LESSON CLUSTER 1
States of Water

Activity 1.1: Changing Solid Water to Liquid Water -- Fast

You will show that ice is really solid water by changing it into liquid water, as quickly as possible.

Get an ice cube and seal it in a plastic bag so that nothing can get in or out. Now see how quickly you can change the ice into liquid water. Time yourself.

Starting time _____:_____and_____ seconds

Ending time _____:_____and_____seconds

Melting time _____minutes and _____seconds

1. How did you try to speed up the melting?

_____

_____

_____

2. How does this activity show that ice and water are really the same?

_____

_____

_____

3. How could you change the liquid water in your bag back into ice?

_____

_____

_____

4. Do you think you would have more, less or the same amount of ice as started out with? _____ Explain your answer.

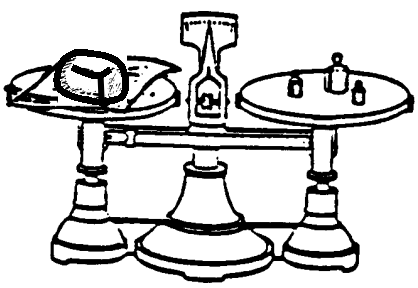
_____

_____

_____

5. My friend predicted that the liquid water from a melted ice cube would weigh less than the solid ice cube. My friend designed an experiment to find out whether her prediction was true. She placed an ice cube in a ziplock bag, weighed it, allow the ice to melt, and weighed it again. Note the results:

BEFORE **AFTER**



Notice that there was no change in weight. Explain the results of the experiment.

_____

_____

_____

_____

Demonstration 1.2: Distilling Water

Answer the questions below after your teacher has demonstrated the distillation of water.

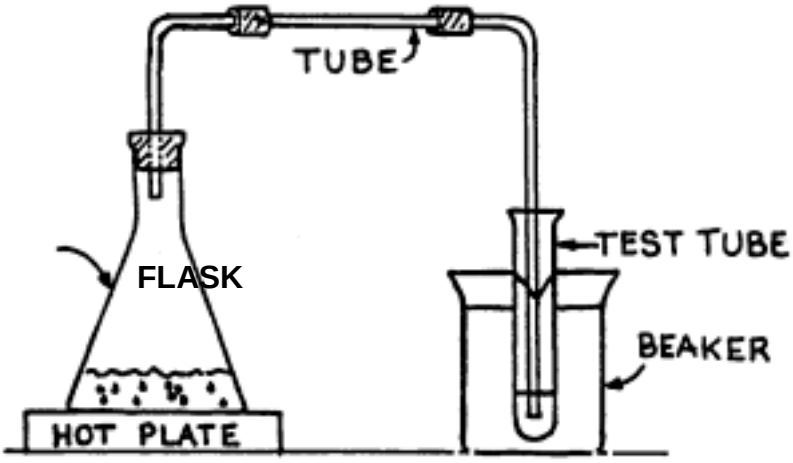
1. Would you expect the flask to have more water in it, the same amount, or less water at the end of the experiment? _____ Why?

_____

_____

_____

2. Draw arrows on the picture below to show how the water is moving through the distillation apparatus.



3. Complete the following sentences:

a. Inside the flask, water is changing from _____ _____ to _____ _____.

b. _____ _____ is traveling through the tube.

c. In the test tube, water is changing from _____ _____ back into _____ _____.

d. The bubbles in the boiling water are made of _____ _____.

4. My friend watched a pot of water boiling on the stove and said, “Oh, look at the air bubbles in the water.” Was what my friend said correct? _____ Explain.

_____

_____

_____

5. a. Look carefully at the tube. Can you <u>see</u> the water vapor inside the tube? ____

   b. Can you <u>see</u> the water vapor inside the bubbles of boiling water? ____

   c. What does this show you about water vapor?

_____

_____

_____

6. How does this experiment verify that liquid water and water vapor are two different states of the same substance?

_____

_____

_____

Question Set 1.3: The Smallest Pieces of Water

I. What are the smallest pieces of water called? _____

What are these smallest pieces made of? _____

2. Draw a picture of a water molecule and label the atoms in it.

3. Suppose you saw a tiny speck of dust floating in a drop of water. Draw a picture to show how the size of the speck of dust compares to the size of water molecules.

4. Draw arrows in the picture you drew above to show how the water molecules are moving.

5. My friend said that if you froze some water into ice, then let the ice sit completely still in the freezer, the water molecules would eventually slow down and stop moving.

Was my friend right? _____

Explain your answer.

_____

_____

_____

Question Set 1.4: Molecules and the States of Water

I. How are ice, liquid water, and water vapor the same? (Talk about molecules in your answer).

_____

_____

_____

2. How are ice, liquid water, and water vapor different? (Talk about molecules in your answer. Draw pictures if it helps.)

3. My friend says that when water freezes the molecules get cold and turn hard. Do you agree? _____ Explain your answer.

_____

_____

_____

4. My friend says that there is water between the molecules of liquid water. Do you agree? _____ Explain your answer.

_____

_____

_____

5. My friend says that there is air inside the bubbles of boiling water. Do you agree? _____ Explain your answer.

_____

_____

_____

LESSON CLUSTER 2
Other Solids, Liquids, and Gases

Question Set 2.1: Are Other Substances Made Of Molecules?

3. See if you can classify the following substances by writing a solid, liquid, or gas. Can you think of other solids, liquids, or gases to add to the list below?

Steel _____	Alcohol _____
Helium _____	Sugar _____
Milk _____	Carbon dioxide _____

2. Draw pictures to show how you think the molecules might be arranged and might be moving in:

Alcohol liquid:

Ice (solid water):

Oxygen gas:

(You will learn more about the answer to this question in Lesson 2.3)

3. How are liquid water and water vapor the same? How are they different?

_____

_____

_____

4. How are water vapor and oxygen gas the same? How are they different?

_____

_____

_____

5. Why can you change ice into water but not into glass?

_____

_____

_____

6. My friend says that we see the sunlight because the sun sends light molecules to us on earth. What do you think?

_____

_____

_____

Activity 2.2: Making Mixtures

1. Make each of the mixtures listed below and stir it thoroughly. Look at each mixture with a magnifying glass, then describe it using the chart below.

Mixture	Can you see different substances in the mixture?		What does the mixture look like? (write or draw)
Salt & pepper	YES	NO	
Salt & sugar	YES	NO	
Dirty water	YES	NO	
Sugar & water	YES	NO	
Syrup &water	YES	NO	

2. Can you tell a pure substance from a mixture by looking at molecules with a magnifier? _____ Explain your answer.

_____

_____

3. What is a pure substance? What is a mixture? Talk about molecules in your answer.

_____

_____

4. What do you think happened to the sugar grains when you mixed it with water? Talk about molecules in your answer.

_____

_____

5. Suppose you could look at the sugar water with magic eyeglasses that showed the molecules. What do you think you could see? Draw or write your answer.

_____

_____

Question Set 2.3: Molecules in States of Matter

1. Pick: a solid, a liquid and a gas other than ice, liquid water or water vapor. Then, fill out the chart below.

a. The substances that you picked:_____

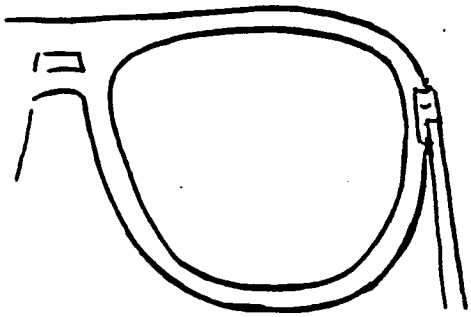
solid: _____ liquid: _____ gas: _____

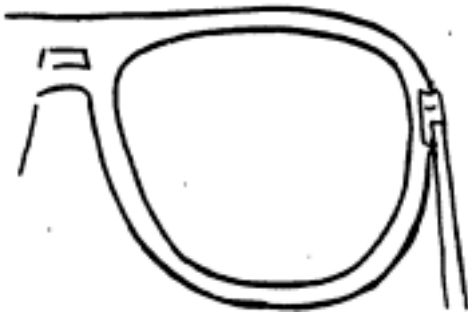
b. What does a single molecule look like? (make up a shape if you don't really know!).

