Weather Together

Wyoming Science

Objectives:

- Students will explore the movement of water vapor into the atmosphere.
- Students will experience the evaporation of water molecules as a cooling process.
- Students will appreciate the volume of moisture in the atmosphere and the space available to hold it.
- Students will show the relationship between saturated air and the ability of water to condense at the Dew Point.
- Students will explore the two types of clouds that form from surface-heated moisture.
- Students will measure moisture in the atmosphere.
- Students will explore the term heat index and its relationship to air humidity.

Background:

If the troposphere was just comprised of gas molecules, winds created by the sun's unequal heating of the earth and its atmosphere would blow dust storms across an unlivable planet. The earth supports life because, even in the driest places, the air always carries at least a little water. Not only does the water in the air create clouds and bring needed rain, it also contributes to a relative feeling of discomfort in hot humid conditions.

But where does this water come from and how does it get in the air? This can be answered with an explanation of the water cycle. As the sun's heat warms the planet's surface, some of the earth's water evaporates into the air as a gaseous vapor. This water vapor rises and then cools to the point where it condenses into visible clouds made of tiny water droplets. When the clouds become saturated, this condensed water falls back to earth. When the moisture reaches the surface, it becomes absorbed into the ground, or by plants and other living creatures. Other water flows into streams, eventually reaching lakes, rivers, or even oceans. As this moisture gets redistributed, some of it evaporates back into the atmosphere completing the cycle.

What fuels the water cycle is a constant supply of energy from the sun and water. Approximately three-fourths of the earth's surface is covered with water. This water is comprised of invisible molecules of hydrogen and oxygen. When these molecules are near the surface of the water and are heated by the radiant energy of the sun or the surrounding air, they begin to move quickly, break away (evaporate),

Wyoming Agriculture In The Classroom

Standards

Science

Earth, Space, & Physical Systems: 1.4, 1.5, 1.6, 1.7, 1.8,

Science as Inquiry: 2.1, 2.2A, 2.2B, 2.2C, 2.2D, 2.2E

Materials

- Desk lamp or bright flashlight
- Large piece of cardboard
- Gallon jug of water
- 3-oz. plastic drinking cup
- Dropper
- Paper towels
- Typing paper
- 9-oz. plastic drinking cup
- Black marker
- 3-oz. plastic drinking cups
- 7" plastic sandwich plates
- 4 oz. water
- Food coloring
- Dropper or toothpick
- Dishwashing detergent
- Ice
- Pencil
- 12" human hair
- Tape
- Hygrometer (hair type)
- Psychrometer: (wet/dry type)

Estimated Time

(5) - 40 Minute **Activities**

Grades 5-6

notes:

and enter the air in the form of water vapor. As the vapor departs, it pushes off neighboring molecules, causing them to slow down and cool. This is why the evaporation of water vapor from our skin feels cool and the reason why we enjoy the breeze from a fan in the summer.

The amount of water on the earth and in the air as vapor can be likened to the contents of a liter bottle. Approximately 972 milliliters would be contained in the oceans as salt water leaving only 28 milliliters as fresh water. Of this amount, 23 milliliters would be found as ice and 4 milliliters as underground fresh water. That leaves roughly two big drops (2 milliliters) as water in lakes and rivers and one very small drop. (1 milliliter) as water in the air.

Even though the air starts out perfectly dry, water molecules (water vapor) eventually break free and enter the air. After a while water molecules are going from the air to the water as well as from the water to the air. Eventually, as many molecules will be going back into the water as are leaving it. When this happens, we say the air is saturated with water vapor. Saturated air depends on the temperature of air and the amount of water vapor contained in it. If the air is warm, there is more space for water molecules to enter. If the air is cool, there is less space for the water to enter the air so it fills up sooner. Because of this, at any location, there will probably be more water vapor in the air during warm weather than during cold weather.

This relationship between air temperature and its capacity to hold water is described as Dew Point, or the temperature at which condensation occurs. At this point, the moving molecules of water cool and slow down, lose pressure, and come together (condense) in sets of six; the cohesive power of the molecules helps keep them together when they touch. This coming together of molecules can be seen as the mist (condensation) on your bathroom mirror after a shower, dew on the grass, fog on the ground, or stratus and cumulus clouds. Heavily laden clouds of water vapor will eventually reach the point of saturation whereupon the vapor condenses and is released in the form of precipitation – rain or snow. It takes 1,000,000 cloud droplets to form a raindrop. If the air temperature is below freezing when they condense, the molecules eventually form six-pointed crystals called snowflakes.

The base height of stratus clouds is normally in the 2,000 ft. range of the atmosphere. The term stratus is the Latin word for mist. The clouds form in moist stable air which has little or no turbulence. As warm saturated air cools, the water vapor droplets condense into these flat-bottom clouds. As a rule, stratus clouds only bring mist, drizzle, or light precipitation. Cumulus clouds, meaning heaped, form in columns of

rising moist air that is being heated by the sun and surface and made to rise rapidly. These are the puffy, cotton-shaped clouds that appear in warm skies. As the air rises it cools, and its water vapor condenses into clouds. These types of clouds bring moderate to heavy showers. As long as there are convection currents carrying moist air to a height where water vapor condenses, these clouds will continue to develop, eventually forming large upward swirling masses of cumulus clouds.

Since Dew Point is based on how much water vapor is in the air, it really is an indication of humidity. To determine the amount of water vapor present in the air, an instrument called a hygrometer is used. A hygrometer comes in two forms, a hair hygrometer and a psychrometer.

A hair hygrometer is based on the fact that hair expands and twists in the presence of humidity. New England colonists were known to hang a piece of bailing cord from the ceiling of their barns with a heavy stick indicator tied below. As the cord swelled from excess humidity, it would point to a place on the floor marked stormy.

Another was the European weather guide made in the form of a tiny house with two doors, from which emerged either a boy or girl. The boy and girl figures were attached to either ends of a stick which was suspended from the ceiling of the house by a human hair. As the hair expanded and twisted from humid air, the boy would appear to step out from one of the doors while the girl appeared to step back, signifying stormy weather ahead.

Today's modern hygrometers still rely on the use of human hair or synthetic filaments and are constructed. The reading on a hygrometer is given in terms of relative humidity, the percentage of available space taken up by water vapor. A psychrometer is another type of hygrometer which uses two thermometers to measure relative humidity – a dry-bulb and a wet-bulb thermometer. Since the result of evaporation is a cooling process, as water evaporates from the wet-bulb thermometer, the temperature lowers. If the air is close to its Dew Point, very little moisture will evaporate from the wet-bulb thermometer, causing only a slight drop in temperature. The difference between the wet-bulb and the dry-bulb thermometers provides a reading of relative humidity. See the figure below.

Meteorologists use relative humidity to determine the likelihood of rain; highly saturated air is a good predictor of rain. They also use relative humidity in combination with the air temperature to calculate a heat index or humidity. At high temperatures and high humidity, the air often feels hotter than it is because of the higher content of heated moisture in contact with the skin.

vocabulary:

- *troposphere*
- *atmosphere*
- *molecules*
- *condensation*
- *precipitation*
- *turbulence*
- *humidity*
- *evaporate*
- *stratus*
- *cumulus*
- *cirrus*
- *altitude*
- *vapor*

materials:

Activity 1
Water in the Air

- Water Molecule Cut-Out
- Desk lamp or strong flashlight
- Large piece of cardboard
- Worksheet 1, (2 sheets) The Water Cycle - Cut-Outs
- Worksheet 2, The Water Cycle
- Transparency A, The Water Cycle

Talk About the Topic

Point out that if the troposphere was just comprised of gas molecules, winds created by the sun's unequal heating of the earth and its atmosphere would blow dust storms across an unlivable planet. See if the group can guess what else is in the atmosphere that brings life to all living things. Hopefully, they will guess that it's water.

Explain that the earth supports life because, even in the driest places, the air always carries at least a little water. Not only does the water in the air create clouds and bring needed rain, it also contributes to a relative feeling of discomfort in hot humid conditions. Conclude the discussion by introducing the water cycle.

Activity Procedures:

Activity 1—Water in the Air

1. Review the background information with students. Show the overhead of Transparency A, The Water Cycle, to the group. Once you've explained the cycle, have them complete Worksheet 1, Water Cycle Cut-Out.
2. See if the group can guess where the water comes from and how it gets there. Be sure to point out that 75 percent of the earth's surface is covered by water. If you have a world globe, point out the regions of water and land. Also be sure to point out that at least half of this water at any given time is exposed to sunlight and all of it is exposed to moving air.
3. Put the students in groups of 3-4 students. Distribute copies of the Water Molecule Cut-Out to each group member.
4. Have them cut out the molecule along the dotted line. Point out that a water molecule consists of two parts hydrogen and one part oxygen. However, they are so small they appear invisible just like air molecules.
5. Have the group stand, holding their molecule, in a circle facing inward.
6. Explain that the light you are holding represents the warmth of the sun. As sunlight shines on water, it causes the molecules to move. In their case, as the light from the light touches them, they will begin twisting at the hips. As the light moves away from them, they will begin to slow.
7. Repeat the same activity using a large piece of cardboard. Explain that the fanning of the cardboard represents the movement of air. As they feel the moving air, have them begin twisting slowly at the hips. When they stop feeling it, have them stop.
8. Have the students complete Worksheet 2, The Water Cycle.

