DEFINITION OF MATTER

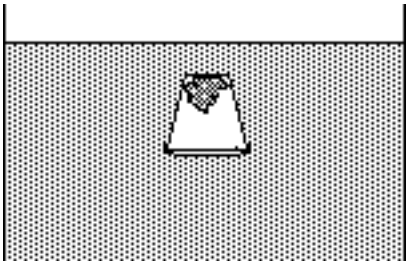
PROBLEM PRESENTATION / EXPLORATION

A. Station A Setup

1. Student stations will be identically equipped with the following materials: a meter stick, 3 pieces of string, 2 balloons, Scotch® tape, and a straight pin.
2. Inflate both balloons equally. Take a number of strips of the tape and affix them to one of the balloons so that a large portion of the external surface is covered. Using two pieces of string, tie one balloon to each end of the meter stick. Tie the third piece of string to the middle of the meter and hang it from some type of overhead support so that the meter stick is balanced and the balloons hang equally. Then burst the balloon with the tape by using the pin. Record all observations. [The balloon being burst loses air and that side goes up showing that the air really does have mass. The purpose of the tape is to keep the pieces of the balloon from flying all over the place when the balloon is burst. Although this demonstration does not take into consideration the buoyant effect of the balloon before it was burst, the demonstration should dramatically demonstrate the fact that air has mass.]

B. Station B Setup

1. Student stations will be identically equipped with the following materials: a piece of tissue, a paper or Styrofoam cup, water, and a beaker or similar container.
2. Fill the beaker or similar container half full of water. Crumple the tissue and place in the bottom of the cup so that it fits tightly. Next, turn the cup upside down and slowly lower in a line perpendicular to the table into the container of water until the whole cup is under water. Finally, remove the cup by lifting it straight up out of the water. Record all observations.



3. After punching a small hole in the bottom of the cup with a pen or pencil, repeat the procedure and explain the results. [Because the air can leave the cup through the hole as the cup is lowered into the water, the water can enter and wet the tissue. In the first instance the water could not enter because the air took up the space. As we have seen in other places, two types of matter can not be in the same place at the same time.]

CLASS RESPONSE / CONCEPT INVENTION

A. Matter Has Mass

1. Reconstruct the balancing balloons. Ask whether it would be possible to put air into one of the balloons thus making that side heavier which would really show that, indeed, air does have mass.
2. To help students figure out how to do this take another balloon, blow it up, tie it off, and put a piece of scotch tape on the outside surface of the balloon. Arrange another piece of tape so that it will make an X. Peel back the second piece of tape so that it is still affixed to the balloon but not crossing the first piece and making the X. (We will reform the X shortly.)
3. Have one student carefully insert a needle through the first piece of tape attached to the balloon. The tape will contract around the needle and seal it

off so that the balloon will not burst or leak (at least not for a while). Upon removal of the needle the second piece of tape can then be quickly pushed down over the hole left by the needle. If all goes as planned, the needle won't burst the balloon, and when the needle is removed and the second piece of tape pressed to the balloon no air will escape. [Do you really think this will work??? Try it, you'll be surprised.]

4. Taking it one step further, a syringe instead of the needle can be used to puncture one of the balloons balanced on the meter stick. Once the entry has been made the plunger of the syringe can be pushed in and introduce air into the balloon. As in #3 above, when the syringe is removed and the second piece of tape pressed down onto the balloon it should result in this balloon having more air that it started with and it should hang down indicating its greater mass.

B. Matter Occupies Space

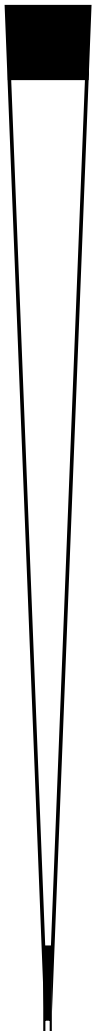
1. Have each group report its observations. Ask them, "Why didn't the tissue get wet in the first case?" Make sure that they understand that the water couldn't occupy the same space as the air. Even though they can't see the air, it is still made up of matter and takes up space.
2. What would happen if the cup with the tissue paper wasn't lowered straight down but tilted at angle? [Someone probably did this in the exploration phase and got their paper wet.] Here the air had a way to get out from under the edge of the cup when it was tilted thus allowing the water to get in.
3. To illustrate this repeat lowering the cup with tissue paper straight down under the water. At this point no water has entered and wetted the tissue. Now, submerge a squeeze bottle filled with colored water. At an angle aim the stream of water under the lip of the cup. In doing so the stream of water will force out some air and allow the water to enter.

C. After all observations have been recorded, try to get the class to come to a consensus on what two properties of air were exhibited in this experiment. [Air has mass and occupies volume.]

CONCEPT EXTENSION

A. I Bet You Can't

1. Insert a long stem funnel into a one-hole rubber stopper and insert it into an Erlenmeyer flask, a Florence flask, or into any other bottle for which the stopper fits.
2. Make sure the stopper has been tightly pushed in.
3. Ask students to predict what will happen upon pouring water into the funnel. [Depending on how fast you pour the water into the funnel you may see slightly different things. If it is trickled in, some air will be able to escape up and out of the funnel allowing water to trickle in. If you pour it in quickly, air will not be able to leave. Some may drop in resulting in a slight burping sound. Only a small amount of water will enter the bottle.]



B. Describe what would happen when you blow air into the balloon above. Explain what you see happen. [They will now be able to inflate the balloon to any great degree since the space around the balloon is filled with matter that pushes pack. The air surrounding the balloon can be compressed a little but not much.]