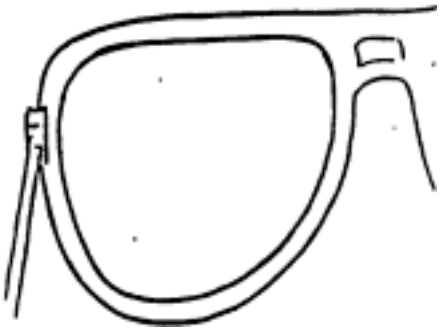
solid: liquid: gas:

c. How the arrangement and motion of the molecules of the substances would look with "magic eyeglasses."

solid: liquid: gas:







d. If you didn't already, draw arrows to show how the molecules of each substance are moving.

2. The sun was shining in the window and we could see specks of dust floating in the air. "Oh," my friend said, "I can see the dust molecules in the air." What my friend said was almost right, but not quite. Can you explain what was wrong?

_____

_____

_____

3. My friend and I went out on a boat in the ocean one day. We went swimming, and the water tasted very salty. However, the ocean water looked very clear. I said, "The ocean water appears to be pure here." My friend said, "Even 'clear' ocean water is really a mixture."
   Was my friend right? _____

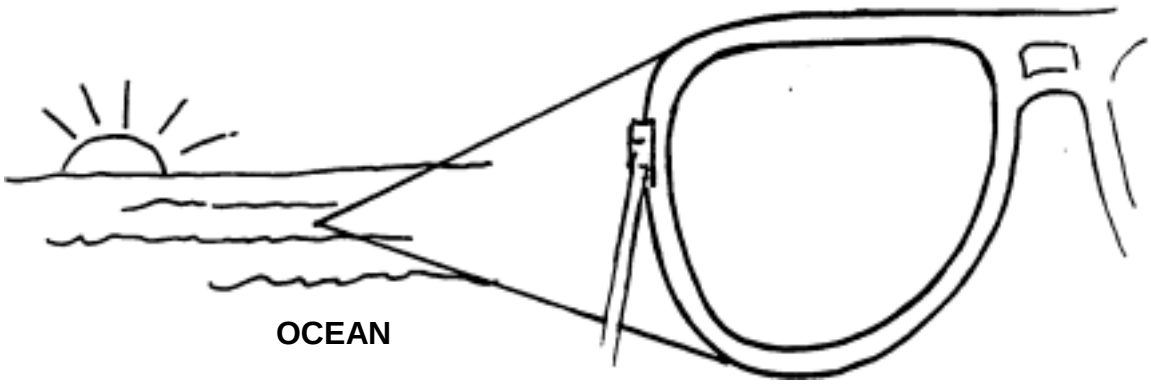
   Explain your answer.

_____

_____

_____

Draw your idea of what the molecules of "pure" ocean water would look like with magic eyeglasses.



LESSON CLUSTER 3
What is Air?

Activity 3.1: Is the Air in a Cup a Real Substance?

Let's try some activities to find out more about air. Collect some air in a small plastic bag by moving it through the air. Try to answer the following questions:

1. How do you know air is in the bag? _____

_____

Squeeze the plastic bag. Then, answer the following questions:

2. Can you feel the air when you squeeze the bag? _____

3. As you squeeze the bag harder and harder, do you notice any difference? _____
   If so, describe the difference.

_____

_____

Try another activity. First, push an upside-down cup into a container of water and mark the level of water inside the cup with a grease pencil. Then, remove the cup, tape one end of a hose inside the cup, and leave the other end so it will be outside the water. Place the cup and hose in the container as shown in the picture. Do you think you can fill up the cup with water, without turning it rightside-up?

Suck the air out of the cup through the hose.

4. Do you notice any change in the surface level of water inside the cup? What happens?

_____

_____

5. Blow air back in the cup through the hose. Do you notice any change in the surface level of water inside the container? What happened?

_____

_____

6. How can you explain this? _____

_____

_____

7. You might have noticed that however hard you pushed the glass into the water, you could not fill up the cup with water. Use what you know about molecules to explain this.

_____

_____

Question Set and Demonstration 3.2: Clean Air and Smells

I. Name the four major gases that make up air. _____

_____

2. My friend said that all molecules in the air are the same. Is my friend right? Explain why you think so.

_____

_____

_____

3. Your teacher will release a small amount of perfume in the room. What do you think perfume is made of?

_____

4. How did the perfume travel from where it was released to your nose? Use molecules in your explanation.

_____

_____

_____

_____

5. Ammonia is another substance that you can smell. Invent a shape for ammonia molecules and draw a picture of what air in your kitchen might look like with magic eyeglasses shortly after you opened a bottle of ammonia.

Activity 3.3: Breathing Out and Breathing In

Let's do a simple activity. Breathe on a cool piece of plastic.

I. What do you see?

_____

_____

2. What do you think the fog is made of?

_____

_____

3. Where did the fog come from?

_____

_____

4. What does this tell you about what is in the air that you breathe out?

_____

_____

Now let's try an activity about carbon dioxide in air. Your teacher will give you a straw and a cup full of water mixed with BTB. BTB is a substance that is normally blue, but carbon dioxide gas ($C0_2$) turns it yellow. The tiny amount of carbon dioxide gas usually present in the air around us is not enough to change the color of BTB from blue to yellow.

5. Use the straw to bubble your breath through the BTB solution. Describe the change in the solution.

_____

_____

6. What does this tell you about the air you breathe out?

_____

_____

7. How does the air you breathe in differ from the air you breath out?

_____

_____

Question Set 3.3: Cluster Review

I. What kinds of molecules is air made of?

Name	Formula	Picture

2. How does the size of a carbon dioxide molecule compare with the size of a speck of dust?

_____

_____

3. When you smell something, what does that tell you about the molecules in the air?

_____

_____

_____

4. How do smell molecules move through the air and get to your nose?

_____

_____

_____

5. (Fill in the blanks below with the names of gases in the air -- nitrogen, oxygen, carbon dioxide, and water vapor.) Compared to the air you breathe in, the air you breathe out has more _____, more _____, and less _____ .

LESSON CLUSTER 4
Compressing and Expanding Air

Demonstration 4.1: Molecules Hitting Things

Answer the questions below after your teacher has done the demonstrations.

1. In your own words, explain how the ping pong ball stays up in the air. Try to use molecules of air in your answer.

_____

_____

_____

_____

2. Why doesn't the basketball/football get flat when you sit on it? What is holding you up?

_____

_____

_____

_____

3 a) Are there molecule hitting the chimes when the air is still?

_____

_____

b) Why don't the wind chimes ring when the air is still?