Questions for Inquiry:

- Which had the greatest influence on quickly moving the molecules? (The light from the lamp.)
- Which had the greatest sustaining influence on the molecules? (The fanning from the cardboard; when the sun sets, water continues to evaporate from moving air.)

Activity 2—Evaporation; A Cool Process

1. Continue your discussion concerning the movement of water molecules. Explain that when the molecules get moving fast enough, they break free from the surface and enter the atmosphere as pure water vapor, even if they come from polluted or salty water. This breaking away of water molecules is called evaporation. As the vapor departs, it pushes off neighboring molecules, causing them to slow down and cool. This is why the evaporation of water vapor from our skin feels cool and the reason why we enjoy the breeze from a fan in the summer.
2. To demonstrate this, have the group moisten the back of one hand with their tongue. With their mouth loosely covering the moistened portion of their hand, have them inhale. What they feel is a cooling sensation. Explain that the coolness is caused by the process of evaporation.
3. Ask the students if they think the air from a fan cools us by causing molecules to evaporate. (Yes)

Activity 3—How Air Holds Water

1. With the constant evaporation of water into the atmosphere, one would think that the troposphere contains a great supply of freshwater for the planet. Using a two-liter bottle filled with water, show them how much water there actually is in the atmosphere. Pour out some of the water into a 3-oz. plastic drinking cup. Fill the cup 2/3 with water. Explain that the water in the cup represents all the fresh water on the planet, including the icecaps. Likewise, the water in the bottle represents all the salt water on the planet. Using an eyedropper, remove some of the water from the cup. Then holding the cup, squeeze two drops from the dropper into the cup. Explain that those two drops represent all the water that's in the atmosphere at any given time.
2. Continue your remarks by asking: Why doesn't the troposphere fill up from all the water on the planet? Explain that air only has a certain amount of spaces available to hold water vapor. Once the spaces are filled, the air is said to be full or saturated. The warmer the air, the more room for water molecules. The colder the air, the less room for water molecules.
3. Take a sheet of paper towel and write the words "warm air"

materials:

Activity 2
Evaporation; A Cool Process

- Worksheet 3, Super Water!

materials:

Activity 3
How Air Holds Water

- Gallon jug of water
- 3-oz. plastic drinking cup
- Dropper
- Paper towel
- Typing paper
- 9-oz. plastic drinking cup
- Black marker
- 3-oz. plastic drinking cups
- 7" plastic sandwich plates
- 4 oz. water
- Food coloring
- Dropper or toothpick
- Dishwashing detergent
- Worksheet 4, Space for Water

materials:

Activity 4
Dampness & Dew Point

- Spray bottle
- Droppers
- 9-oz. clear plastic cups
- Water
- Paper towels
- Ice
- Transparency B, Dew Point Chart
- Worksheet 5, Dew & Frost
- Transparency C Basic Cloud Formations
- Worksheet 6, Kinds of Clouds
- Worksheet 7, How Clouds Form
- Worksheet 8, Rain & Snow

4. Take a sheet of copy paper and write the words "cold air"
5. Using a 9-oz. clear plastic cup, fill it one-fourth of the way with water.
6. Explain that like cold air, the copy paper has little space for lots of water molecules.
7. Demonstrate this by balling the copy paper up and putting it into the cup with the water. As you lift the saturated paper from the cup, chances are the cup will still have some water left in it and that the paper will be dripping.
8. Repeat the process using a same-sized piece of paper towel. Explain that like hot air, the paper towel has lots of space to absorb water. Demonstrate this by balling the paper towel up and placing it into the cup filled again with the same amount of water. As you lift the saturated paper from the cup, chances are it will have absorbed all of the water from the cup.
9. Distribute Worksheet 4, Space for Water, to teams of group members along with plastic sandwich plates, bottles of food coloring, a few drops of detergent in a 3-oz. plastic bathroom cup, and 4 oz. of water in clear 9-oz. plastic cups. Have each team pour the water onto the plastic sandwich plate.
10. Place three equally spaced drops of food coloring in the middle of the plate of water. Then, have them place a drop of detergent onto each of the drops of food coloring.
11. Explain that the reaction they are observing is the saturation of the water with detergent molecules. The detergent molecules are filling in between the water molecules, just as water molecules fill in between air molecules.
12. As the reaction slows and stops, explain that all of the space between the molecules is filled in or saturated. Explain that if you heat the water causing it to expand and create more space, the reaction will begin again.
13. Ask the question: At which time of the year would we find the least amount of water vapor present in the air? (Winter, because the air is colder and less space is available for water vapor.)

Activity 4—Dampness and Dew Point

1. Explain that the relationship between air temperature and its capacity to hold water is described as the Dew Point, or the temperature at which air condenses. At this point, the moving molecules of water slow down, lose pressure, and come together (condense). This coming together is caused by the cohesive nature of water molecules which come together in sets of six, hence the reason for six pointed snow flakes. This coming together of molecules can be seen as the mist on your bathroom mirror after a shower, fogging of your bathroom after a shower, dew on

the grass, fog on the ground, or clouds in the air.

2. Show the overhead of Transparency B, Dew Point Chart. The chart shows the maximum number of grams of water that can be held by a cubic meter of air at a given temperature.
3. Explain that a cubic meter of air of 95°F can hold up to 37 grams of water when saturated.
4. Use a spray bottle to demonstrate what this looks like by saturating the surface of a window with mist. After a while the surface becomes saturated, the mist condenses, due to the cohesive power of water molecules, into drops and rolls down the window.
5. Have them observe the cohesive power of water molecules by placing two drops on the bottom of an upside down 9-oz. plastic cup. Have them place the drops near each other. Using a toothpick, have them move one drop close to the other. When close enough, both drops will appear to move toward each other. Once together, have the group try to separate the drop. The force that draws the drops together and keeps them together is the cohesive force of water molecules. Further explain that the molecules come together in sets of six, the basis from which six pointed snow flakes are formed.
6. Condensation can also be observed by distributing 9-oz. clear plastic cups to group members. Have each member exhale onto their cup. As they do, they will see condensation occurring on their cup. Explain that we exhale invisible water vapor which can be seen as it cools and condenses on the cup.
7. See if they can saturate the side of their cup with water vapor so that it condenses into water droplets.
8. In their groups, have students complete Worksheet 5, Dew and Frost. This can be used as a homework connection.

notes:

Questions for Inquiry:

- Why does the condensation evaporate almost as quickly as it appears? The warm air surrounding the cup warms up the vapor making it evaporate almost as fast as it condenses.
- Would the condensation stay longer in colder air?

Teachers can extend this lesson with the following activity.

Condensation Clouds

1. Make a copy of Transparency C, Basic Cloud Formations, and project it for the group to see. Explain that evaporation followed by Dew Point condensation can lead to the formation of stratus and cumulus clouds. Point out how the base height of stratus clouds is normally the 2,000-ft. range of the atmosphere. The term stratus is the Latin word of mist. Stratus clouds form in moist stable air which has little or no turbulence. As warm saturated air cools, the water vapor droplets condense into these flat bottom clouds. As a rule, stratus clouds only bring mist, drizzle, or light precipitation. Cumulus clouds, meaning

materials:

Activity 5
A Measure of Dampness

- Pencil
- 12" human hair
- Tape
- Hygrometer (hair type)
- Psychrometer (wet/dry bulb type)
- Transparency D, Hygrometers
- Worksheet 9, Exploring Relative Humidity
- Transparency E, Heat Index

heaped, form in columns of rising moist air that is being heated by the sun and the earth's surface and made to rise rapidly. These are the puffy, cotton-shaped clouds that appear in warm skies. As the air rises, it cools, and its water vapor condenses into clouds. These types of clouds bring moderate to heavy showers. As long as there are convection currents carrying moist air to a height where water vapor condenses, these clouds will continue to develop, eventually forming large upward swirling masses of cumulus clouds.

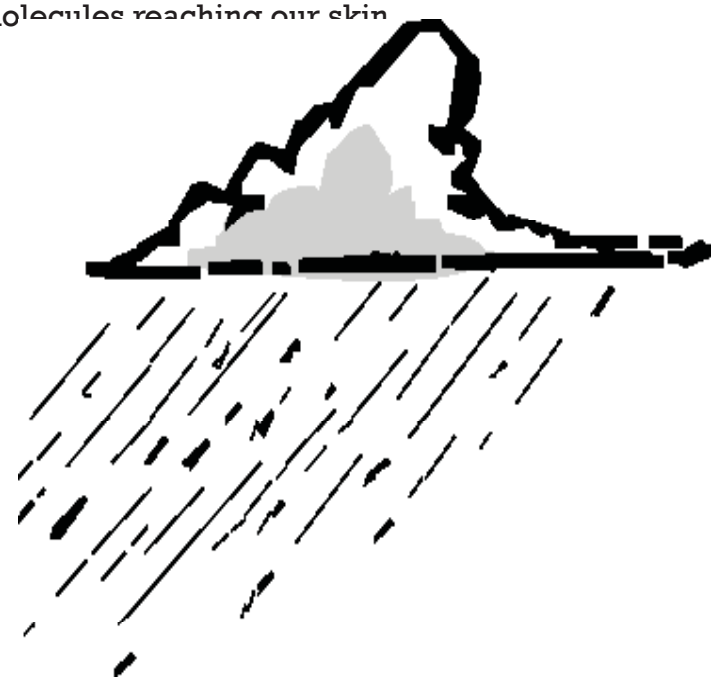
2. Distribute 9-oz. clear plastic cups containing ice to teams of group members.
3. Allow the cups to stand untouched for 10 minutes.
4. Eventually, condensation will form on the outside surface of the cup. Point out how this condensation experiment is similar to the formation of stratus clouds. Warm moist air condensing off water or land quickly condenses in cold, low-altitude air.
5. You can replicate this experiment for the group much quicker by holding an ice filled cup over a pot of near boiling water. The hot vapor leaving the water will quickly condense on the surface of the ice-filled cup. Explain that the same thing happens when warm moist air evaporating from lakes condenses and creates storms in the Great Lakes region of the United States.
6. Distribute copies of Worksheet 6, Kinds of Clouds. Have them complete the worksheet on their own.
7. Have the students complete both Worksheets 7 and 8, How Clouds Form, and Rain and Snow as a homework connection.

