Demos without a Home
(Wherever They May Roam)

Table of Contents

Demo Name	Page #
Burning Iron and Magnesium	2
Cathode Ray Tube/Pinwheel	2
Coffee Cup Calorimeter	3
Conservation of Mass	3
Density of Coke vs. Diet Coke	4
Detection of Radioactivity	4
Diffraction of Light	4
Dry Ice Sublimation	5
Elements and Compounds	5
Ferromagnetism	5
Gas Discharge Tubes of the Noble Gases	6
Happy and Unhappy Balls	6
Lead Nitrate and Potassium Iodide – Solid and Liquid Reactions	7
Light Sticks	7
Mole Samples	7
Pickle Electrocuter	8
Precision and Accuracy	8
Separation of a Mixture: Iron and Sulfur	8
Smashing things with Liquid Nitrogen	9
Solubility and Temperature	9
Solution formation in different temperatures	10
Steel Wool Reaction Rates	10
Sulfur + Heat + Water → Rubbery Polymer	11
Surface Area Reaction Rates – Iron Strip and Powder	11
Vapor Pressure: Evaporation/Volatility	12
ZnO and HCl	12

Burning Iron and Magnesium

Chemicals and Equipment Needed

- Iron strip ─ **F1**
- Magnesium ribbon ─ **F3**
- Tongs ─ **U2**
- Matches ─ **U1**
- Bunsen Burner ─ **T**

Preparation

- On delivery, attach rubber tubing to methane spigot. Make sure gas is OFF
- Set iron strip(s) and magnesium ribbon into weigh boats

Presentation

- Hold the iron strip in the flame to show it does not burn. Repeat with the magnesium. Warn the students not to stare at the bright light.

Clean-Up

- The iron strip is re-usable

Cathode Ray Tube and Pinwheel – Electrons as particles and waves

Equipment Needed

- Cathode Ray Tube ─ **M4**
    - And/or Pinwheel ─ **M4**
- Stick/bingo Magnet ─ **M2**
- Banana Cables/alligator clips ─ **M3**
- Power Supply ─ **M3**

Preparation

- Before class begins, connect the banana cables to the power supply
- Attach positive (red) and negative (black) alligator clips to their corresponding positions on the cathode ray tube.
    - For the pinwheel, it doesn't matter how it's hooked up.

Presentation

- Turn on the power supply.
    - CRT: Use the magnet to deflect the green beam of electrons, showing that electrons have charge.
    - Pinwheel: electrons act as particles and spin the paddles of the pinwheel. The paddles are also coated in a material that lights up when struck with electrons.
- You must be very careful to handle the power supply one handed. Put your hand in your pocket to avoid touching anything else and potentially completing the circuit.
- Do not leave the CRT on for more than 30s at a time. It can put out harmful X-rays.

Coffee Cup Calorimeter

Chemicals and Equipment Needed

- d-H_2O
- $CaCl_2$ ─ **E4**
- Styrofoam cup ─ **P4**
- Dewar lid with hole ─ **A3**
- Thermometer ─ **U1**
- Buret clamp ─ **J1**
- Short ring stand

Preparation

- Add ~50 mL d-H_2O to the coffee cup. Measure out ~10 g $CaCl_2$ into a weighboat, wrap with aluminum foil and label.
- Set the coffee cup on the base of the ringstand. Thread the dewar lid onto the thermometer, and use the buret clamp to secure the thermometer so that the bulb is submerged in the water.

Presentation

- Read the temperature of the water, or have a student read it. Add the $CaCl_2$ to the cup and use the thermometer to stir it. Re-read the temperature.

Clean-Up

- Solution can go down the drain.

Conservation of Mass

Chemicals and Equipment Needed

- 0.1M $Co(NO_3)_2$ ─ **G4**
- 0.1M Na_2CO_3 ─ **H2**
- 2-300 mL tall beakers ─ **Q3**
- Balance ─ **Back corner table**

Preparation

- Pour 100 mL 0.1M $Co(NO_3)_2$ into one beaker and 100 mL 0.1M Na_2CO_3 into the second beaker.

Presentation

- Place both beakers on the balance and have a student read off the mass.
- Pour one beaker into the other, producing a lavender precipitate. Replace the empty beaker on the balance, and have the student re-confirm that the mass is the same.

