Demonstration 9.1: Distilling Dirty Water

Teaching Suggestions:

Make sure that all the students can see the apparatus during the demonstration. Keep students alert to the demonstration by asking questions (such as 'What do you see happening here?") as you go along.

Student Responses:

1.

a) A colored liquid bubbling in the flask

b) Nothing (Some condensation is possible but not likely if the flask has been boiling for at least 10 minutes.)

c) Clear or uncolored liquids

2 .

a) Molecules of water, dye and salt

b) Water molecules or molecules of water vapor

c) Water molecules in liquid water

3. No, because only the water made it to the test tube; Water is the only substance boiling. If the dye or salt had been boiling, some of the molecules of dye or salt would have also made it to the test tube.

4. Students should include the following ideas in their responses:

a) All the substances in the flask are being heated, so the molecules are moving faster. The molecules of water that are moving fast enough so that liquid water changes directly to water vapor on the bottom of the flask and forms bubbles which rise to the top of the mixture and escape.

b) Invisible water vapor must be passing through the glass tubing because water vapor is condensing to liquid water in the test tube. Water vapor is invisible because water molecules are too small to see and they are far apart and moving freely through the tube.

c) The water vapor enters the cold test tube and changes back to liquid water. When the water molecules enter the cold test tube, they are moving rapidly, are far apart, and are moving freely. In the cold test tube, the water molecules begin to slow down and cluster together to form liquid water.

Question Set 9.2: Purifying Water Without Boiling

1. a. Cup A
   b. On the underside of the plastic wrap, especially near the weight
   c. Cup A
   d. All through the container
   e. Cup B and underneath the plastic wrap

2. The amount of water is becoming less or decreasing. The water in Cup A is evaporating or changing from a liquid to a gas. As Cup A is heated, more of the water molecules are moving fast enough to escape the surface and mix with the air.

3. Drops of water. As the fast moving molecules in the water vapor come near the cool plastic wrap, they slow down and the attraction between molecules causes them to cluster together to form droplets of water.

4. The salt and food coloring boil at a much higher temperature than water; they do not evaporate from Cup A.

5. Yes, the water molecules are moving rapidly, are very far apart, and too small to see.

Question Set 9.3: Evaporating and Condensing

Student Responses:

1. a. In the dirty salt water, in the air, in the water droplets on the plastic cover, and in the drinking water

   b. In the salt water

   c. In the air

2. If you look at ocean water with magic eyeglasses, you would see water molecules, salt molecules, and a variety of other kinds of molecules. If you look at the drinking water with magic eyeglasses, you would see only water molecules.

3. a. The hot shower water evaporates, and water molecules mix in with the air. (Hot water evaporates faster than cold water. Even in cold water, some of the molecules are moving fast enough to escape the surface of the water. When the water is heated though, more molecules are moving fast enough to escape the surface of the water drops coming from the shower.)

   b. The humid air spreads throughout the bathroom. The water molecules coming from the shower mix with the other gases in the room and move all through the bathroom.

c. Water droplets collect on the cool surfaces of the bathroom, including the walls and bathroom mirror. As the molecules move throughout the air in the bathroom, they hit cooler surfaces, slow down, and form droplets of water.

3. Bathroom fans move the moist humid air out of the bathroom before the water vapor has a chance to condense. The water molecules that would slow down and form droplets of water on mirrors and walls are blown out of the bathroom before they have a chance to hit cold surfaces, slow down, and form droplets of water.

4. Soap does not get on the bathroom mirror because it does not evaporate and condense as readily as water. The molecules of soap are very large and do not move fast enough to escape the surface of the soapy water.

6. a. Water evaporates from the food, the soup, and your mouth.

b. The water condenses on the plastic wrap, the pot lid, or in the air.

c. The water molecules spread throughout the air until they reach something cool enough to make them slow down and condense.

Question Set 9.4: The Water Cycle

Student Responses:

1. Your friend should realize that the water on the outside of the glass came from water vapor in the air which condenses on the outside of the cold glass when the molecules of water slow down and come together to form droplets.

   (Some students think that the water on the outside of the glass has just evaporated from the glass, moved around the glass, and condensed on the outside. They often do not realize that there is always some water vapor in the air that can condense on the glass; it will appear even if the glass has a cover over its top.)

2. Water vapor condenses on cold objects such as the glass because the water molecules slow down and cluster together. The water molecules would not slow down near a hot cup of coffee: The hot cup would actually make them move faster.

3. The water evaporates from the oceans in the form of water vapor which condenses to form clouds. The water molecules, when the water is heated by the sun, move faster which increases the number of molecules moving fast enough to escape from the water's surface into the air.

3. The air around the grass, which contains invisible water vapor, is cooling down. The water molecules begin to slow down. These slower moving molecules cluster together, forming water droplets directly on the grass.

5. No. If only a few pounds of Oobleck evaporated from Mount Neeka-tave, only a few pounds of Oobleck should condense later.

Question Set 9.5: Explaining Precipitation

1. Complete the chart

   a. 2. Spreading--the water vapor mixes and is carried high up.

   b. 1. Evaporation--Water evaporates from oceans, plants, etc.
   3. Cooling and Condensation--Air cools and water vapor condenses into small droplets of water which we call fog.

   c. 2. Spreading--Water vapor mixes with the air. 3. Cooling and condensing--Air cools and water vapor condenses on the grass and other plants on the surface of the earth (dew).

2. Dew is like fog in that water vapor from the air condenses when it comes in contact with a cool object (grass or the mirror).

3. a. Student drawings in the magic eyeglasses should show different kinds of molecules in ocean water such as water, salt, etc.; and only water molecules inside a cloud droplet.

b. Ocean water contains a number of different substances including salt and water. A cloud droplet contains almost pure water.

c. Water evaporates and eventually forms clouds, but ocean salt does not evaporate.

Question Set 9.6: Cluster Review

1.

a. condensing

b. expanding

c. boiling

d. melting

e. dissolving

f. evaporating

g. condensing

2. a. water droplets

b. "Steam is formed when fast moving molecules escape from the water surface to form water vapor and then, when cold, the molecules slow down, move closer together, and form tiny water droplets that we call "steam."

3. Set up a solar still so that the water would evaporate away from the poison, condense on the plastic cover, and drop into a cup. this water is pure enough to drink.

4.

a. When water in the soup is boiled, the water molecules moved fast enough to fly apart, so the water changes directly into water vapor or a gas.

b. The humid air from the boiling water spreads throughout the kitchen. When the bubbles of water vapor come to the surface, the water vapor is mixed with the air and spreads throughout the kitchen.

c. The water vapor in the air condenses on cool surfaces in the kitchen, such as the windows. As the water vapor in the air cools, the water molecules slow down and form droplets.

5. The water in the raindrops has come from the oceans, lakes, rivers, and a little from plants and animals.

6. The faster moving molecules escape the surfaces of rivers, lakes and plants, and mix with the air. As the air rises and is cooled, the water molecules slow down and cluster together in large numbers as clouds. Then, when the clouds gather and the air is cooled further, the water molecules slow down, cluster together into larger droplets and fall as rain.