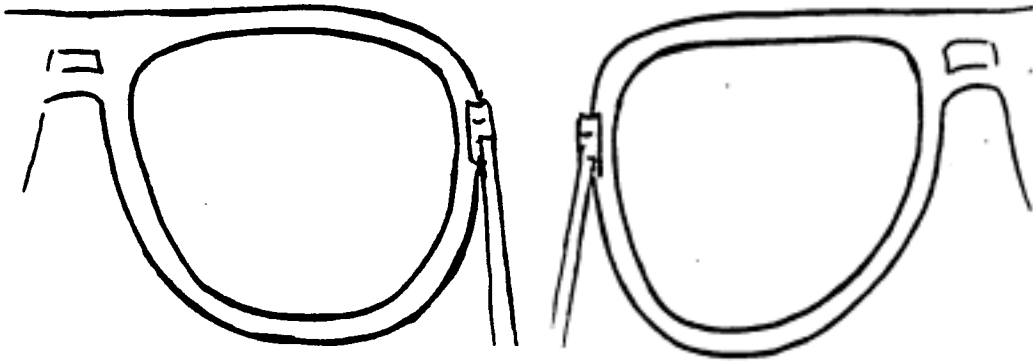
_____

_____

Activity 4.2: Compressing Air and Water

Before we begin this activity, let's review what we've learned about how molecules are arranged and how they move in liquids and gases. Draw in one of the magic eyeglasses below how molecules are arranged in a liquid like water, and in the other magic eyeglasses how molecules are arranged in a gas like air.

WATER (LIQUID) **AIR (GAS)**



1. How far apart are the molecules of a gas compared to a liquid? _____

_____

2. In which of these two states of matter do you think it would be easier to push to molecules? _____

   Why?

_____

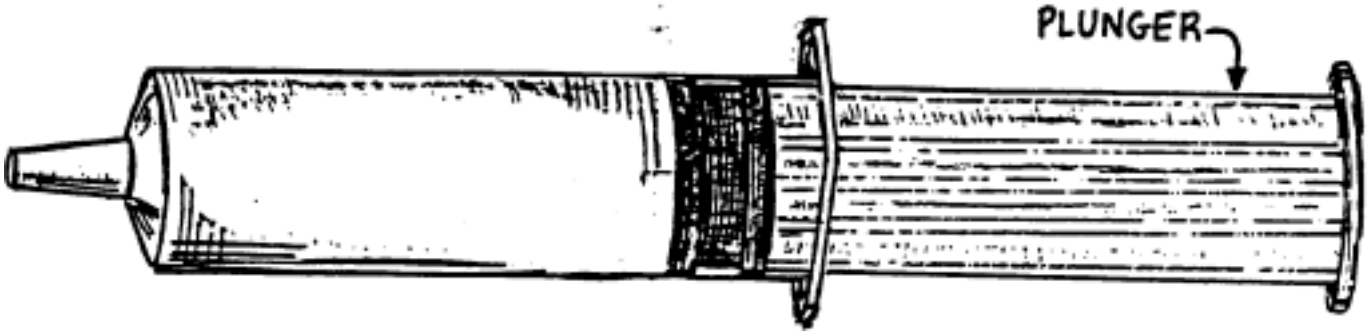
_____

_____

The following activity will help you see if your prediction is correct.

Your teacher will give you a plastic syringe and a cup of water. Look carefully at the syringe and move the plunger in and out. Notice that the end of the plunger has a seal so that no air can get past the plunger. Air can move in and out only through the hole in the tapered end. While you are moving the plunger in and out, feel the air coming out of the syringe.

3. Below is a drawing of a syringe. How would molecules of air be arranged in the syringe when the plunger is all the way out? Draw the air molecules in the syringe.



4. Now fill your syringe with water. Hold it over the cup. Now carefully place your thumb over the end of the syringe so that no water can escape and try to push the plunger in when the syringe is filled with water?

_____

5. Now try the same experiment with air instead of water and pull the plunger out as far as it will go. Place your thumb firmly over the end of the syringe. Keep your thumb on the syringe tightly so no air can escape. Try to push the plunger in. What happened?

_____

_____

_____

6. Why can you push the plunger in when there is air in the syringe, but not when there is water in it?

_____

_____

_____

7. Why can't you push the plunger all the way in with air in it?

_____

_____

_____

Did your explanations for Questions 6 and 7 talk about molecules? Remember that a good explanation talks about molecules. These explanations should talk about the way molecules are arranged in liquids (water) and in gases (air). Go back and write some more for Questions 6 and 7 using these ideas about how molecules are arranged in order to explain what happens in the syringe.

Now, pull the plunger out as far as it will go. Place you thumb firmly over the end of the syringe and push it in as far as it will go. Keep your thumb on the syringe. Let go of the plunger.

Explain why the plunger moves back out.

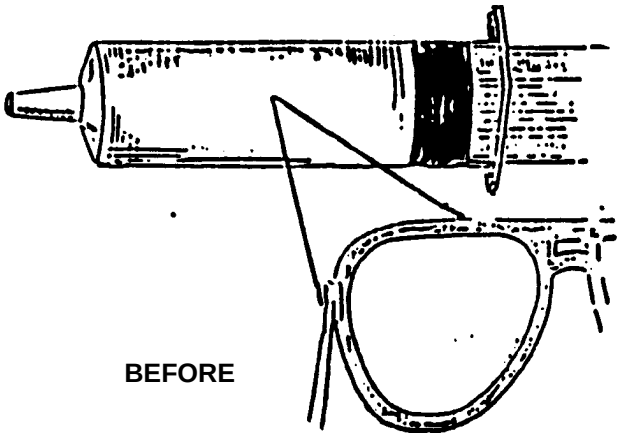
_____

_____

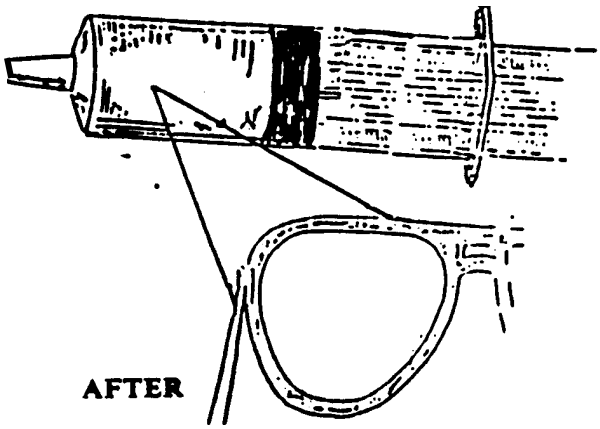
_____

Question Set 4.3: Thick Air and Thin Air

1. In the drawings of the syringes below, draw what you think the molecules draw what you think the molecules of air would look like in the syringe BEFORE you compressed it and AFTER you compressed it.

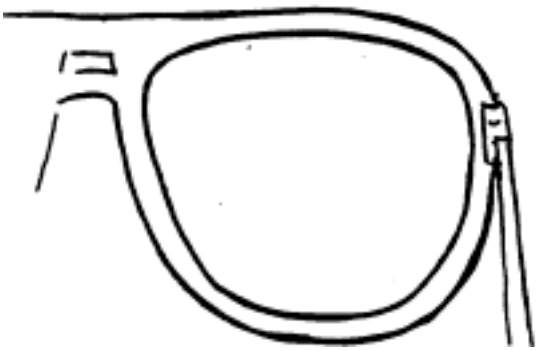


BEFORE

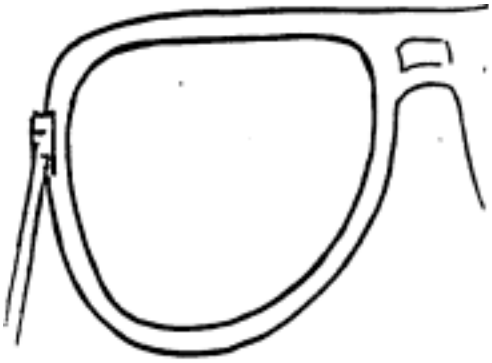


AFTER

2. In the magic eyeglasses below, draw what the molecules of air would look in mountain air and in a scuba tank.



MOUNTAIN AIR



SCUBA TANK

3. Which would have more molecules in a gallon: a gallon of air from the top of a mountain or a gallon of air from a valley? Explain your answer.

