at the time of Rutherford's experiment. Students will apply observational skills in order to make a comparison between the picture frames.

Rutherford's Gold Foil (5-7 min)

Pre-demonstration questions:

1. Define Alpha particles
2. Explain the plum pudding model
3. Based on the plum pudding model, if positively charged alpha particles are shot through gold atoms, what would you expect to see?

Demonstration Procedures:

1. Take two 5 in. x 7 in. picture frames and remove the glass and backing keeping the first frame empty.
2. Place a piece of plastic in place of the glass in the second frame. This will be the scattering frame.
3. Take a laser and shine it through the first frame explaining that was what Rutherford expected to see.
4. Then take the laser and shine it through the second frame and observe the scattering of the laser.

Post-demonstration questions:

1. What is the difference between what was expected and what was actually observed by Rutherford's experiment?
2. Why was there so much scattering?

Course: Chemistry

Grade Level: 10 and 11

Purpose: Students will understand the importance of nomenclature including the correct use of ending when naming a compound**.**

Objective:
Students will be able to:

1. Develop an understanding of nomenclature
2. Understand the importance of different ending in naming compounds
3. Observe the potential risk in experimentation if proper chemicals are not used

Prior Knowledge:

Students will have a basic understanding of naming based on lecture. They will also have an understanding of basic lab safety and why it is adhered to at all times not matter what is being tested.

What's in a name…nomenclature demo (Chapter 5-7 min)

Pre-demonstration questions:

1. Define nomenclature
2. What are the different ending for nomenclature?

Demonstration procedures:

Obtain 2g (or less) of KCl and 2g (or less) of KClO3…it should fill up about ¼ inch into the test tube.

Put each into a test tube/jar and heat on a hot plate. Once heated place a gummy bear into each and observe.

Post-demonstration questions:

1. Was there a difference in the results?
2. Why is naming correctly so important?

Course: Chemistry

Grade Level: 10 and 11

Purpose: Students will observe the reactivity of different Alkali metals and note the increase in reactivity going down the group.

Objectives:
Students will be able to:

1. Develop and understanding of how the periodic table is organized according to groups
2. Explain their observations on the reactivity of each
3. Compare the different reactions of each to determine how the reactivity trend progresses along the group.

Prior Knowledge:

Students will have a basic understanding of the periodic table and who was responsible for the way it was organized. Students will also have background on the names of the groups and blocks in the periodic table.

Reactivity of Alkali Metals (10 min)

Pre-demonstration questions:

1. What do we know about elements placed within the same group in the periodic table?
2. Will all elements within a group always have similar properties? Explain using examples.
3. What is the name of the group 1 elements?

Procedures:

1. Obtain Li, Na, and K in oil.
2. Fill a 1000mL beaker half-full of water.
3. Starting with the Li, take a small piece of metal with tweezers and wipe off excess oil on a paper towel. (Show students how it can be cut using a knife)
4. Carefully add metal piece to water and move away while reaction takes place.
5. Repeat with Na and K.

Li sizzles, Na produces lots of smoke and sparks (orange flame), while K will burst into violet flames as the H2 gas being produced is ignited. For Li and Na, a lighter can be used to help produce a flame around the piece of metal as it reacts. Lithium will produce a red flame while sodium will produce a yellow flame.

Post-demonstration questions:

1. Write down your observations for each metal.

2. Did they all react with the water? Did they react the same way?
3. Rank the reactions from weakest. Does it fit with how the elements are placed on the periodic table? How?

Course: Chemistry

Grade Level: 10 and 11

Purpose: Students will observe and identify an exothermic decomposition reaction and write down the chemical equation as well as balance it.

Objectives:
Students will be able to:

1. Make observations of the reaction to determine it is exothermic
2. Write out a chemical equation
3. Balance the chemical equation
4. Understand the use and importance of a catalyst in a chemical reaction
5. Determine the catalyst based on the chemical equation

Prior Knowledge:

Students will have an understanding of what an exothermic reaction is as well as understanding how to read a chemical equation based on the symbols in the equation.

Elephant toothpaste, a look at a decomposition reaction (5-7 min)

Pre-demonstration questions:

1. Using symbols/letters, write out a general decomposition reaction.
2. Describe how this reaction works in your own words.

Procedures:

1. While wearing gloves and goggles, pour roughly 50mL of 30% hydrogen peroxide solution into a graduated cylinder.
2. Squirt a few drops of dishwashing detergent into the beaker and swirl it around.
3. Place 5-10 drops of food coloring along the wall of the cylinder to make the foam resemble striped toothpaste.
4. Add 10 mL of KI solution. Do not lean over the cylinder.