Activity 5—A Measure of Dampness

1. Begin your discussion by showing an overhead of Transparency D, Hygrometers. Explain that a hygrometer is used to determine the amount of water vapor present in the air and that hygrometers come in two forms – a hair hygrometer and a wet/dry bulb psychrometer. Note that a hair hygrometer is based on the fact that hair expands in the presence of humidity. New England colonists were known to hang a piece of bailing cord from the ceiling of their barns with a heavy stick indicator tied below. As the cord swelled from excess humidity, it would point to a place on the floor marked stormy. Demonstrate this idea by hanging a pencil from a piece of long hair. Below the pencil, place a sheet of white paper. At the spot on the paper where the tip of the pencil is pointing, mark the condition of the day. Explain that the hair will twist as the humidity increases or untwist as the humidity decreases.
2. Continue by mentioning that today's modern hair hygrometers still rely on the use of human hair or

synthetic filaments. Explain that the reading given by a hygrometer is in terms of relative humidity – the percentage of available space taken up by water vapor.

3. Explain that a psychrometer is another type of hygrometer which uses two types of thermometers to measure relative humidity – a dry bulb and a wet bulb thermometer. Since evaporation is a cooling process, as water evaporates from the wet bulb thermometer, the temperature lowers. If the air is close to its Dew Point, very little moisture will evaporate from the wet bulb thermometer, causing only a slight drop in temperature. The difference between the wet bulb and the dry bulb thermometers provides a reading of relative humidity. Distribute copies of Worksheet 9, Exploring Relative Humidity, along with psychrometers for teams of group members to take humidity and Dew Point readings.
4. Explain how meteorologist measure relative humidity to determine the likelihood of rain; highly saturated air is a good predictor of rain. They also measure relative humidity in combination with air temperature to calculate something called a Heat Index (use Transparency F, Heat Index). At high temperatures and high humidity, the air often feels hotter than it is because of the higher content of heated moisture in contact with the skin. Another index used by meteorologist is wind chill. Because evaporation is a cooling process, our skin is sensitive to moisture evaporating from it. In colder temperatures with high winds, the chill of moisture leaving our skin is compounded by the chill of the air molecules reaching our skin.



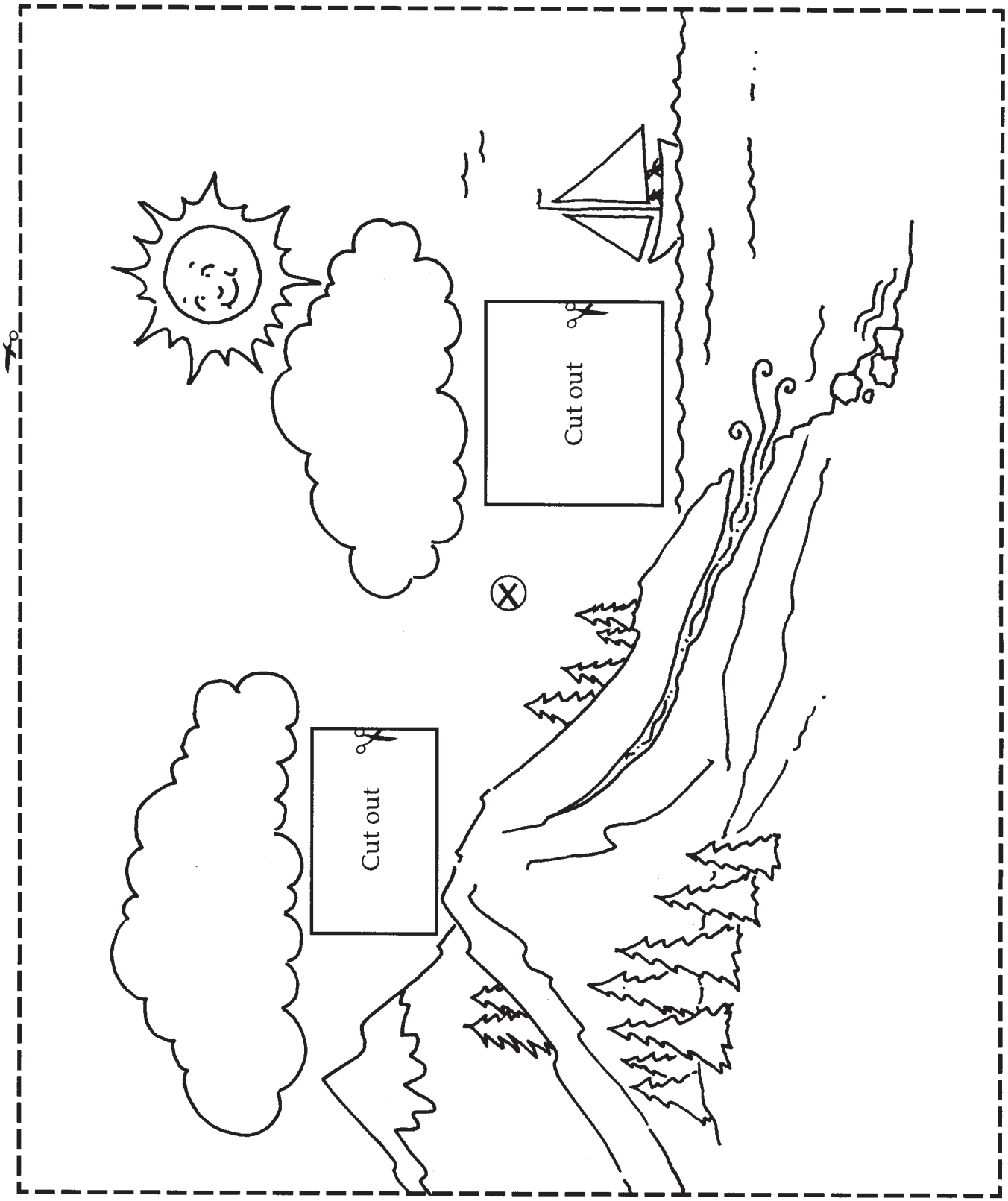
Lesson Adapted from "Weather Together"
Ohio State University Extension

notes:

Worksheet #1 (part 1)

Name_____

Water Cycle Cut-Out

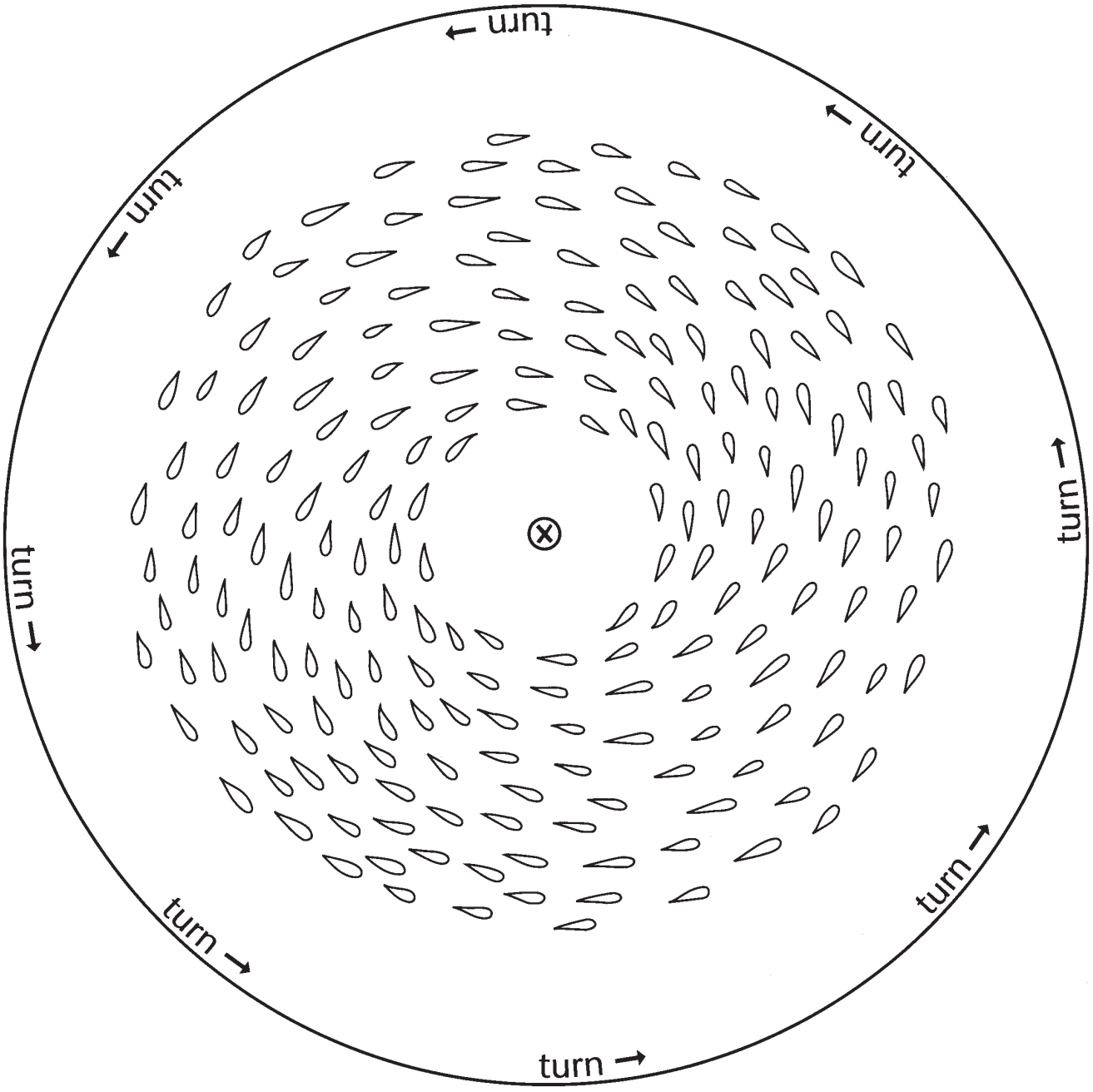


Color. Cut out the parts marked. Use with next page.