_____

_____

4. If the valve of a scuba tank full of air is opened, what do you think will happen? Use what you know about molecules to explain your answer.
Answer:

_____

_____

Question Set 4.4: Explaining Bicycle Tire

1. What is happening to the air as it is being pumped into a bike tire? Is it expanding or being compressed? _____ Explain in terms of molecules.

_____

_____

_____

2. My friend says there is more air near the valve of the bike tire where the air was pumped in. Do you agree with him? Explain why or why not.

_____

_____

_____

3. What is happening to the air as it is released from a bike tire? Is the air expanding or being compressed? _____ Explain in terms of molecules.

_____

_____

_____

4. Briefly state the two parts of a good explanation.

a) _____

b) _____

Question Set 4.4: Cluster Review

1. What are the two questions that a good explanation must answer?

a. A question about _____ : _____

_____

_____

b. A question about _____ : _____

_____

_____

2. Explain what is happening to the air as it is being pumped into a bicycle tire. Make sure your explanation answers both questions.

_____

_____

_____

_____

3. Explain what happens if you run over a nail on your bicycle and the tire starts to leak. Make sure you answer both questions.

_____

_____

_____

_____

4. Look back at the explanation you gave for Question 8 in Activity 4.2. Why does the plunger of the syringe move back out after you let go of it? Did your explanation answer both questions? Try to write a better explanation now, one that does a good job of answering both questions.

_____

_____

_____

_____

5. Helium balloons are filled with gas from a helium tank. A whole balloonful of helium gas can be compressed into one tank.

HELIUM BALLOON

HELIUM TANK

Explain how all that helium can fit in the tank. Make sure your explanation answers both questions.

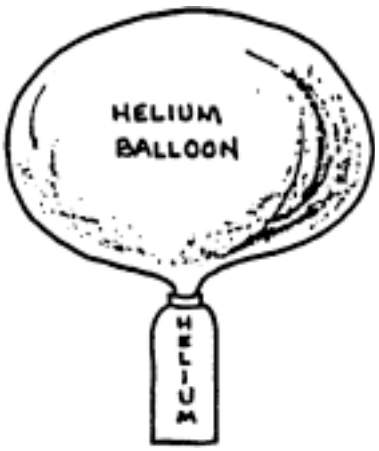
_____

_____

_____

_____

6. Explain what happens when the gas in a helium tank is used to fill a balloon. Make sure you answer both questions.



_____

_____

_____

_____

_____

_____

LESSON CLUSTER 5

Explaining Dissolving

Activity 5.1: Where Did The Sugar Go?

I. Look at a tea bag and some grains of sugar with a magnifying glass. Draw how they look below.

TEA BAG

GRAINS OF SUGAR

a. Does the tea bag have holes in it? _____

b. Are the holes in the tea bag big enough for a grain of sugar to get through? (If you aren't sure, try it and see! Put some sugar in the tea bag and shake it. Does any come out?)

_____

c. Do you think the holes in the tea bag are big enough for **molecules** of sugar to get through? Explain your answer.

_____

_____

2. Put half a spoonful of sugar in the tea bag. Drape it over the rim of the cup. Add just enough water to reach the bottom of the tea bag.

a) What do you see happening underneath the tea bag? (You can draw on the picture on the previous page to illustrate your answer if you want.)

b) Taste the water. What do you taste?

c) Why can't you see the sugar anymore?

d) How do you think the sugar got out of the tea bag?

Now look back at your text. See how your explanation compares with the one there!

e) If you let this cup stand overnight, would the sugar rise to the top, settle to the bottom, or spread evenly throughout the water?

Talk about molecules to explain your answer.

Activity 5.2: Dissolving, Fast and Slow

I. Fill two cups with the same amount of water and put half a spoonful of salt in each. Can you think of a way to make the salt dissolve faster in one cup than in the other? How? (Don't try it yet.)

_____

_____

2. Try your method on one of the cups (Cup A) while you leave the other cup (Cup B) alone. How long did it take you to make the salt in Cup A dissolve? _____ minutes.

   Are there still salt grains in the other cup? _____

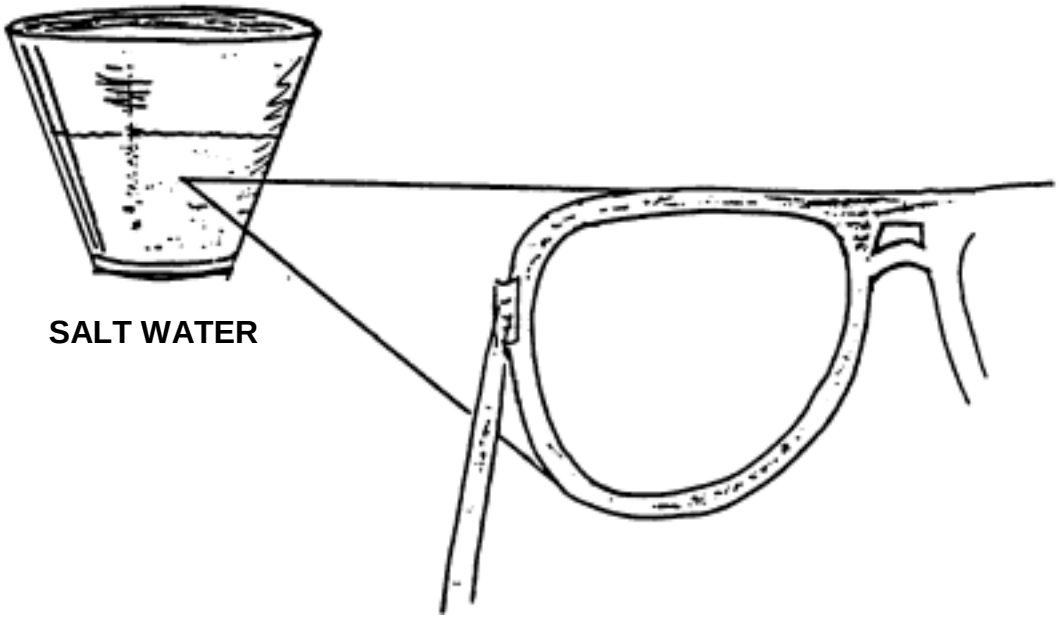
   If you answered yes, then you did it! You made the salt dissolve faster in one cup!

3. You can't see the salt in your cup anymore. Does that mean it is gone? How could you tell that it is still there?

_____

_____

4. Draw a picture to show how the salt solution would look through "magic eyeglasses" that showed the molecules.



5. Why did your method dissolve the salt faster? Remember, your explanation should include something about substances and something about molecules.

_____

_____

_____

_____

_____

6. Can you dissolve salt and sugar in the same water? Try it and see! Use the space below to draw a "magic eyeglasses" picture of the molecules in a solution of salt and sugar in water.

7. The salt is still there in your salt water solution, but the salt grains have been broken up into molecules. Can you think of a way to get the solid salt back? Describe your idea below.

_____

_____

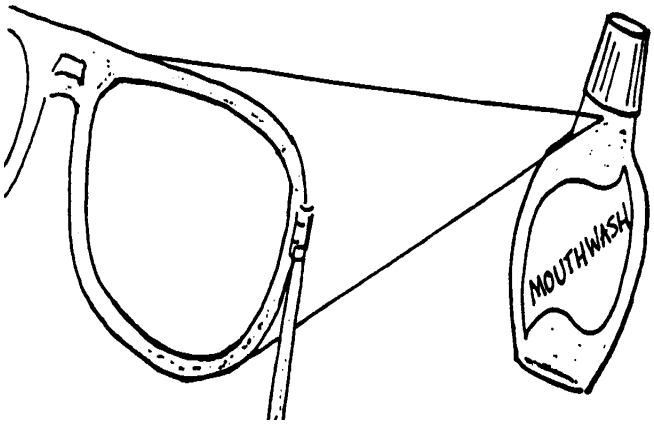
_____

_____

Check with your teacher to see if you can try your method.

