

Christmas Lab
Check-out Sheet

Name _____ Course _____ Date _____

There will be four labs set up in Chem Lab 101 C.

Experiment (Ornament)	Chemistry Concepts
Marbled Paper Cards	Polar/nonpolar interactions
Christmas Ornaments	REDOX: Oxidation of Aluminum and Reduction of Copper
Snow Sticks	Viscosity and Density
Bouncing Snow Balls	Polymerization and cross linking

General Directions

1. Each lab can be found at a different table. You may start at any lab station, complete the lab and move to the next station until all 4 labs are completed.
 - a. The **Marbled Paper** lab takes a long time to show results and should be started early in the lab period.
 - b. The **Christmas Ornament (Pail)** lab takes some time to complete.
 - c. The **Snow Stick** lab is quick.
 - d. The **Bouncing Snow Ball** lab takes at least 5 minutes.
2. You may take the ornaments with you if you can explain the chemistry behind them.
3. To complete the lab, hand your data sheet to any of the Instructors (Dr. Bunce or Ms. Sosinsky) in Lab. They will ask you to explain the chemistry behind one of the four labs. Your grade will be based on both your written and oral explanations of the chemistry. There will not be any lab report required beyond the written explanation sheet at the back of your handout.
4. The grade (25 pts for each of 4 experiments/ornaments) will be counted as a lab grade.

SNOW STICKS

- 🌲 Use the funnel to add about 1/4 spoonful of glitter to the plastic tube and ONE or TWO pieces of confetti
- 🌲 Fill the tube with water to about one inch below the rim of the tube
- 🌲 Add 20 drops of glycerin
- 🌲 Replace the cap on the tube and invert several times
- 🌲 Watch it snow!

Chemistry of Snow Sticks

The density of the glitter is greater than the density of water. As a result the glitter falls to the bottom of the test tube. Density is a ratio of the mass of a substance to the volume of the substance. If we increase the mass while keeping the volume the same, the density will increase. In this experiment, the density of water is increased by adding glycerin molecules. This increase of density of the water-glycerin mixture is now closer to the density of the glitter. Glitter still has a greater density than the mixture and will still fall to the bottom of the tube but now the glitter will take longer to fall through the liquid. In addition to the increase in the density of water, we have also increased the viscosity of water. This happens by choosing molecules that are large compared to water molecules such as glycerin. The glitter particles are now hindered in their "fall" through the water. They must pass between the glycerin and the water molecules in order to fall to the bottom. The two principles of density and viscosity slow the fall of the glitter through the liquid thus giving the appearance of an actual snowfall. The confetti particles are too big to show much interference by the increased density or viscosity and thus fall to the bottom unencumbered. When the tube is inverted, both the glitter and confetti are physically moved to the top of the tube again where they once again make their way between the glycerin and water molecules.

REDOX ORNAMENTS

- 🌲 Polish one side of the galvanized metal pail with steel wool.
- 🌲 Use one of the punches to make a sticker
- 🌲 Pull the backing off the sticker
- 🌲 Place the sticker in the center of the polished side of the pail, making sure all the portions of the sticker are well adhered
- 🌲 Tie a string to the handle on the pail to both lower and raise the pail into the solution.
- 🌲 Put the ornament into the $\text{Cu}(\text{NO}_3)_2$ solution for no more than 10 minutes.
- 🌲 After 10 minutes, dip the ornament into the beaker of water to wash off the remaining $\text{Cu}(\text{NO}_3)_2$ solution
- 🌲 Carefully scrub the ornament with the designated Acetone sponge to remove the sticker and glue.
- 🌲 Tie a piece of ribbon through the hole in the top of the metal pail to complete your ornament (there is a ribbon station located in lab).

Chemistry of Redox Ornaments

The reaction taking place on the surface of the sheet metal ornament is a reduction-oxidation reaction ("redox" for short). During redox reactions, electrons are moving from one substance to another. Whenever metal ions in solution gain electrons they are said to be reduced. In our reaction, the blue copper ions (Cu^{2+}) in solution are being reduced through the gain of electrons. The copper ions each gain 2 electrons from the aluminum metal. This results in a neutral copper atom (Cu^0) that adheres to the pail. The aluminum atoms (Al^0) each loses 3 electrons and moves into solution as an Aluminum

ion (Al^{3+}). Where the copper atom (Cu^0) adheres to the aluminum pail, the color becomes dull, however the area under the sticker where no Copper atoms adhere remains shiny. The sticker protects the aluminum pail from the redox reaction.

SPRINGY SNOWBALLS

-  Put the two halves of the mold together to form a sphere
-  Fill the mold with crystals (in alternating colors if you wish)
-  Tap the mold lightly on the lab bench to settle the crystals
-  Continue filling until mold is full below the neck. Do not put any crystals in the neck of the mold
-  Lower the mold into a beaker of distilled water for approximately one minute and hold it under water
-  Remove from the water and allow it to sit for three minutes
-  Remove the mold and allow the ball to air dry for a few minutes

Chemistry of Springy Snowballs

Polymers are long chains of individual units called monomers. The crystals that were poured into the mold are made of a long chain polymer called Polyvinyl alcohol (PVA). The crystals are also coated with sodium tetraborate (Borax), a chemical that can act as a cross-linker. The element Boron is able to combine with two separate strands of PVA polymer resulting in a mega molecule that has different properties than PVA. The purpose of water in this procedure is to allow the PVA polymer chains comes to swell up as water molecules are incorporated into the tangles. The Borax in the coating of the PVA molecules that contains the element Boron then cross-links the chains to form a solid in the shape of the mold.

MARBLED PAPER GIFT TAGS & CARDS

Each student will complete this experiment with one small index card (to create a gift label) and one large index card (to create a Christmas card). To complete the gift label at the end of the lab, fold the small card in half, punch a hole in the upper corner on the folded side, and attach a piece of ribbon from the ribbon station in the lab. To completed the card, fold the large index card in half.

-  Spray a pile of shaving cream the size of your fist onto a paper plate. Use a scoopula to shape the pile so that the top surface is flat and slightly larger than the largest paper that you will marble.
-  Apply 4-6 drops of food color to the shaving cream surface, one drop at a time. You may use multiple colors but the total amount of food color used should not exceed 6 drops.
-  Drag a toothpick through the shaving cream and food color to create colored patterns. Press an index card firmly onto the shaving cream surface.
-  Lift the paper off of the shaving cream. Scrape off any excess shaving cream with a scoopula back onto the plate of shaving cream.
-  To get ready for the next marbling experiment, use the scoopula to mix the leftover pile of colored shaving cream until it is one uniform color.
-  Repeat steps 2-4 (adding food coloring, dragging the toothpick, pressing your index card, mixing the leftover pile) with your second index card.
-  Leave the left over shaving cream for the next group

Shaving cream contains soap, which consists of long ionic species that have a polar (hydrophilic) head and a non-polar (hydrophobic) tail making it only partially polar.

Paper contains cellulose, which is polar due to the presence of numerous hydroxide groups. Food coloring is also polar. This means that when the index card is applied to the pile of shaving cream, the polar food coloring will be attracted to the polar cellulose molecules of the index card rather than the partially polar soap molecules of the shaving cream. Thus the dye adheres to the paper more than to the shaving cream.

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Check-out Sheet

Name _____ Course _____ Date _____

Experiment (Ornament)	Explanation of Chemistry Concepts	Grade
Marbled Paper Cards		
Christmas Pails		
Snow Sticks		
Bouncing Snow Balls		