Worksheet #1 (part 2)

Name_____

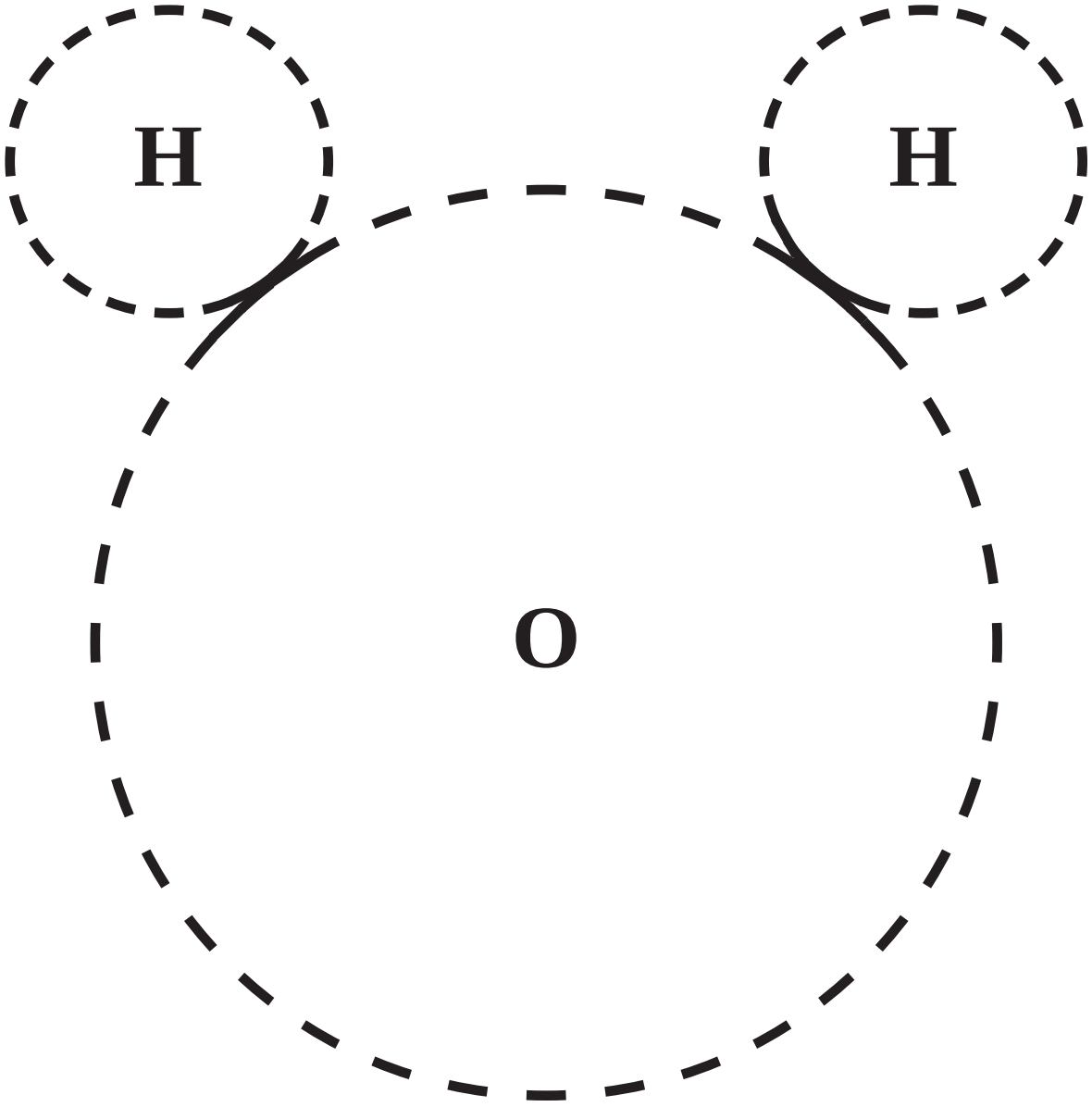
1. Color the water drops blue.
2. Cut out the circle.
3. Place the circle behind the worksheet.
4. Put a paper fastener through both.
5. Turn to see the water cycle.



Name_____

Cut-Out Activity #1

Water Molecule Cut-Out



Worksheet #2

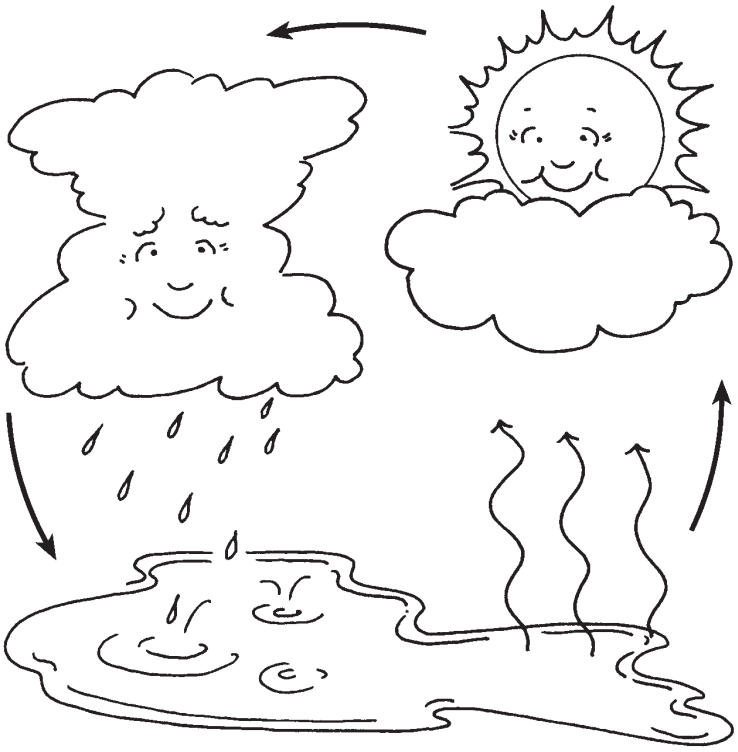
Name_____

The Water Cycle

The dark clouds begin to rain. The rain falls on the grass and the streets, making puddles. It falls on the hills, running down in little streams. They flow into lakes and rivers and on into the ocean.

The rain is over. Out peeks the sun. The water in the puddles, streams, lakes, and ocean gets warm. It changes to vapor, like steam rising out of a boiling teakettle. It disappears into the air.

Warm air rises, so up it goes. The air is cooler up here. There are specks of dust. When the vapor hits a cool speck, it sticks to it and condenses. These bits of dust and water drops come together to make clouds. When the clouds are heavy with water, down comes the rain again.

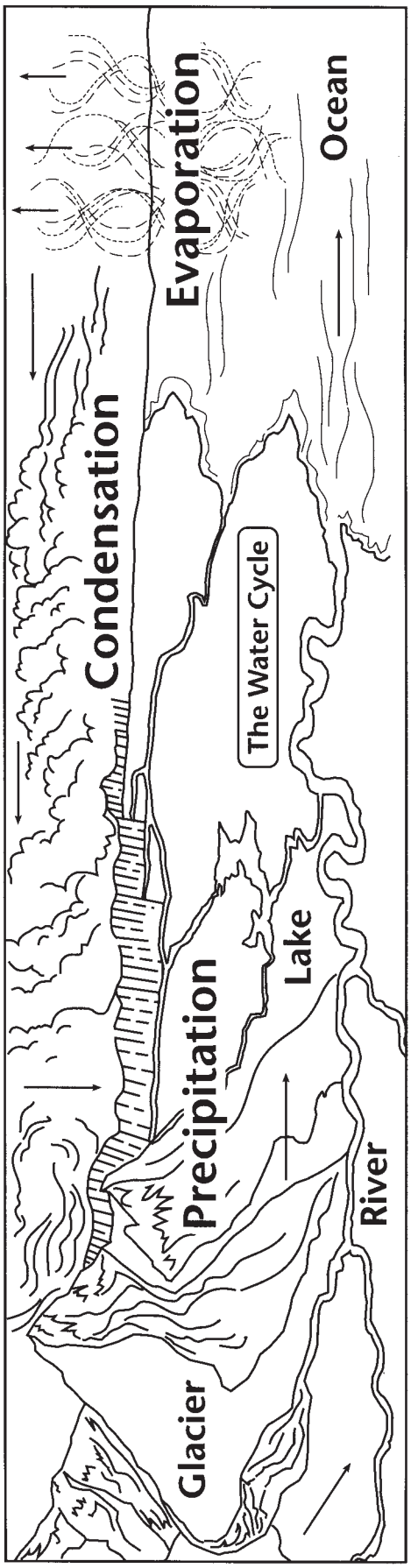


Do you see why it is called a cycle?