Post-demonstrations questions:

1. What does the steam indicate about the reaction? Define the term the fits.
2. What is a catalyst?
3. Of the chemicals I placed into the graduated cylinder, which one acted as the catalyst?
4. Now that you know what chemicals were involved, write out the decomposition of H2O2 (leave out the KI since it is the catalyst.)
5. Looking at the decomposition reaction, what do you think the purpose of the dish soap was?

Course: Chemistry

Grade Level: 10 and 11

Purpose: Students will visually see and feel the difference of a mole of multiple substances in order to understand the purpose of the mole unit.

Objectives:
Students will be able to:

1. Develop an understanding of the purpose of the mole unit
2. Understand how the unit is used as the "middle man"
3. Compare the mole to another unit commonly used, i.e. dozen, pair
4. Reinforce the understanding that a measurement needs a unit along with the number.

Prior Knowledge:

Students will understand the purpose of a unit in measurements. Students will have a basic knowledge of the number of atoms within a mole of a substance.

Visualizing the Mole (4-5 min)

Pre-demonstration questions:

1. Explain how the words dozen and pair can be used.
2. How many particles does 1 mole represent?
3. Define the word unit

Procedures:

1. Obtain 1 mole of water, 1 mole of copper (1) oxide and 1 mole of potassium chromate.
2. Obtain bars of metal made of 1 mole of zinc, 1 mole of aluminum, 1 mole of iron and 1 mole of copper.
3. Have students pass around each chemical.

Post-demonstration questions:

1. Why do each of these objects seem to be made up of different amounts when each is 1 mole?
2. Explain how a mole is a unit, remember to use number of particles in your explanation.

Course: Chemistry

Grade Level: 10 and 11

Purpose: Students will understand how a limiting reactant affects the amount of product produced in a reaction.

Objectives:
Students will be able to:

1. Understand that the limiting reactant will dictate the amount of product produced
2. Explain in their own words how adjusting the amount of limiting reactant will affect the outcome of reactions
3. Draw conclusions based on the reaction and be able to explain to the class
4. Develop an understanding of the importance of identifying the limiting reactant in a reaction.

Prior Knowledge:

Students will have an understanding of the mole and its use as the "middle" man. They will be able to write and balance chemical equations and use stoichiometry to solve problems. They will be able to apply their knowledge of stoichiometry to limiting reactants.

Limiting Reactants (7-10 min)

Pre-demonstration questions:

1. Define limiting reactant.
2. Explain in your own words what would happen to an experiment if you changed the amounts of the limiting reactant you use each time the experiment is run.

Procedures:

1. Put 100 mL of vinegar into each of the four 250 Erlemneyer flasks
2. Place ¼ tsp of baking soda into flask 1 and cover with a balloon.
3. Add ¾ tsp, 1 ½ tsp, and 3 tsp of baking soda into the remaining flasks respectively.
4. Cover each with a balloon and observe.

Post-demonstration questions:

1. What did you observe?
2. Based on your definition of the limiting reactant, what can you conclude?
3. From what you have learned in this demo, explain why it is important to determine the limiting reactant in industry.

Course: Chemistry

Grade Level: 10 and 11

Purpose: Students will be able to identify the difference between a physical and chemical change.

Objectives:
Students will be able to:

1. Develop an understanding of both a physical and chemical change
2. Be able to identify the difference between a physical and chemical change
3. Increase observational skills and ability to explain those observations

Prior Knowledge:

Students will have a basic understanding that many things go through changes. They will understand that some of the changes are permanent and some are reversible.

Physical Change vs. Chemical Change (5 min)

Pre-demonstration questions:

1. Define and explain the difference between a physical change and a chemical change
2. Name an everyday example of a physical change and a chemical change.
3. Write observations of each chemical before procedures take place.

Procedures:

1. Place 15g of Lead Nitrate into a test tube.
2. Place 15 g of Potassium Iodide into a test tube.
3. Obtain ice and place in a beaker. Allow students to write down observations of each substance.
4. Allow the ice to sit and melt.
5. While the ice melts, place the lead nitrate and potassium iodide into a single beaker. Cover with thumb and shake to mix.

Post-demonstration questions:

1. What changes do you see occurring in the ice as it sits? Would you describe your observations as physical or chemical? Why?
2. What changes do you see when you combine the potassium iodide and lead nitrate? Would you describe your observations as physical or chemical? Why?