Question Set 5.3: Cluster Review

I. The label on my mouthwash says it contains "water, glycerin, benzoic acid, polysorbate 80, FD&C Blue No. 1," and several other substances. Imagine how the molecules of those substances might be shaped, and draw a picture of what my mouthwash might look like through "magic eyeglasses."



2. I dissolved some sugar in water. One of my friends said that the dissolved sugar had just disappeared. Another friend said that the sugar melted, then became part of the water. What would you say?

_____

_____

_____

3. Compare your explanation of how you got the salt to dissolve faster in Activity 5.2, Question Number 5 with the explanation in the science book. Can you make your explanation better? Try rewriting your explanation in the spaces below.

   Try explaining why your method got the salt to dissolve faster. Use the parts of an explanation that you have learned about.

_____

_____

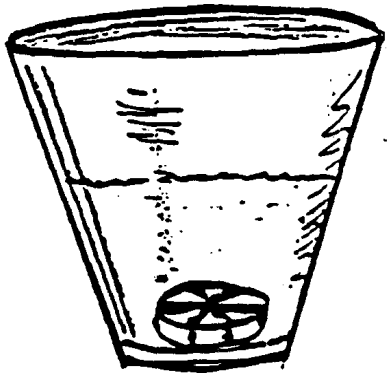
_____

4. What are the most important things you learned from this lesson cluster? Use the space below to summarize some of the most important ideas in this lesson cluster.

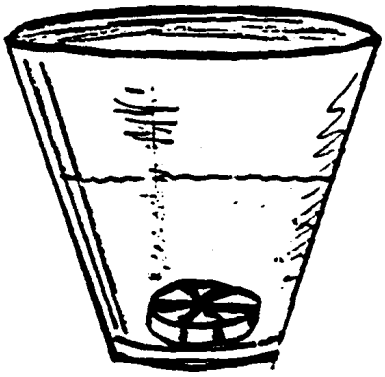
LESSON CLUSTER 6
Heating and Cooling, Expanding and Contracting

Activity 6.1: Candy in Hot and Cold Water

Try doing this experiment: Fill two cups half full with water, one with hot water and one with cold water. Both cups should have the same amount of water. Drop identical pieces of hard candy into each cup. Do not stir the water. Wait and watch for about 10 minutes.



HOT WATER



COLD WATER

While you are waiting try making some predictions:

1. a) How do you think what happens in the two cups will be the same?

_____

_____

_____

b) How do you think what happens in the two cups will be different?

_____

_____

_____

c) Explain your predictions.

_____

_____

_____

Look at the two cups after 10 minutes and compare them. Were your predictions correct? Try describing and explaining what you see.

2. a) How are the two cups the same?

_____

_____

b) How are the two cups different?

_____

_____

3. There are many ways that the two cups are the same after 10 minutes, and one important way is that some of the candy dissolved in each cup. Try to write an explanation of how this happened. Look back at Lesson Cluster 5 if you need to. Remember to answer the question about and the question about molecules in your explanation.

   Explain what happened to the candy in the water.

_____

_____

_____

_____

4. An important difference is that the candy dissolved faster in one of the cups.

   In which cup did the candy dissolve faster?_____

   What was different about the molecules of hot and cold water that would make the candy dissolve faster or slower? (Write down your best guess, then discuss your answer with the class.)

_____

_____

_____

_____

Question Set 6.2: Heating and Cooling Solids

I. Try to summarize the main points of this lesson by writing two sentences, one about heating solids, and one about cooling solids. Your sentences should mention both changes in substances and molecules.

Heating solids: _____

_____

_____

Cooling solids: _____

_____

_____

2. Three of my friends were arguing about why heating the metal ball made it bigger. This is what they said:

Barry: The ball gets bigger because the heat makes the metal molecules expand.
Mary: The ball gets bigger because you are adding heat molecules to the ball.
Terry: The metal molecules are still the same size but they move farther apart.

Who was right? _____ Why do you think so? _____

_____

_____

_____

3. My friend taught me a way to open stuck jar lids. If you run hot water over the lid, it gets a little looser and some times you can open it. Try to explain why this works.

_____

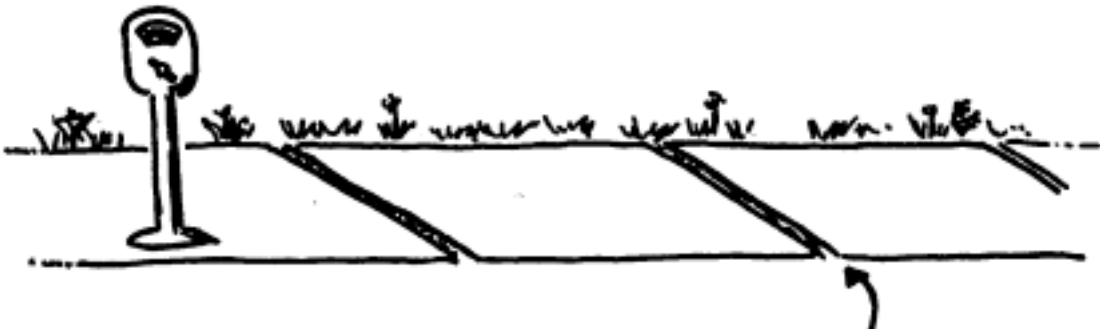
_____

_____

_____

_____

4. Most sidewalks have cracks filled with tar every few yards. These are called expansion joints. During the summer these cracks are very narrow. During the winter they are wider. Explain why this happens. (Hint: First explain what happens to the concrete slabs, then explain what happens to the size of the cracks.)



EXPANSION JOINTS

Activity 6.3: The Thermometer

NOTE: DO NOT TOUCH THE BULB OF THE THERMOMETER DURING THIS ACTIVITY.

1. Look very carefully at the thermometer that your teacher gave you. The colored column looks thick when you look at it from the front, but that is because the glass magnifies it. Look at the thermometer from the side. Can you see how thin the column of colored liquid really is? Where is almost all of the colored liquid in the thermometer?

_____

2. Read the temperature on the thermometer. What is the thermometer reading? _____ Do you think the thermometer reading would change if you turned it in different directions? Now, without touching the bulb, try reading the thermometer when it's on its side and upside down. Does turning the thermometer around change the reading?

_____

3. Now put the thermometer into warm water and watch what happens to the column of the colored liquid. Try explaining it.

   a) What do you think happens to the molecules of the colored liquid when the water warms it up?

_____

_____

   b) How does that make the colored liquid move?

_____

_____

4. My friend says that the liquid goes up when the bulb gets warmer because "heat rises." Do you think that is the correct explanation? _____
How could you show that you were right?

_____

_____

_____

_____

5. Try putting the bulb of the thermometer in cold water. What happens to the colored liquid?

_____

How could you explain what happened?

_____

_____

_____

_____

Activity 6.4: The Dancing Dime

1. Your teacher will give you an empty soda bottle from the refrigerator. The bottle isn't really empty, though.

   What substance is inside it? _____

   Do you think that substance is hot or cold? _____

2. Wet the rim of the bottle and place a dime on it. Make sure that the space between the dime and the rim is wet enough to seal the opening so that nothing can get in or out. Wrap your hands around the bottle to warm it. What happened?

_____

_____

_____

3. Can you explain what happened? Talk about both substances and molecules in your explanation.

_____

_____

_____

4. Instead of placing a dime on the rim of a cold soda bottle, my friend placed a balloon over the rim.
   a. What do you think would happen to the balloon as the bottle got warm?

_____

   b. Use molecules in your answer to explain what happened to the balloon.

_____

_____

   c. My friend said that if you turn the soda bottle upside down, the balloon would get smaller. Was my friend right? _____

   Use what you know about molecules to explain your answer.