Write the answers to the questions.

1. What falls from the dark clouds? _____
2. What warms the water? _____
3. When water is warmed, what happens? _____
4. When vapor hits a cool speck, what does it do? _____

The Water Cycle



Worksheet #3

Name_____

Super Water!

When you turn on the faucet, you get water. When you swim, you swim in water. When you sail in a boat, you ride on water. When it rains, that is water.

So you know what water is. Then what is an ice cube? That is water, too!

Water is not like you. It can change when the weather changes. You know water as a liquid. But when it gets very cold, liquid turns into a solid. We say it freezes. Ice is solid water.

When liquid water gets warm, it turns to a gas. (This is not like the gas you put in your car.) The air around you is gas. You cannot see it, but it is real. This water in the form of gas is called water vapor.

So water can be solid, liquid, or gas.

Write the answers to the questions.

1. How is water not like you? _____
2. When water gets very cold, it _____ .
3. When water gets warm, it _____ .
4. What is the air around you? _____
5. Water can be _____ .

Worksheet #4

Name_____

Space for Water

Materials

- 7-in. plastic sandwich plate
- 4-oz. water
- food coloring
- dropper or toothpick
- 1 Tablespoon detergent

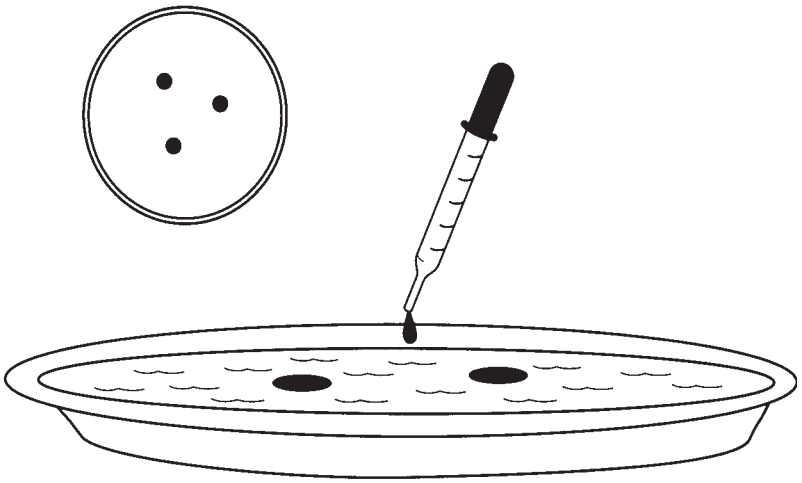
Purpose To appreciate the volume of moisture in the atmosphere and the space available to hold it.

Procedure

1. Place 1/3 cup of water on a 7-in. plastic sandwich plate.
2. Using food coloring, add three drops of the coloring as shown.
3. With an eye dropper or toothpick, dab each spot of color with a drop of detergent.

Results

The detergent (as seen when marked by color) moves quickly to fill in the spaces between the water molecules. The same is true as water enters the atmosphere; it moves quickly to fill in spaces between air molecules.



Question

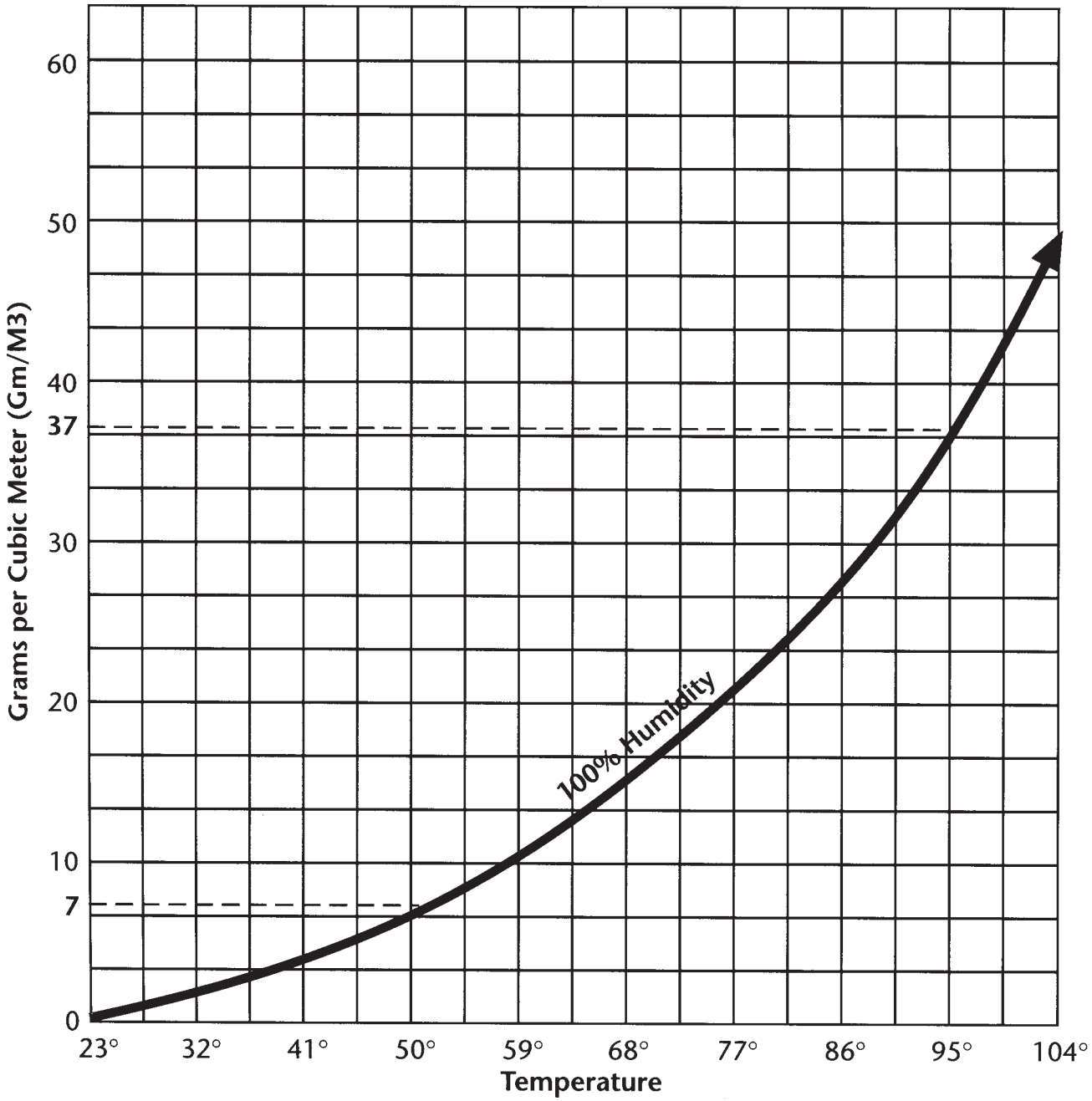
1. Why does the reaction eventually stop? _____

_____

2. At which time of year would you find the least amount of water vapor in the air—summer or winter, and why? _____

_____

Dew Point Chart

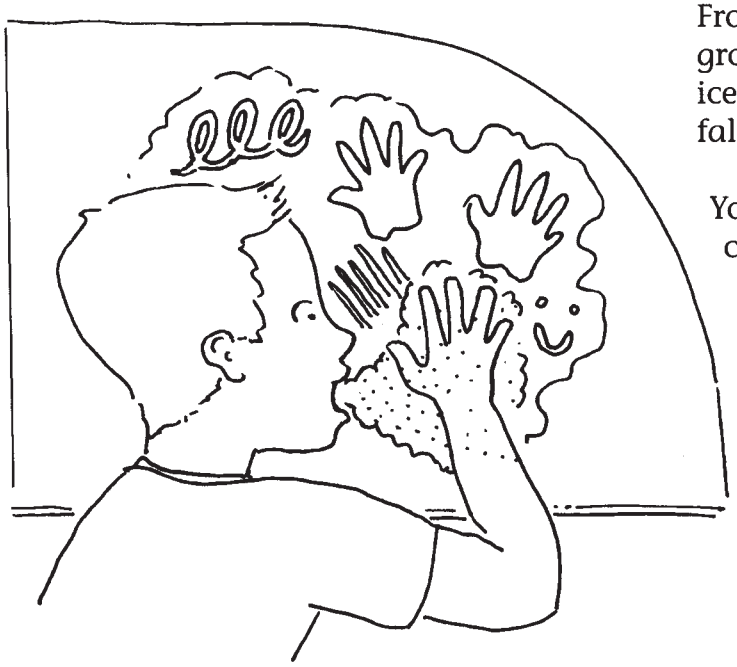


Worksheet #5

Name_____

Dew and Frost

Some mornings you may look outside to a bright blue sky. But all the ground is wet. "Did it rain?" you wonder. No, it is dew. Dew does not fall from clouds as rain. But it does come out of the air.