Clean-Up

- Dispose of solutions in the white waste container.

Density of Coke vs. Diet Coke

Chemicals and Equipment Needed

- Full cans of Coke and Diet Coke **— O3**
- Display Tank or aquarium **— W/Top of E**

Preparation

- Fill Display tank 3/4 with water and place on cart

Presentation

- Drop the cans into the aquarium. The coke sinks but the diet coke floats. Invite the students to provide explanations.

Detection of Radioactivity

Chemicals and Equipment Needed

- NaCl – **G1**
- NaI – **G2**
- $UO_2(NO_3)_2$ or $UO_2(C_2H_3O_2)_2$ – **G3**
- Decimeter lead block – **L4**
- Geiger counter – **M4**

Preparation

- Place all items on the bench

Presentation

- Show the students background radiation, then compare to the radiation from the chemical samples. You may take the lid off the uranium salt jars, but do not touch the material.
- Make sure to test the Geiger counter before delivery. Replace the batteries (2 D-cell) if needed. There is a little door below the dial where the batteries are located.

Diffraction of Light

Chemicals and Equipment Needed

- Laser pointers and diffraction grating – **V1**
    - Red, green, and blue/purple
    - Diffraction grating has 8 different patterns

Preparation

- Place all items on the bench

Presentation

- Show the students the different colors of the laser pointers.
- Hold the diffraction slide in front of the laser pointer to illustrate the different diffraction patterns.

Dry Ice Sublimation

Chemicals and Equipment Needed

- d-H_2O
- Dry Ice
- 600 mL beaker – **Q2**
- Dewar ─ **A3**
- Rubber-tipped tongs ─ **U2**

Preparation

- Fill beaker halfway with water
- Place dry ice in dewar and cover

Elements and Compounds

Chemicals and Equipment Needed

- Elements and Compounds Kit – **O1**

Presentation

- Display the Elements in a row, with the corresponding compounds between them
    - You may want them in a W pattern

Ferromagnetism

Chemicals and Equipment Needed

- Ferromagnetism Device ─ **M1**
    - Should contain cow magnet

Presentation

- Place cow magnet into the bottle and watch the iron filings jump to the magnet
- Shows the three-dimensionality of the magnetic field

Gas Discharge Tubes of the Noble Gases

Equipment Needed

- Gas discharge tubes ─ **M4**
- Banana Cables ─ **M3**
- Power Supply ─ **M3**

Preparation

- Before class begins, connect the banana cables to the power supply
- Attach positive (red) and negative (black) alligator clips to their corresponding positions on the gas discharge device.

Presentation

- Turn on the power supply to show the students the different colors produced by the various noble gases.
    - The device tends to arc between colors/gases, so the safest thing is to turn off the power supply each time you want to show a different color.
- You must be very careful to handle the power supply one handed. Put your hand in your pocket to avoid touching anything else and potentially completing the circuit.

Happy and Unhappy Balls

Chemicals and Equipment Needed

- “Happy and unhappy” balls ─ **L4**

Presentation

- Take the two identical balls and begin discussing potential and kinetic energy. Drop the two balls on the ground, one will bounce back and the other will absorb energy and does not bounce.

Lead Nitrate and Potassium Iodide – Solid and Liquid Reactions

Chemicals and Equipment Needed

- d-H_2O
- $Pb(NO_3)_2$ (s) ─ **F2**
- KI (s) ─ **F5**
- 0.1 M $Pb(NO_3)_2$ (aq) ─**G5**
- 0.1 M KI (aq) ─ **H1**
- 2-300 mL tall beakers ─ **Q3**
- 600 mL tall beaker – **Q2**
- 2 medium test tubes ─ **P4**

Preparation

- Fill one test tube with ~1 cm solid $Pb(NO_3)_2$, and the other with ~1 cm solid KI. Stopper and label.
- Pour 25 mL 0.1 M $Pb(NO_3)_2$ into one beaker, and 0.1 M KI into the other. Add 50 mL d-H_2O to each beaker. Lid and label.

