Encouraging **T**omorrow's **C**hemists

Characteristics of Matter

I. Introduction

Science, in general, is the investigation of physical characteristics and properties if the world around us through observation, experimentation, and deduction. Science satisfies our natural curiosity of how and why things are the way they are. It also gives us knowledge to manipulate and use our environment to our advantage. Therefore, scientists investigate fundamental properties of the world around us and develop ways to apply the knowledge gained to problem solving.

We will get a feel for what it is like to do fundamental investigations. We will study some basic properties of matter. There are three forms (also called stages or phases) of matter. We will spend a portion of the day observing the conversion of one form of matter into another. This process is called phase change. The remainder of the time will be spent investigating the effect of pressure on various forms of matter.

II. Experiments and Suggestions

The best approach to this lab is to give a very quick introduction to the whole class, and then split the class into two sections. Each volunteer will then interact with each group for a half of a class period. Most of these experiments are not hands-on for the students, so this keeps group numbers lower and the students closer to the demonstrations… hopefully lending to increased interest. Sections A and B should be done by one volunteer, and C and D by the other. Read through all experiments and try to tie together what the students of the second half of the class period with what they just saw and learned.

A. Pressure and Density

Before you start, consider these questions:

What is density?
What is pressure?
How could you relate these to one another?

You will layer four liquids (corn syrup, coffee, vegetable oil, and alcohol) in a graduated cylinder. *Have they ever seen liquids that don't mix? Ask them how they expect the layers to form (what order).* Layer them in the order given. *Can they think of other liquids that are immiscible with water?* After getting their predictions, drop various solids in the layers and observe where they rest.

Have them take a syringe and push the plunder all the way in. Tightly press a finger against the tip of the syringe and pull the plunger back. Release the plunger while keeping the finder tight. *What happens?* Take the finger off and pull the plunger back. Now put a finger on the end again, depress plunger and again release. *Now what happens? Are these properties observed in everyday life in other places?*

Draw a small amount of water in a syringe and again put a finger over the tip. Try again to depress without moving the finger. *Can you get compression of the liquid? Compare/contrast these results with the previous one. Any uses of this phenomenon?*

Place a filled balloon in liquid nitrogen. *What happens? Why?*

B. Boiling

Before you start, consider these questions:

What kind of phase change occurs during boiling?

What temperature is required for boiling? (They will answer the temps for water and discuss property difference between various materials)

Ask about the temperature of liquid nitrogen. *Very hot or very cold? Why do you see the bubbles when an object is submerged?* After observing the properties of a racquetball, place it into the liquid nitrogen. *What property changes are expected?* Throw the ball to the floor and observe what happens. *Why the change in properties?*

C. Vacuum

Before you start, consider these questions:

What does it mean to have a vacuum?

Observe a filled balloon and discuss its properties. *What do they think will happen if it is placed in a vacuum?* Place the balloon in the vacuum and start the system. *What was observed? What do they think will happen when the vacuum is removed?* Take the system back to normal pressure and observe.

Do the same series of questions and experiments with a marshmallow. *What are the similarities and differences?*

Put a beaker of water in the desicator. *What predictions are made for water in a vacuum?* Pull a vacuum and observe the boiling. *Is the water hot, cold, or room temperature?*

D. Sublimation and Melting

Before you start, consider these questions:

What kind of phase change occurs during sublimation and melting?

Can they give an example of each?

Place a small amount of iodine crystals in the bottom of a jar. Place a clean cotton ball on the top and seal (make sure they are not touching). Let this sit for a bit and later examine the cotton ball. *What happened?*

Place a small chuck of dry ice onto the table. *What observations can one make? What would happen if it were placed into water?* Drop a chunk into water and observe. If possible, place a balloon over the mouth and observe. *What is happening? Why does the observed gas fall to the table over the edge of the glass when there is no balloon?*

Ask for any other examples of formation of a gas. Put a piece of dry ice in a film canister and snap the lid on. *What do you think will happen?* Set aside and eventually the lid will pop off when enough carbon dioxide has collected in the canister.