Air is full of water vapor. You cannot see it. At night the ground cools off. The bits of vapor come close to the cool grass. They get cool. They stick to the grass. They condense to drops of water.

Frost happens in the same way. If the ground is freezing cold, the vapor turns to ice. Everything looks white, as if snow has fallen.

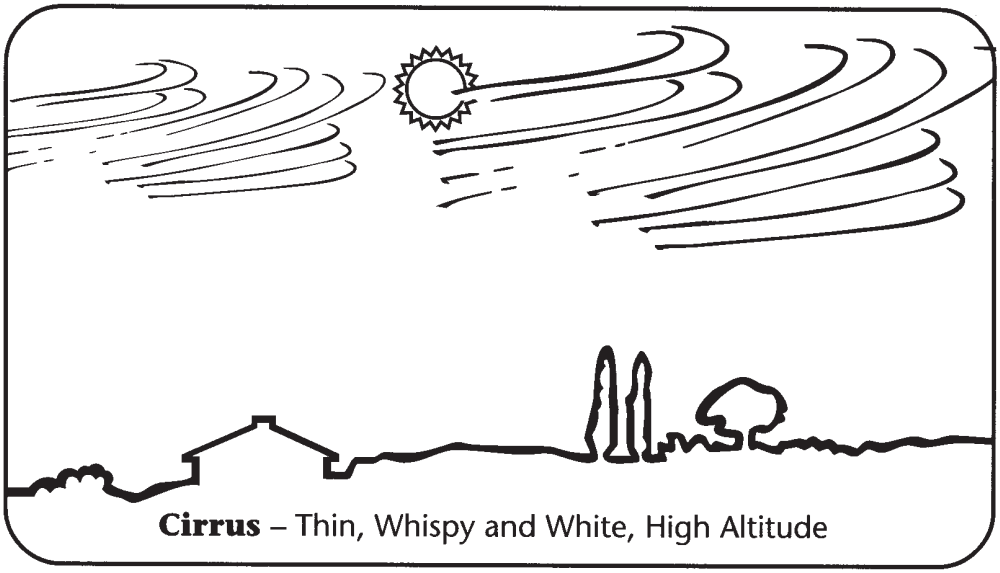
You find dew and frost when the sky is clear. Clouds act like a blanket. They keep the earth too warm for dew and frost to form.

Write the answers to the questions.

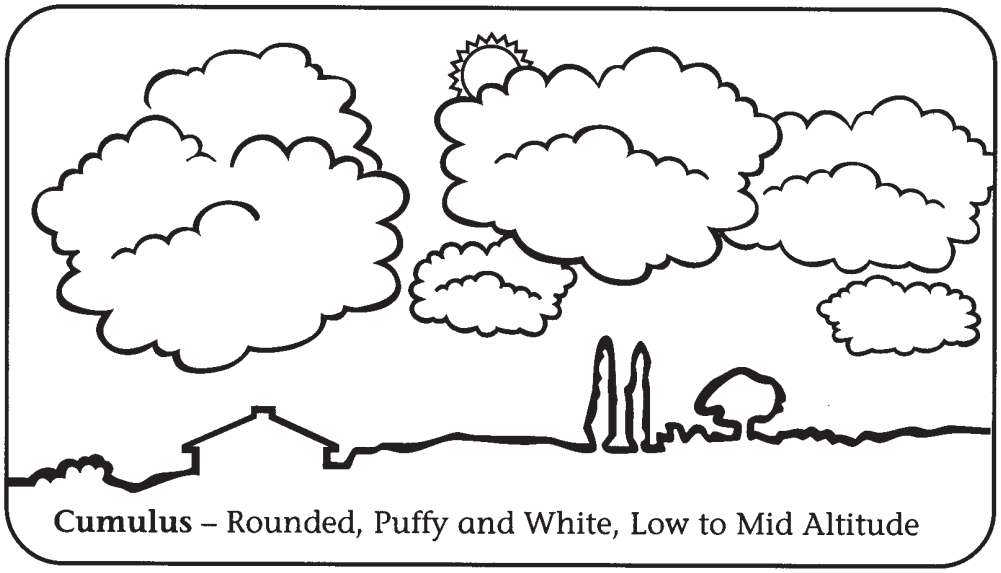
1. What wetness does not fall from clouds? _____
2. Where did the dew come from? _____
3. What happens when the vapor comes near something cold? _____

   _____
4. What looks white like snow? _____
5. When do you find dew and frost? _____

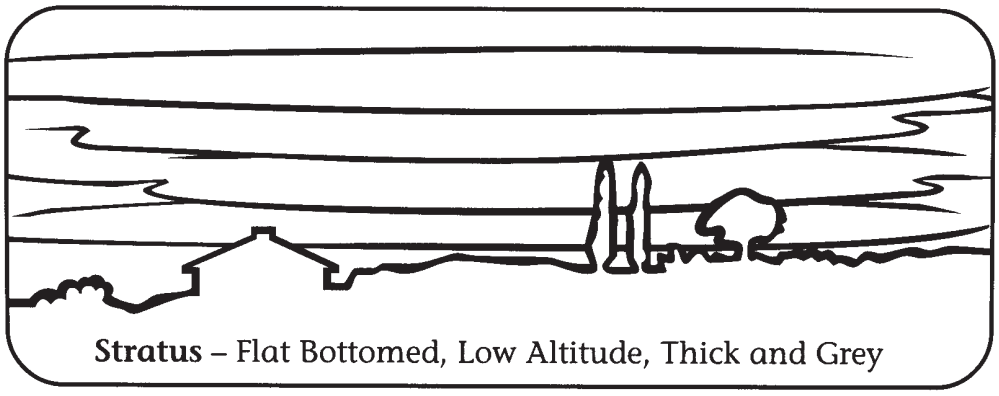
Basic Cloud Formations



Cirrus – Thin, Whispy and White, High Altitude



Cumulus – Rounded, Puffy and White, Low to Mid Altitude



Stratus – Flat Bottomed, Low Altitude, Thick and Grey

Fog – The Lowest of All Clouds; You Can Walk Through This Cloud.

Worksheet #6

Name_____

Kinds of Clouds

The fluffy white clouds you like to draw are cumulus clouds. They pile up like great balls of cotton. Cumulus means "pile." These clouds don't have a lot of water in them. They are "fair weather" clouds.

When the whole sky is covered in a blanket of gray, that's stratus clouds. If they are low, there will be a light rain called a drizzle.

cumulus

stratus

Cirrus clouds are the highest in the sky. They can be 8–10 miles up in the sky. They look like wisps of smoke and are made of ice.

You can walk through the lowest cloud. We call it fog.

These cloud types are often combined to describe other types of clouds.

cirrus

Write the answers to the questions.

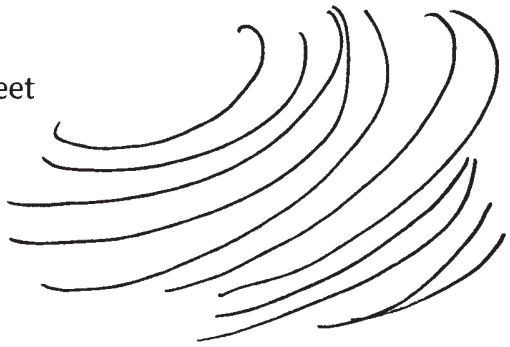
1. What are the "fair weather" clouds?_____
2. What are the rain clouds? _____
3. What is like a gray blanket? _____
4. What is the highest cloud? _____
5. What is the lowest cloud?_____

Worksheet #6 (cont.)