_____

_____

Question Set 6.4: Lesson Cluster Review

1. Try to summarize the main points of this lesson cluster by answering the two questions below. Talk about substances and molecules in each answer.

   a) What happens when substances are heated?

_____

_____

_____

   b) What happens when substances are cooled?

_____

_____

_____

2. In the ball and ring experiment, my friend figured out a good way to get a hot ball through a cold ring. He heated the ring! Explain why his method worked.

_____

_____

_____

3. Is it correct to say that heat makes the molecules of a substance expand? Why or why not?

_____

_____

_____

4. If you want something to dissolve fast, should you mix it with hot water or cold water? _____

   Why?

_____

_____

_____

LESSON CLUSTER 7
Explaining Melting and Solidifying

Question Set 7.1: Melting Ice and Freezing Water

1. Fill in the blanks.

   a) When a solid changes to a liquid, the process is called:

   _____

   b) When a liquid changes to a solid, the process is called:

   _____ or _____

   c) When a liquid changes to a gas, the process is called:

   _____ or _____

   d) When a gas changes to a liquid, the process is called:

   _____

2. What causes water molecules to break out of their rigid pattern when the ice is warmed up?

_____

_____

_____

3. What causes water molecules to stick close together in a rigid pattern when water gets cold?

_____

_____

_____

4. How is melting like expansion caused by hearing? How is it different?

_____

_____

_____

Activity 7.2: Melting and Solidifying Kitchen Substances

1. Your teacher will demonstrate the heating of four substances. One is a liquid, olive oil. The other three are solids, shortening, chocolate, and paraffin or candle wax. Can all three of the solids be changed into liquids? Heat the solids in boiling water. Which solid melts at the highest temperature?

   _____

2. Will all four substances change to solids in ice water? Which substance solidifies at the lowest temperature?

   _____

3. What are some other substances that can change states in a kitchen? List as many as you can?

   _____

   _____

   _____

4. Pick one solid kitchen substance and explain what happens to its molecules as it melts.

   _____

   _____

   _____

5. Pick one liquid kitchen substance and explain what happens when it solidifies.

   _____

   _____

   _____

6. Expansion occurs when heating a substance makes the molecules move faster, so they jiggle farther apart. How is melting different?

   _____

   _____

   _____

Question Set 7.3: Cluster Review

1. Fill in the names for the changes of state.
   a. When a solid changes to a liquid, the process is called _____
   b. When a liquid changes to a solid, the process is called _____
   c. When a liquid changes to a gas, the process is called _____
   d. When a gas changes to a liquid, the process is called _____

2. Why do molecules of a solid break out of their pattern if the solid is heated enough?
   _____
   _____
   _____

3. Why do molecules of a liquid form a rigid pattern if the liquid is cooled enough?
   _____
   _____
   _____

4. How is melting gold like melting ice? How are they different?
   _____
   _____
   _____

5. How is freezing liquid oxygen like freezing water? How are they different?
   _____
   _____
   _____

6. Label the following changes as melting, dissolving, expansion, or solidifying.
   a. _____ candle wax turns from solid to liquid.
   b._____ the liquid rises in a thermometer.
   c._____ Kool-Aid is stirred in water until all the solid pieces are gone.
   d._____ lava flowing out of a volcano cools and hardens.

LESSON CLUSTER 8
Explaining Evaporation and Smells

Question Set 8.1: Explaining Evaporation

1. How many situations can you think of where water evaporates? List as many as you can in the space below.

_____

_____

_____

2. Pick one of the situations above and explain what is happening. Be sure that your explanation discusses both substances and molecules.

_____

_____

_____

3. Will a towel dry out faster in humid air or in dry air? _____ Explain why.

_____

_____

_____

4. If you want your towel to dry out quickly after you have used it, should you leave the bathroom door open or closed? _____ Why? _____

_____

_____

_____

5. (BONUS) a) Evaporation occurs when fast-moving water molecules escape from liquid water and leave the slower-moving molecules behind. What do you think happens to the temperature of the liquid water?
Why?

_____

_____

b) Why does your get cold if you go outside without drying your hair?

_____

_____

Question Set 8.2: Where Does the Water in the Air Come From?

Look back to Activity 3.3. Do you remember seeing the moisture when you breathed on the glass? Try explaining how that moisture got there in more detail.

1. Where did the water molecules in the air that you breathed out come from?

_____

2. How did they get into the air?

_____

_____

3. Why can't you usually see water in the air that you breathe out?

_____

_____

4. Every day billion of gallons of water flow into the oceans from rivers all over the world, but the amount of water in the ocean stays about the same That means that billions of gallons of water must also be getting out of the oceans every day. How is this happening?

_____

_____

_____

5. Explain what is happening to the water at the surface of the ocean. Talk about both substances and molecules in your explanation.

Substances:_____

_____

Molecules:_____

_____

6. Identify each of the changes in substances below as: expansion, contraction, dissolving, melting, solidifying, or evaporating.

a. _____: melted candle wax drips down and turns hard

b. _____: a puddle dries up

c. _____: a balloon blows up on top of a bottle when the bottle is warmed

d. _____: the level of the liquid goes down in a thermometer

e. _____: dew on the grass dries up when the sun shines on it

f. _____: iron is heated in a furnace until it turns into a liquid

g._____: sugar is stirred in a glass of water until all the solid pieces are gone

Activity 8.3: Alcohol Evaporation Race

1. Your teacher will give you two ml of alcohol, which evaporates more quickly than water. See how fast you can evaporate it completely. Time yourself.

   Starting time: _____ : _____ minutes and _____ seconds

   Finishing time: _____ : _____ minutes and _____ seconds

   Time to evaporate: _____ : _____minutes and _____ seconds

2. Describe what you did to make the alcohol evaporate faster.

_____

_____

_____

3. The molecules of alcohol are different from water molecules (see Lesson Cluster 2 for a picture of an alcohol molecule). But the process of evaporation is essentially the same. Try explaining how the alcohol evaporates.

_____

_____

_____

4. Can you think of another way to change the liquid alcohol into alcohol gas that would be even faster? If you can, describe how you would do it.

_____

_____

_____

Question Set 8.4: Lesson Cluster Review

I. The story “Bartholomew and the Oobleck,” by Dr. Seuss, tells how King Derwin of Didd got his magician to make millions of tons of a sticky green substance called Oobleck. Everyone in the kindgom is stuck until the king says, “I’m sorry.” Then,

> “The sun began to shine and fight its way through the storm.., all the oobleck that was stuck on all the people and on the animals of the Kingdom of Didd just simply, quietly, melted away.”

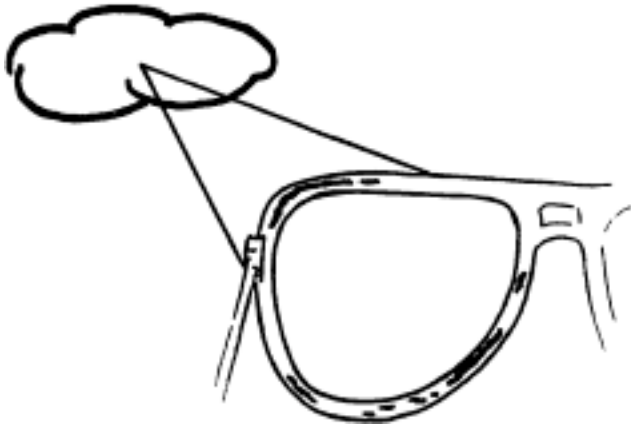
(a) What would be a more scientifically accurate word than “melted” to describe what happened to the oobleck?_____

(b) What must have happened to the molecules of the oobleck?

_____

_____

(c) Show what the air of the Kingdom of Didd might have looked like through magic eyeglasses after the oobleck “melted away.” (You can invent your own shape for oobleck molecules.)



