The Ultimate Cloud Demo

From RODNEY'S HOMEPAGE for Earth Science Teachers
http://formontana.net/home.html

PURPOSE
1. To show what is needed for clouds to form. . . vapor (in this case, alcohol vapor), condensation nuclei, and cooling.
2. To demonstrate that air cools as it expands.

MATERIALS
1. A wide-mouth gallon jar (pickle jar)
2. A "punchball" balloon (there is quite a difference in durability among the various brands. . . some work better than others)
3. An overhead projector and a darkened classroom
4. Rubbing alcohol
5. Matches
6. Tongs
7. Goggles (important to wear these)

PROCED URES
1. Put 20-30 ml of rubbing alcohol into the big jar. Put the lid on and then shake the jar for several seconds. Set the jar aside.

2. Cut the balloon off as shown in the TeacherTube video.

3. Darken the room, turn the overhead projector on, and place the big jar onto the projector.

4. Remove the lid and cover the mouth of the jar with the balloon. Compress the air in the jar for 5-7 seconds by forcing your hand several inches into the jar. Use the other hand to help keep the balloon from slipping off.

5. Expand the air in the jar by pulling up on the balloon. A cloud may form, but without condensation nuclei, it should be minimal.
6. Next, remove the balloon and put your goggles on. **CAUTION: Before you place the smoking match into the jar, make sure that the flame has been extinguished. The alcohol vapors are flammable!** Light a match, blow it out, and then hold it for 3 seconds to make sure the flame is out. Next, use tongs to lower the smoking match into the jar. Just in case the match is not completely extinguished, keep your hands and face away from the jar as you use the tongs to lower the match. Holding the match with tongs, wave it around inside the jar for a few seconds to get some condensation nuclei (smoke) into the jar.

7. Put the balloon back on, and repeat the compression and expansion.

EXPLANATION
As the air is compressed, it heats up, becoming slightly warmer than the dew point. Then as the air expands, it is cooled to its dew point, and some of the vapor condenses on the smoke particles, forming the cloud. Light from the projector is reflected off of the cloud droplets, so the students will see the impressive white cloud.

COMMENTS

1. As air moves upward in our atmosphere, it expands. The cooling caused by this expansion causes clouds to form. Ask the class to offer some reasons why air might begin to rise in our atmosphere. Answers include fronts, mountains, and convection.

2. When atmospheric pressure is “high”, skies tend to be clear. When it is “low”, clouds are more likely to be present. Emphasize this as you are pulling and pushing on the balloon, making the cloud appear and disappear.