Name_____

Kinds of Clouds – continued

Cirrus
Above 18,000 feet

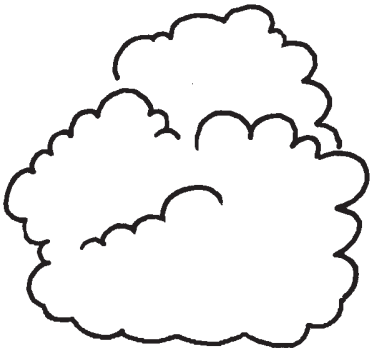


Cirrocumulus
Above 18,000 feet

Altostratus
6,000 to 20,000 feet

Altocumulus
6,000 to 20,000 feet

Stratocumulus
Below 6,000 feet



Cumulus
Below 6,000 feet

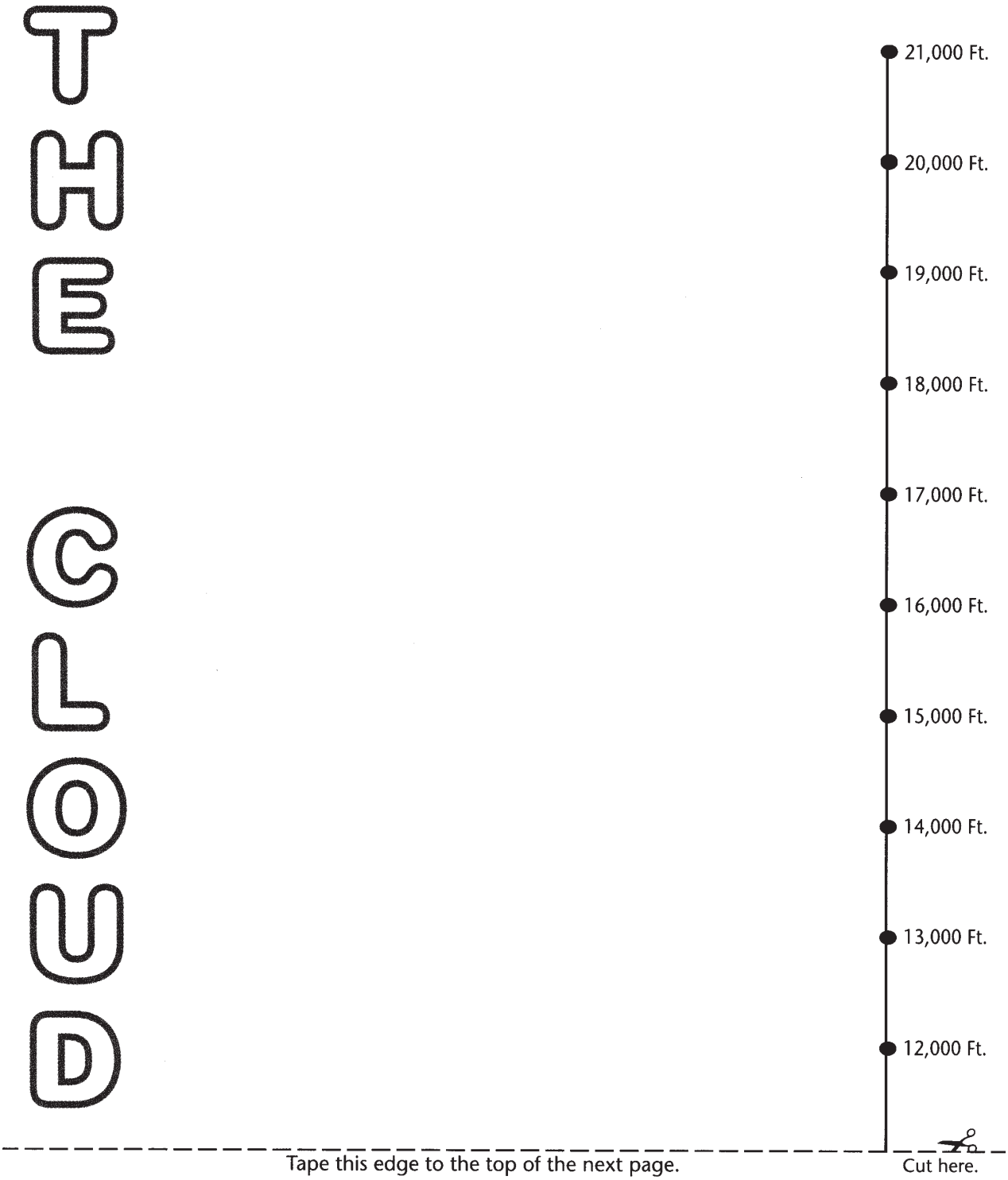
Stratus
Below 6,000 feet

Cloud Activity

Name_____

Activity

Using the cloud illustrations as your guide, complete the following cloud activity.



Cloud Activity (cont.)

Name_____

Cut Here

Cut along the dotted line and tape the top half of the cloud chart here.

CHART

11,000 Ft.

10,000 Ft.

9,000 Ft.

8,000 Ft.

7,000 Ft.

6,000 Ft.

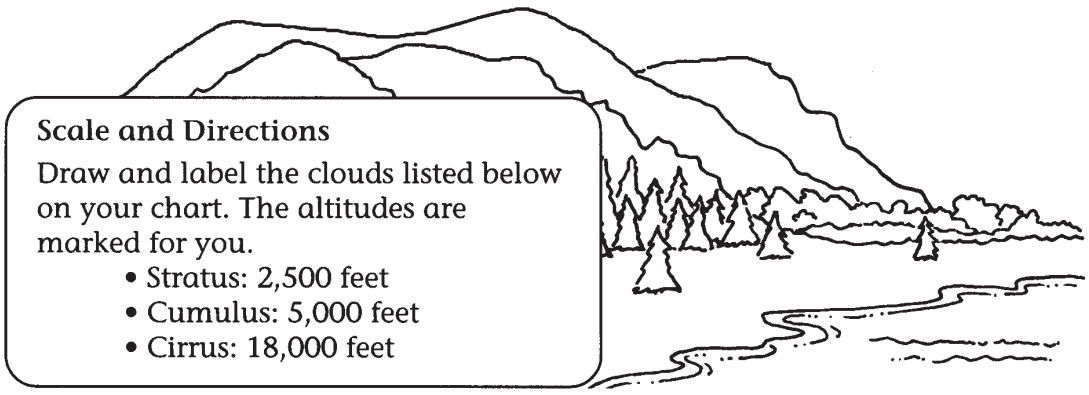
5,000 Ft.

4,000 Ft.

3,000 Ft.

2,000 Ft.

1,000 Ft.



Scale and Directions

Draw and label the clouds listed below on your chart. The altitudes are marked for you.

- Stratus: 2,500 feet
- Cumulus: 5,000 feet
- Cirrus: 18,000 feet

Worksheet #7

Name_____

How Clouds Form

Stratus and cumulus clouds are made of tiny drops of water and specks of dust. Some clouds are made of tiny bits of ice. These drops or bits are very tiny! More than 100 million could fit in a teaspoon!

The sun shines on the oceans, rivers, and lakes. When the water is warmed, it is changed to a gas called water vapor. We say, "It evaporates."

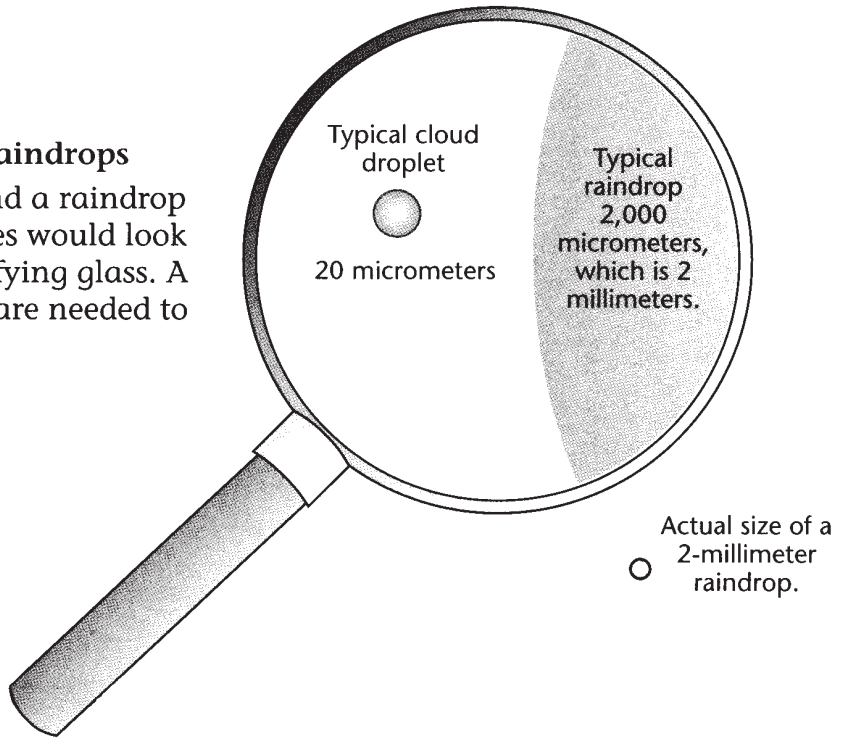
Warm air always rises, so this vapor goes up. The upper air is cooler. Now the water vapor bumps into specks of dust that are cold.

It becomes liquid again. We say, "It condenses." Billions of these drops come together to form a cloud.

Write the answers to the questions.

1. What are clouds made of? _____
2. How many cloud drops fit in a teaspoon? _____
3. When liquid water becomes vapor, it _____.
4. Where does warm air always go? _____
5. When vapor becomes liquid, it _____.

Relative sizes of cloud, raindrops
A typical cloud droplet and a raindrop magnified about 300 times would look like this under the magnifying glass. A million such cloud drops are needed to make one raindrop.



Worksheet #8

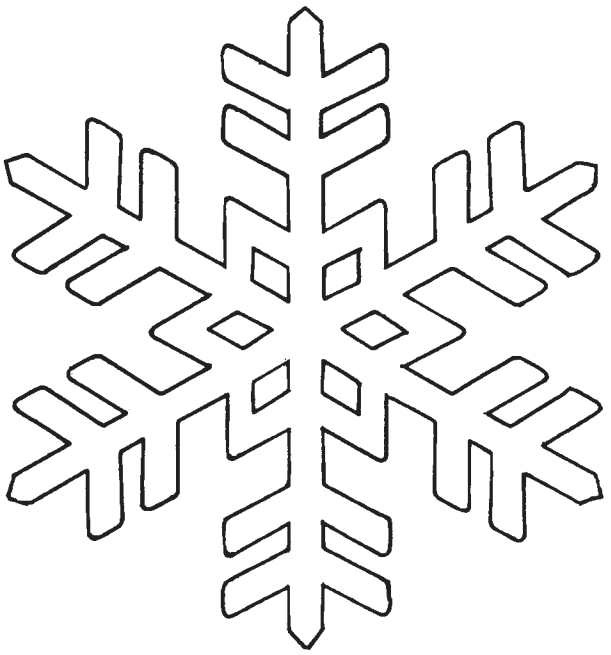
Name_____

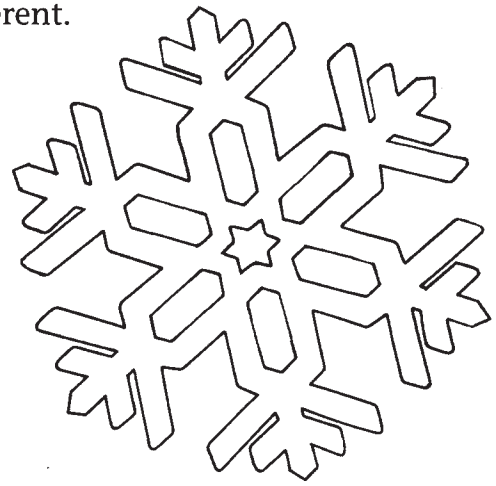
Rain and Snow

Clouds are made of billions of drops of water. When the drops grow very big and heavy, they fall as rain.