Presentation

- Solid reaction: Carefully pour the solid KI into the $Pb(NO_3)_2$ tube. Stopper and shake. Within two minutes, a noticeable yellow color should develop as the solid PbI_2 forms.
- Aqueous reaction: Carefully pour the KI solution into the $Pb(NO_3)_2$ solution. The yellow precipitate PbI_2 forms immediately

Clean-Up

- For both reactions, pour the product into the white waste container and rinse beakers or test tubes as necessary.

Light Sticks

Chemicals and Equipment Needed

- d-H_2O
- ice
- 2 Light Sticks (same color) – **V1**
- 2-400 mL beakers – **Q2**

Preparation

- Heat ~250 mL water in one beaker. To the other, add ice and water to ~250 mL.

Presentation

- Crack the light sticks, add one to the hot water, and one to the ice water

Mole Samples

Chemicals Needed

- Various mole samples (elements and compounds) – **L5**

Preparation

- Choose a nice selection of various mole samples

Pickle Electrocuter

Equipment Needed

- One dill pickle – Jimmy John's or Potbelly
    - Make sure it is whole, not quartered
- Pickle Electrocuter ─ **M1**
- Styrofoam cup – **P4**
- Extra fuse – **U1**

Preparation

- Trim the top 2/3rds off the styrofoam cup. Push the cup over the skewers to serve as a stabilizer for the pickle and to catch the pickle juices.
- On delivery, make sure pickle electrocuter is OFF. Plug into desired outlet.
- Blot the pickle with paper towels and push vertically on top of the skewers, so that almost all of the skewers are covered
- Provide an extra fuse for the pickle electrocutor in case it shorts.

Presentation

- Turn out the lights and flip the switch on the pickle electrocutor. The brine in the pickle conducts electricity, and the pickle glows yellow-green from the excitation of sodium ions.

Clean-Up

- Throw the pickle away and wipe off the skewers. Please don't eat the pickle.

Precision and Accuracy

Chemicals and Equipment Needed

- Precision and Accuracy Kit ─ **V1**
    - Plastic rulers with different scales
    - Brass rods

Presentation

- Place the rulers on the overhead or use a document camera. Use the rulers to measure the brass rods and show the students how one obtains more significant figures when the scales have more divisions

Separation of a Mixture: Iron and Sulfur

Chemicals and Equipment Needed

- Fe/S Kit ─ **O4**
    - Vials of iron/sulfur mixture
- Stick magnet ─ **M2**

Presentation

- Show how the stick magnet can be used to pull the iron out of the mixture

Smashing things with Liquid Nitrogen

Chemicals and Equipment Needed

- Liquid Nitrogen (LN2)
- Racquet ball ─ **L4**
- Wide mouth dewar ─ **A3**
- Rubber-tipped tongs ─ **U2**
- Cryo gloves ─ **U4**

Presentation

- Submerge the racquetball in the liquid nitrogen. Leave it for several minutes.
- Throw the racquet ball to the ground. The ball should break into many pieces with a loud crack.

Solubility and Temperature

Chemicals and Equipment Needed

- Solubility and Temperature kit – **O4**
  - Saturated solutions of $Ca(C_2H_3O_2)_2$ and KNO_3
- Large Hotplate – A4

Presentation

- Take the stoppers out of the flasks and place them on the hotplate. Turn the hotplate on to 200-300°C, depending on instructor preference.
- As the saturated solutions heat, the KNO_3 will dissolve more while the $Ca(C_2H_3O_2)_2$ will dissolve less, coming out of solution. Most solids dissolve more at higher temperatures, with a few exceptions
- Solution recipes:
  - $Ca(C_2H_3O_2)_2$ – 100g solid in 270 mL d-H_2O
  - KNO_3 – 100 g in 250 mL d-H_2O

Solution formation in different temperatures

Chemicals and Equipment Needed

- d-H_2O
- Ice
- $KMnO_4$ ─ **F5**
- 2 Large Crystalizing Dishes ─ **P3**
- 2-1 L beakers – **Q1**
- Microspatula – **U1**
- Hot Plate ─ **A4**
- 2 white backgrounds – **A1**

Preparation

- Heat water in beaker before class. Mix ice and water in the second beaker
- On delivery, place the crystalizing dishes on the backgrounds and provide the beakers of cold and hot water and the hot plate.

