Making a Cloud

Learning goal: Learners will problem solve the "ingredients" required to make a cloud.

Purpose: This is meant to be an activity learners can do in small groups. Each group should share how they made a cloud with the rest of the class, and the class can discuss what common "ingredients" are required for clouds to form.

*Note: Doing the entire procedure may take 2-3 class periods.

Materials needed (suggested list. Allow students to use whatever additional materials they would like within reason):

1. Several empty, clear 2L bottles with caps
2. A few empty, clear glass bottles (like the Lipton tea bottles)
3. Scrap paper
4. Bike pump
5. Hot water
6. Ice
7. Beakers
8. Matches (if age appropriate. Students should request Teacher assistance if they want to use the matches).

Procedure:

1. Challenge students to create a cloud! They can use whatever materials are available to them. They must be able to explain why it is a cloud.
2. Once they have a cloud, they should try to list what they needed to make their cloud.
3. Have each small group present what they did and their list of "ingredients" to the class.
4. Have the class try to generalize their list into at least 3 specific "ingredients".
5. Have them research ingredients needed to make a cloud using textbooks, experts, the Internet, etc.
6. Have them reflect on how their list of ingredients compares to what they learned during their research. Have them revise their list if necessary.

Discussion:

There are lots of possibilities for how students can create a cloud. The most common ones are depicted in Figures 1, 2, 3, and 4.

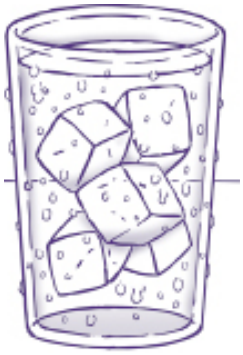

Figure 1

Figure 2

Figure 3

Figure 4

The goal is for students to generate a list of 3 things needed to create a cloud. They should be:

1. Water/moisture
2. Changes in temperature and/or pressure (which are directly related to each other)
3. Surface for condensation to occur on

Further Discussion:

The first ingredient is intuitive: water is needed for a cloud to form. The amount of water needed is actually related to the second ingredient: temperature or pressure change. The atmosphere always has some water present; if the temperature or pressure decreases significantly, clouds can form.

You can see condensation (clouds) on the side of a glass filled with very hot water (as steam rises and touches the cool glass; Figure 1) or on a glass with very cold water (when moisture from the warm air touches the cold glass; Figure 2). These are examples of severe temperature changes that can lead to condensation.

Figures 3 and 4 are examples of using pressure to cause cloud formation on ash particles. When you increase pressure (by squeezing the plastic bottle or adding air to the glass

bottle), the cloud goes away. But lowering pressure (by releasing the plastic bottle or removing excess air from the glass bottle) causes the cloud to form.

As mentioned above temperature and pressure are directly related to each other, which is shown in a simplified version of the ideal gas law equation: PV=T. Assuming volume stays the same (which it does in our atmosphere and inside the bottles), then *pressure and temperature are indirectly related*. Meaning when you increase temperature, pressure decreases; when you decrease temperature, pressure increases. Therefore, when it comes to clouds, either temperature or pressure changes have the same effect on formation.

The difficult thing for most people to recognize is that clouds have to condense on a surface in order to form. It is not possible for clouds to form pure droplets in our atmosphere. For Figures 1 and 2, the surface is the side of the glass. For Figures 3 and 4, the surface is ash particles in the bottles. In the atmosphere, particles (like ash, dust, salt, bacteria, etc) are what droplets condense on during cloud formation. These are called Cloud Condensation Nuclei (CCN). In fact, it is because of CCN that a clean car gets dirty after it rains!