2. Sometimes we say that morning fog is “burned off” by the sun when the sun rises. The fog is made of tiny drops of water. Explain what actually happens to the water molecules in these drops when the sun heats the drops up by shining on them.

_____

_____

_____

_____

3. What is the difference between evaporation and boiling?

_____

_____

_____

_____

4. Explain how you can smell an open bottle of vinegar even though you are across the room.

   (a) What is actually reaching your nose? _____

   (b) How did the vinegar molecules get into the air?

_____

_____

   (c) How did the vinegar molecules reach your nose?

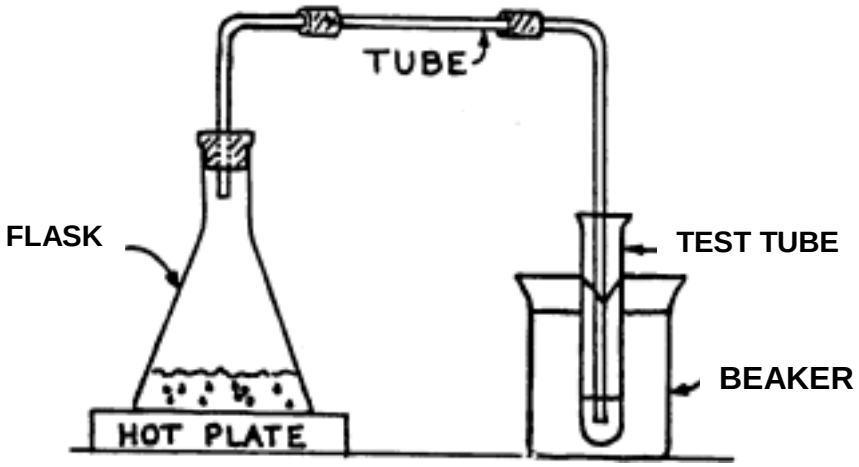
_____

_____

LESSON CLUSTER 9
Explaining Condensation and the Water Cycle

Demonstration 9.1: Distilling Dirty Water

Answer the questions below as your teacher is demonstrating the distillation of dirty water.



I. Describe the appearance of the substances:

a) In the flask of boiling liquid: _____

_____

_____

b) In the glass tubing: _____

_____

_____

c) In the test tube: _____

_____

_____

2. What kinds of molecules would you expect to see with magic eyeglasses:

a) In the boiling liquid: _____

_____

_____

b) In the glass tubing: _____

_____

_____

c) In the test tube: _____

_____

_____

3. Do you think that all of the substances in the flask are boiling? _____

Why or why not? _____

_____

_____

4. Explain what is happening (in terms of substances and molecules):

a) In the flask of boiling liquid: _____

_____

_____

b) In the glass tubing: _____

_____

_____

c) In the test tube: _____

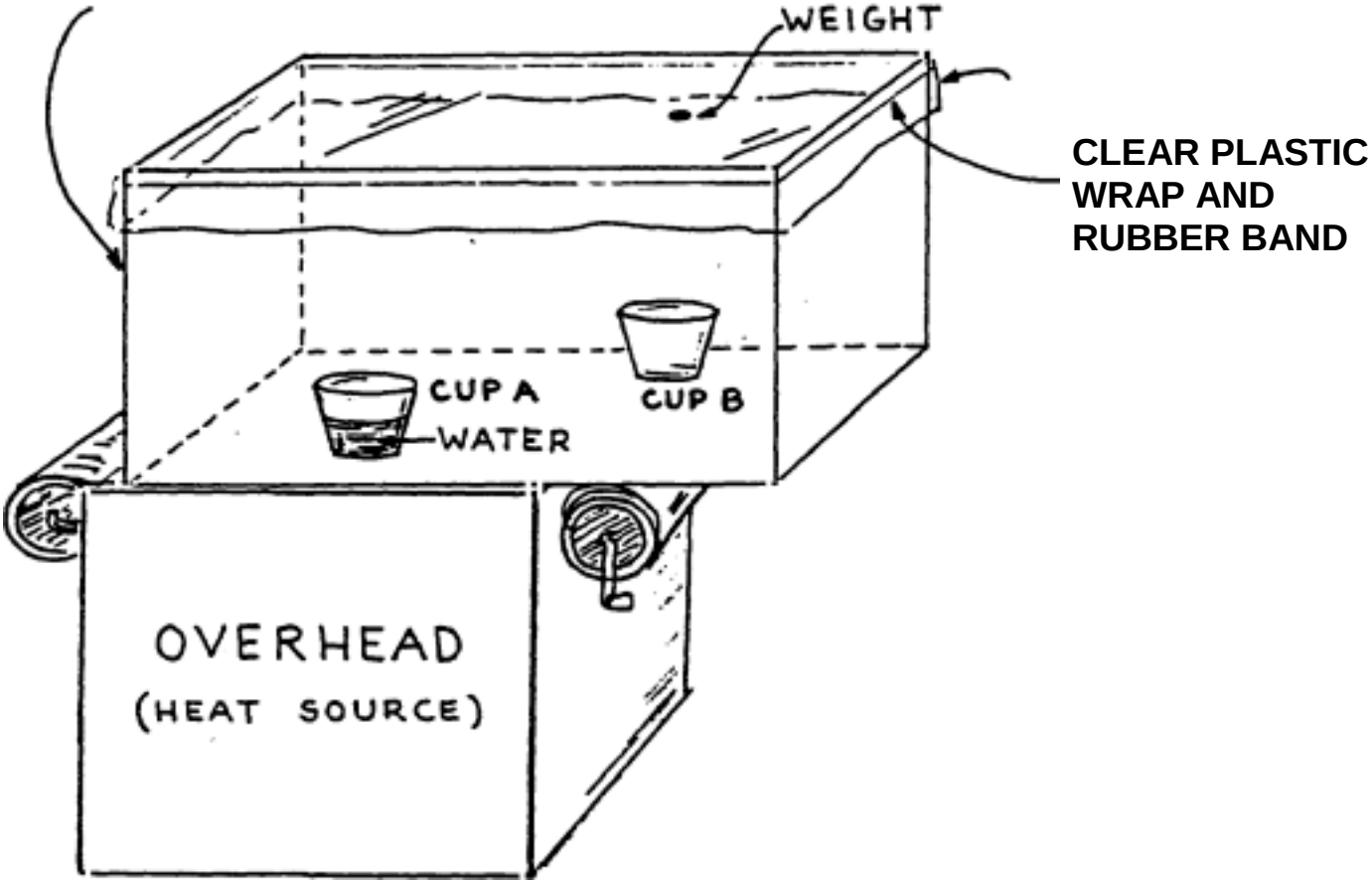
_____

_____

Demonstration 9.2: Purifying Water Without Boiling

Answer the questions below as your teacher is demonstrating the water cycle.

TWO GALLON TERRARIUM



1. Label these things in the illustration above:

   a) a place where water is evaporating.
   b) a place where water is condensing.
   c) a place where there is dirty water.
   d) a place where there is water vapor.
   e) a place where there is pure water.

2. What do you think is happening to the amount of water in Cup A?

_____

Explain what is happening to the water in Cup A in terms of substances and molecules.

_____

_____

_____

3. What do you see on the underside of the plastic wrap, especially under the weight?

_____

Explain where the drops of water are coming from in terms of substances and molecules.