Presentation

- Pour hot water into one crystalizing dish and cold water into the other, avoiding pouring ice in as well.
- Use the microspatula to add a small amount of $KMnO_4$ to each of the crystalizing dishes and observe the different rates of dissolution depending on temperature.
- You may want to use the overhead or the document camera.

Clean-Up

- Pour solutions down the drain.

Steel Wool Reaction Rates

Chemicals and Equipment Needed

- O_2 tank
- Steel wool (small piece) – **T**
- 500 mL dedicated flask – **P1**
- Propane torch – **A4**
- Tongs – **U1**
- Matches or Striker – **U1**
- Rubber stopper for flask – **U3**

Preparation

- Charge the flask with oxygen for 30 s.

Presentation

- Light the propane torch and use it to set the steel wool on fire. Ask the students how the reaction would change if it burned in pure oxygen instead of air.
- Open the flask and quickly drop the burning steel wool into the flask. It will flash up and burn faster and more brightly until it consumes all the oxygen in the flask

Clean-Up

- Cooled steel wool can be thrown away
- Check the flask for cracks and dispose of as needed

Sulfur + Heat + Water → Rubbery Polymer

Chemicals and Equipment Needed

- d-H_2O
- Sulfur ─ **G3**
- 600 mL beaker ─ **Q2**
- Test-tube ─ **P4**
- Bunsen burner ─ **T**
- 3-finger clamp ─ **J2**
- Ring stand ─ **J1**
- Matches or striker ─ **U1**
- Tongs or forceps – **U1**

Preparation

- Fill beaker with ~400 mL water.
- Place sulfur into test tube and clamp it to a ring stand using a 3-finger clamp. Arrange the test tube so that it is at an angle above the Bunsen burner.
- Upon delivery, hook Bunsen burner to gas spigot. Make sure gas is OFF

Presentation

- Light Bunsen burner and arrange under the test tube to heat the sulfur. Heat until the sufur melts and looks like a thick syrup. (The melting point is ~120°C)
- Once melted, detach the 3-finger clamp from the ringstand and use it as a handle to pour the sulfur into the water.
- Rapid cooling in water will turn the sulfur to a rubbery amorphous polymer.
- Pull the sulfur out with the tongs and pass around the class.

Clean-up

- Throw sulfur containing test tube away in contaminated glass. Rubberized sulfur can be thrown in the trash.

Surface Area Reaction Rates – Iron Strip and Powder

Chemicals and Equipment Needed

- Iron strip – **M3**
- Powdered iron – **F1**
- Propane torch or bunsen burner– **A4/T**
- Tongs – **U1**
- Matches or Striker – **U1**

Preparation

- Set out all materials

Presentation

- Light the propane torch and use the tongs to hold the iron strip in the fire. Carefully place to one side when finished
- Squirt the iron powder through the flame and ask the students to compare the reactions. What was the difference between the reagents?

Clean-Up

- Cooled iron strip can be reused

Vapor Pressure: Evaporation/Volatility

Chemicals and Equipment Needed

- d-H_2O
- Methanol ─ **R3**
- Acetone ─ **R1**
- 3-100 mL beakers ─ **Q3**
- 3 paintbrushes ─ **U3**
- 3 Petri dish lids ─ **P3**

Preparation

- On delivery, fill one beaker halfway with water, one with acetone, and one with methanol. Lid and label.

Presentation

- Have 3 students come up and each takes a paint brush and beaker of choice.
- Have the 3 students dip paintbrushes into liquid and paint on the chalkboard. Observe how fast each liquid evaporates.
- The higher the vapor pressure of the liquid, the faster it evaporates.

ZnO and HCl

Chemicals and Equipment Needed

- d-H_2O
- ZnO ─ **G3**
- 1 M HCl ─ **K1**
- 2-100 mL beakers ─ **Q3**
- 2 petri dish lids – **P3**
- Scoopula ─ **U1**
- 2 stir rods – **U1**
- Black background – **A1**

Preparation

- Fill one beaker halfway with d-H_2O, the other halfway with 1 M HCl. Lid and label

Presentation

- Add a scoop of ZnO to the d-H_2O beaker and stir, showing that it does not appreciably dissolve.
- Add a scoop of ZnO to the HCl beaker and stir. Since ZnO is a basic oxide, it reacts with (and therefore dissolves in) acid.