Snow clouds are made of billions of flakes of frozen water vapor. The snowflakes are formed when the upper air layer is freezing. When water vapor reaches this cold layer, the vapor freezes, rather than condenses. Snow is frozen water vapor.

Have you ever seen a patch of snow get smaller and smaller, yet the ground is dry? The weather does not have to be hot for water to evaporate. Evaporation can happen in cold winter weather. Snow does not have to melt to evaporate. Snow is different.



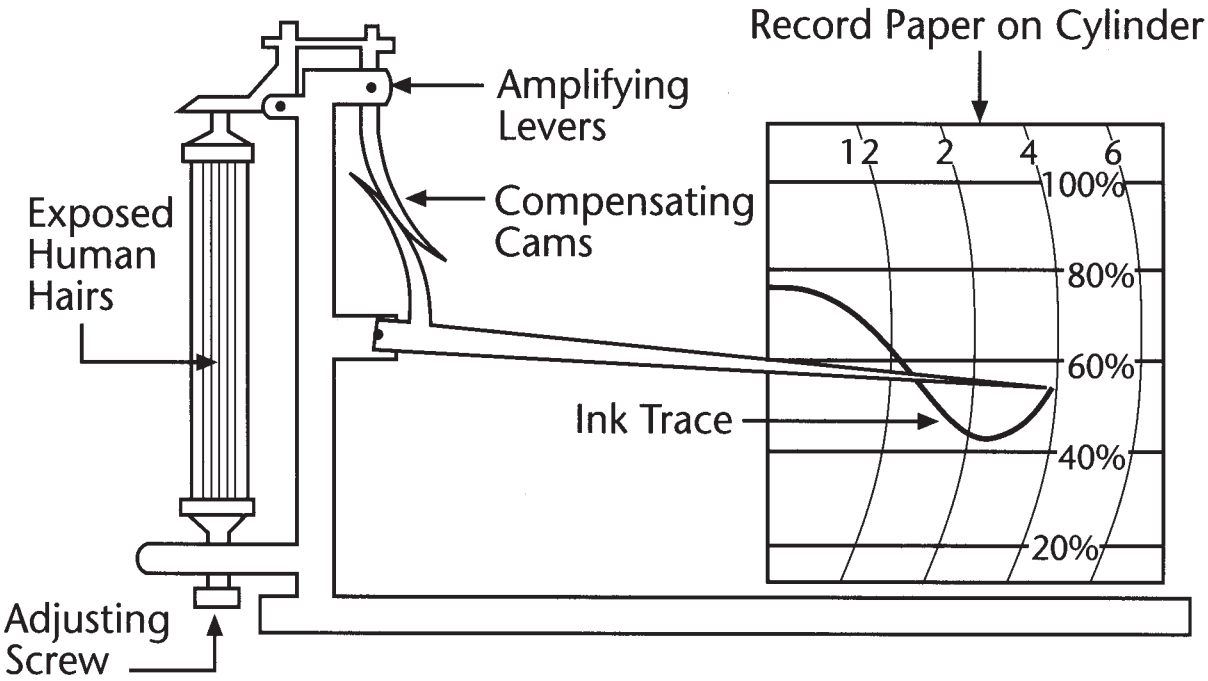


Write the answers to the questions.

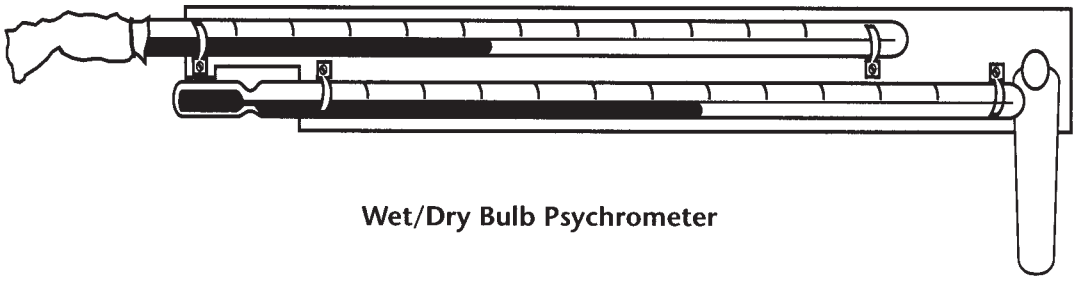
1. When does it rain? _____
2. Can evaporation happen in cold weather? _____
3. What does the water vapor do? _____
4. What is snow? _____
5. What are snow clouds made of? _____

Hygrometers

Instruments Used to Measure Moisture in the Air



Hair Hygrometer



Wet/Dry Bulb Psychrometer

Worksheet #9

Name_____

Exploring Relative Humidity

Finding Relative Humidity and Dew Point

Use your psychrometer and the table included here to find the dew point and relative humidity of your classroom. Then use the tables to find the same for the other places listed.

Dewpoint Temperature

Current Dry Bulb Temperature	Wet-Bulb Depression (Dry-Bulb Temperature Minus Wet-Bulb Temperature)				
	1.8°F	3.6°F	5.4°F	7.2°F	9.0°F
14.0°F	5.9°F		-6.3°F	-33.3°F	
23.0°F	16.9°F	9.0°F	-2.2°F	-24.3°F	
32.0°F	27.1°F	21.4°F	14.4°F	4.4°F	-11.0°F
41.0°F	37.0°F	32.5°F	27.3°F	21.0°F	13.3°F
50.0°F	46.6°F	42.8°F	38.8°F	34.2°F	28.8°F
59.0°F	55.9°F	52.9°F	49.2°F	45.7°F	41.5°F
68.0°F	65.3°F	62.4°F	59.5°F	56.3°F	52.9°F
77.0°F	75.7°F	72.0°F	69.3°F	66.3°F	63.5°F
86.0°F	83.7°F	81.3°F	78.8°F	76.3°F	73.6°F
104.0°F	101.8°F	99.7°F	97.5°F	95.2°F	93.0°F

Relative Humidity

Current Dry Bulb Temperature	Wet-Bulb Depression (Dry-Bulb Temperature Minus Wet-Bulb Temperature)				
	2.0°F	3.6°F	5.4°F	7.2°F	9.0°F
14.0°F	69%	39%	10%		
23.0°F	77%	54%	32%	11%	
32.0°F	82%	65%	47%	31%	15%
41.0°F	86%	71%	58%	45%	32%
50.0°F	88%	76%	65%	54%	44%
59.0°F	90%	80%	70%	61%	52%
72.5°F	92%	83%	76%	68%	61%
86.0°F	93%	86%	79%	73%	67%
95.0°F	93%	87%	81%	75%	69%
104.0°F	94%	88%	82%	77%	72%

	Wet-Bulb Temperature	Dry-Bulb Temperature	Dew Point	Relative Humidity
A. Your Classroom	_____ °F	_____ °F	_____ °F	_____ %
B. Chicago	52°F	59°F	_____ °F	_____ %
C. Atlanta	68°F	77°F	_____ °F	_____ %
D. Houston	76°F	77°F	_____ °F	_____ %
E. Tucson	84°F	88°F	_____ °F	_____ %

F. At which humidity reading would it be driest? _____

G. At which location would it most likely rain soon? _____

Heat Index

Relative Humidity (%)

Air Temperature (F)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
140	125																				
135	120	126																			
130	117	122	131																		
125	111	116	123	131	141																
120	107	111	116	123	130	139	142														
115	103	107	111	115	120	127	135	143	151												
110	99	102	105	108	112	117	123	130	137	143	150										
105	95	97	100	102	105	109	113	118	123	129	135	142	149								
100	91	93	95	97	99	101	104	107	110	115	120	126	132	133	144						
95	87	88	90	91	93	94	98	101	104	107	110	114	119	124	130	136					
90	83	84	85	86	87	88	90	91	93	95	96	98	100	102	106	109	113	117	122		
85	76	79	80	81	82	83	84	85	86	87	88	89	90	91	93	95	97	99	102	105	108
80	73	74	75	76	77	77	78	79	79	80	81	81	82	83	85	86	86	87	88	89	91
75	69	69	70	71	72	72	73	73	74	74	75	75	76	76	77	77	78	78	79	79	80
70	64	64	65	65	66	66	67	67	68	68	69	69	70	70	70	70	71	71	71	71	72

Heat Index	Possible Heat Disorders for People in Higher-Risk Groups
130 or Higher	Heatstroke or Sunstroke Highly Likely With Continued Exposure
105 – 130	Sunstroke, Heat Cramps, or Heat Exhaustion Likely, and Heatstroke Possible With Prolonged Exposure or Physical Activity
90 – 105	Sunstroke, Heat Cramps, and Heat Exhaustion Possible With Prolonged Exposure or Physical Activity
80 – 90	Fatigue Possible With Prolonged Exposure or Physical Activity