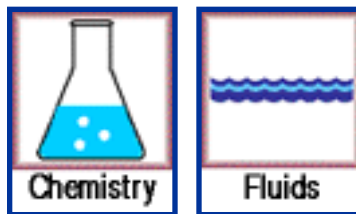
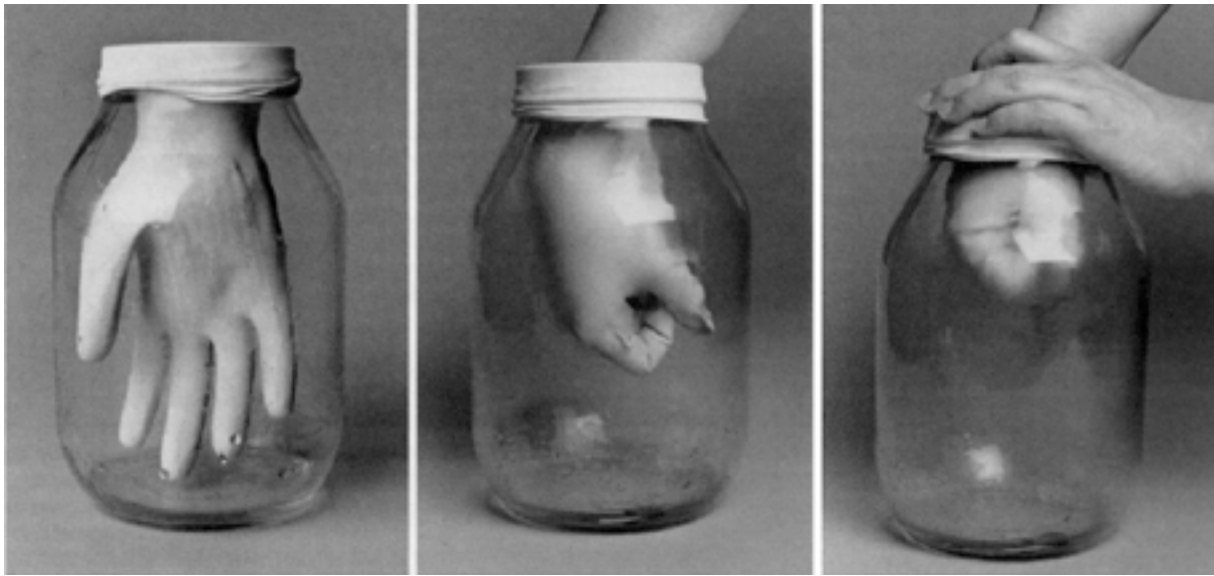




Fog Chamber

Make a portable cloud in a bottle. Now you see it; now you don't!



Clouds form when invisible water vapor in the air is cooled enough to form tiny droplets of liquid water. In the atmosphere, this usually happens when moist air cools as it rises to higher altitudes. At higher altitudes the pressure is lower, so that the gas expands, loses internal energy, and cools. You can accomplish the same cooling effect by rapidly expanding the air in a jar.

materials _____

✓ **One 1 gallon (3.8 liters) clear glass or plastic jar with a wide mouth** (a pickle jar works well).

✓ **A rubber glove** (Playtex™ brand works well).

✓ **Matches.**

✓ **Tap water.**

✓ **Adult help.**

assembly _____

(5 minutes or less)

Barely cover the bottom of the jar with water. Hang the glove inside the jar with its fingers pointing down, and stretch the glove's open end over the mouth of the jar to seal it.

to do and notice _____

(15 minutes or more)

Insert your hand into the glove and pull it quickly outward without disturbing the jar's seal. Nothing will happen. Next, remove the glove, drop a lit match into the jar, and replace the glove. Pull outward on the glove once more. Fog forms inside the jar when you pull the glove outward and disappears when the glove snaps back. The fog will form for 5 to 10 minutes before the smoke particles settle and have to be replenished.

what's going on? _____

Water molecules are present in the air inside the jar, but they are in the form of an invisible gas, or *vapor*, flying around individually and not sticking to one another. When you pull the glove outward, you allow the air in the jar to expand. In expanding, the air must do work, which means that it loses some of its thermal energy, which in turn means that its molecules (including those of the water vapor), slow down slightly. This is a roundabout way of saying that the air becomes cooler!

When the water molecules slow down, they can stick to each other more easily, so they begin to bunch up in tiny droplets. The particles of smoke in the jar help this process along: The water molecules bunch together more easily when there is a solid particle to act as a nucleus. When you push the glove back in, you warm the air in the jar slightly, which causes the tiny droplets to evaporate and again become invisible.

In the atmosphere, air expands as it rises to regions of lower pressure and cools off, forming clouds. This is why clouds often obscure mountain tops. Dust, smoke, and salt particles in the air all provide nuclei that help the droplets condense.

Meteorologists consider a falling barometer reading (low air pressure) to be a sign of an approaching storm, whereas high pressure is usually a sign of clear weather. The temperature at which water vapor begins to form droplets on a surface is called the *dew point*.

etcetera _____

For an added treat, shine a slide projector through the cloud you make in the jar. When the smoke is fresh, the droplets will be large compared to all wavelengths of visible light, and the light they scatter will be white. As the smoke dissipates, the water drops will become smaller, and the light scattered will create beautiful pastel colors at some viewing angles. Light of different colors diffracts around the small droplets, going off in different directions. If you look at clouds near the sun, you can often see bands of these pastel colors. (Remember, you should never look directly at the sun.)

For a longer discussion of this effect, see the book *Clouds in a Glass of Beer* by C. Bohren (John Wiley & Sons, 1987).



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