_____

_____

_____

4. Cup A has water, salt, and food coloring in it. Cup B has pure water. Why can't the salt and food get over to Cup B?

_____

_____

5. Do you think the air in the container has water in it? _____

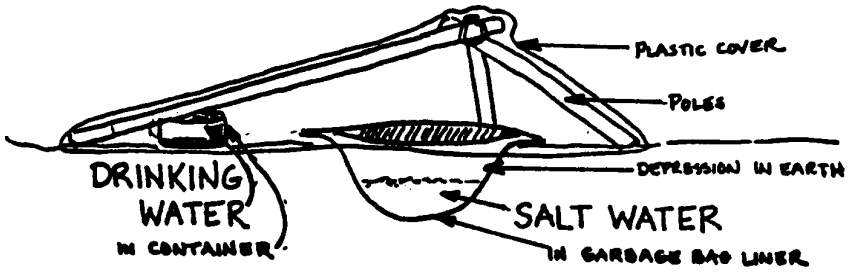
Why can't you see the water in the air? _____

_____

_____

Question Set 9.3: Evaporating and Condensing

CONDENSATION **SPREADING OF WATER VAPOR** **EVAPORATION**



1. Where inside the solar still would you expect to find these kinds of molecules:

a) water molecules: _____

b) Salt molecules: _____

c) Nitrogen and oxygen molecules: _____

2. If you looked at both the salt water and the drinking water in the solar still with magic eyeglasses, what differences would you expect to see in the molecules?

_____

_____

3. Suppose you have just taken a hot shower with the bathroom door closed. The mirror in the bathroom gets cloudy. Explain how this happens. Describe what happens to substances and molecules at each stage.

a) Evaporating: _____

_____

b) Spreading: _____

_____

c. Cooling and Condensing: _____

_____

_____

4. Some bathrooms have a fan that blows air out of the bathroom. If you turn this fan on, there will be less fog on the mirror. Why?

_____

_____

_____

5. The water in the shower is soapy. Why doesn't any soap get on the mirror?

_____

_____

_____

6. Here are some other situations where water evaporates, then condenses:

- food covered with plastic wrap in the refrigerator
- soup warming on the stove (but not boiling) with a lid on the pot
- "seeing your breath" on a cold morning.

Pick <u>one</u> of these situations and answer the questions below.

Situation you picked: _____

a) Where does the water evaporate from? _____

b) Where does the water condense? _____

c) How do the water molecules get from the place where water evaporates to the place where water condenses?

_____

_____

_____

Question Set 9.4: The Water Cycle

1. My friend was upset with the people that make drinking glasses. "You know," he said, "they ought to learn how to make glasses that don't leak. Every time I fill up a glass with cold water, some of it seeps through to the outside of the glass!" How would you explain to my friend where the water really came from?

_____

_____

_____

2. Why does water condense on the outside of a cold glass but not on a cup of hot coffee?

_____

_____

_____

3. My friend was puzzled over something else. "I don't understand," she said, "how the rivers of the world can empty billions of gallons of water into the oceans every day, but the oceans never seem to get any fuller. What's happening to all that water?" Can you answer my friend's question?

_____

_____

_____

4. Sometimes dew forms on grass when the grass cools off at night. Explain how this happens.

_____

_____

_____

5. BONUS: The magicians in "Bartholomew and the Oobleck" made millions of tons of oobleck by boiling a few pounds of a variety of things in one little pot on Mount Neeka-tave. Could such a thing actually happen? Explain:

_____

_____

_____

Question Set 9.5: Explaining Precipitation

1. Complete the chart below:

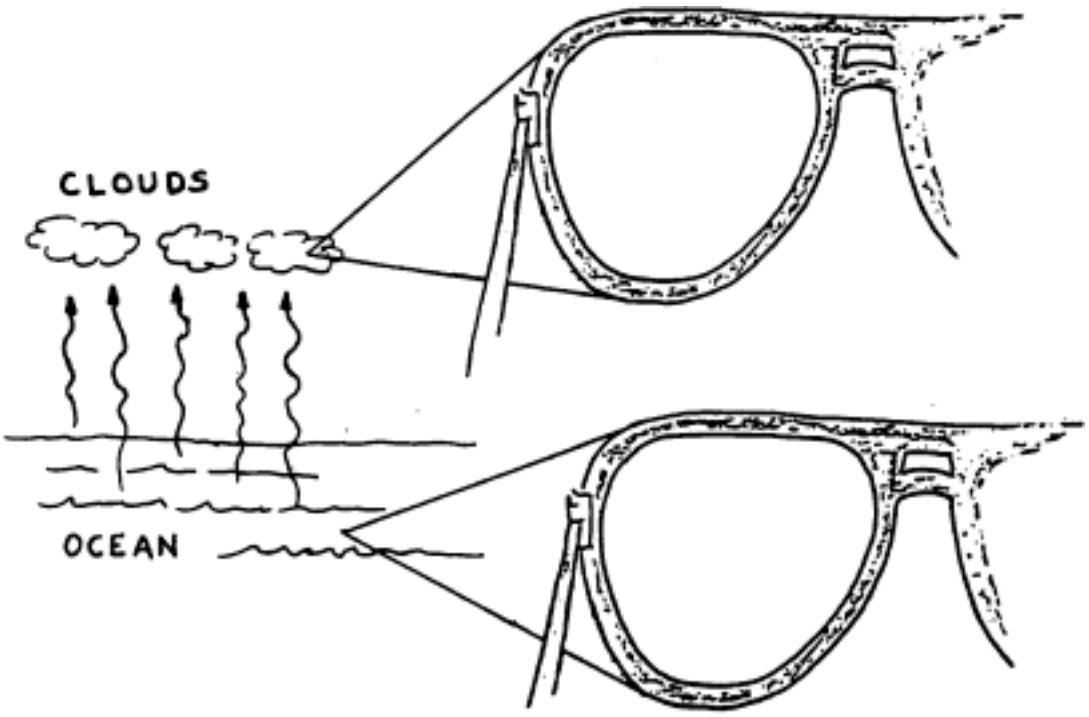
Type of Precipitation	**How it Happens**		
	Evaporation	**Spreading**	**Cooling and Condensation**
Clouds and rain	Water evaporates from oceans, plants, etc…		Air cools off and water vapor condenses into droplets (clouds). Drops fall to Earth (rain).
Fog		Water vapor mixes with air.	
Dew	Water evaporates from oceans, plants, etc…		

2. How is dew like the fog on a bathroom mirror (see Question Set 9.3)?

_____

_____

_____



3. The illustration above shows water evaporating from the ocean, rising, and condensing to form clouds.

a) Use the magic eyeglasses to draw the molecules that you would expect to see in the ocean and inside a cloud droplet.

b) How are the ocean water and the water in the cloud droplet different?

_____

_____

_____

c) Why are the ocean water and the water in the cloud droplet different?

_____

_____

_____

Question Set 9.6: Cluster Review

1. Identify each of the changes in substances below as: expansion, dissolving, melting, evaporating, boiling, and condensation.

a) _____ : when you "see your breath" on a cold day.

b) _____ : a metal bill gets larger when it is held in a flame

c) _____ : soup bubbles on a stove

d) _____ : salt is heated in a furnace until it turns into a liquid

e) _____ : salt is stirred in water until the grains disappear

f) _____ : the sun comes out and "burns the dew off the grass"

g) _____ : fog forms on the inside of a car windshield

2. a) Water vapor is invisible. What is the “steam” that you see above boiling water?

_____

b) How did the “steam” form?

_____

_____

3. I am alone on the desert and the Bad Guys have put poison in my water supply. What could I do to get drinking water?

_____

_____

_____

_____

4 Sometimes the windows of my kitchen get steamy when I cook soup in the winter. Give a three-step explanation of how this happens. Mention both substances and molecules for each step.

a) Boiling:

_____

_____

_____

b) Spreading:

_____

_____

_____

c) Cooling and Condensing:

_____

_____

_____

4. Raindrops keep falling on my head when I go outside on a rainy day. What are some of the places that the water in those raindrops has come from?

_____

_____

_____

5. How did the water molecules get from lakes and rivers to the raindrops that fell on my head?

_____

_____

_____