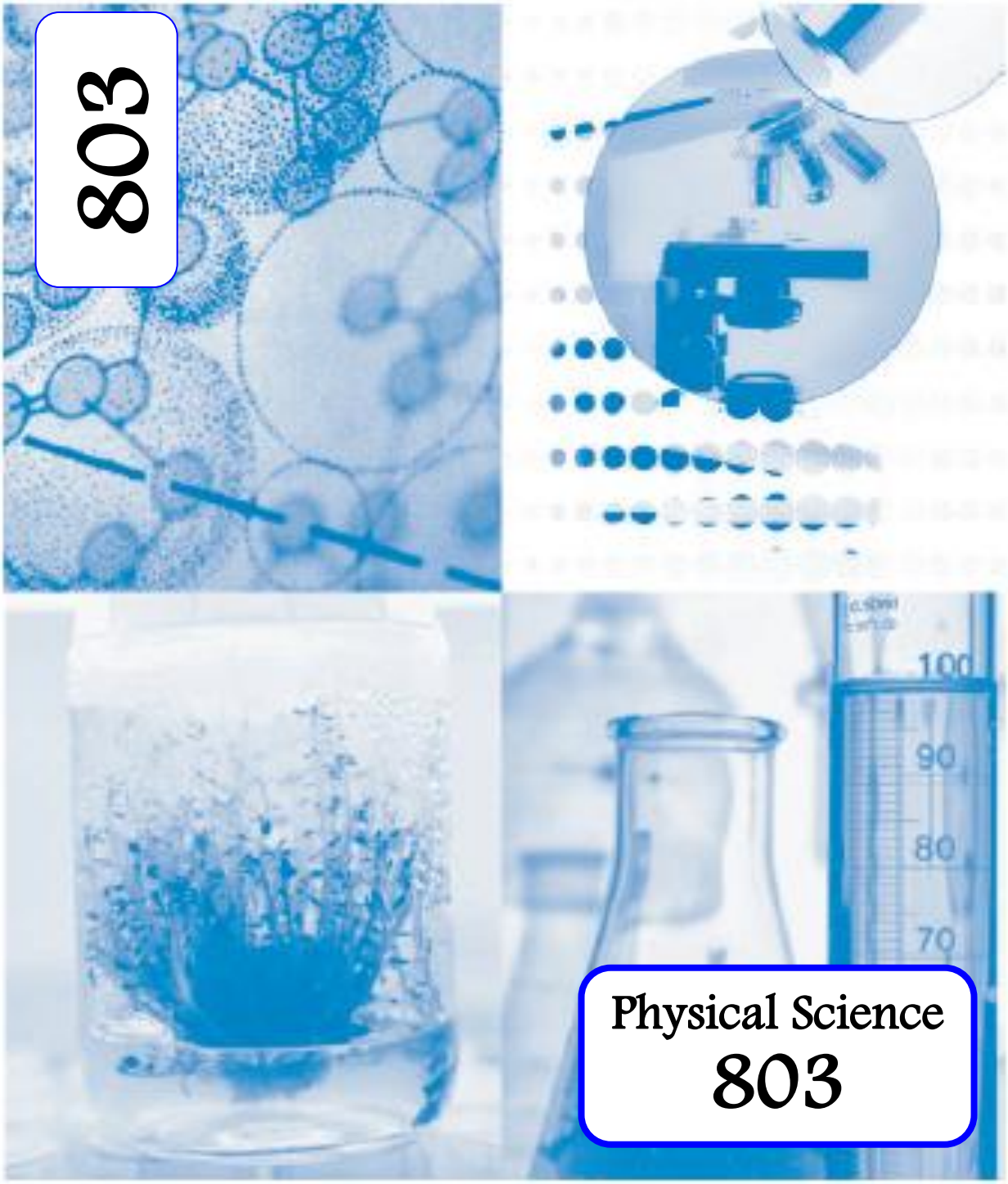
803



Physical Science
803

Date: _____

Name: _____

STARLINE PRESS
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PHYSICAL SCIENCE 803

Objectives

At the end of this unit, the student should be able to:

- Understand a variety of structures in the earth system
- Interpret a weather map
- Understand how the sun is the source of the weather
- Understand why weather changes
- Describe types of clouds
- Know the basic elements of storms
- Understand basics in observing and interpreting the weather

Character Trait

The Character Trait for this unit is being *positive*.

You are being positive when you are *looking for the good in each situation.*

The trip into the future can be exciting, depending on your outlook. Everyone's journey through life will include bends in the road and unexpected circumstances. Life will not always go as you planned. Since you cannot always be sure what is coming next, it helps to know that you can make the uncertainty work in your favor. By seeing the good in each situation, you steer your path towards a desirable goal instead of a dead end.

Suppose you did not get chosen for a sports team that you tried out for. You will not have the excitement at games, the bond with teammates, or the skills you would have developed. You could get very depressed dwelling on these facts. On the other hand, you could focus on the freedom you have to pursue other projects and pastimes. Surely you have more than one! You will have more time to spend with your friends, and your hours will not be tied up in sports practice. There is more than one side to every situation.

During the Renaissance, a certain block of marble was passed over by two separate sculptors. It was not seen as fit for the work they were trying to create. Eventually, a young man named Michelangelo discovered it, and envisioned new possibilities for it. He gradually carved out of it the statue of David, which became his most famous sculpture. The statue of David now stands as an inspiration to artists everywhere, but it was once only a rejected piece of marble. The right person had not discovered it.

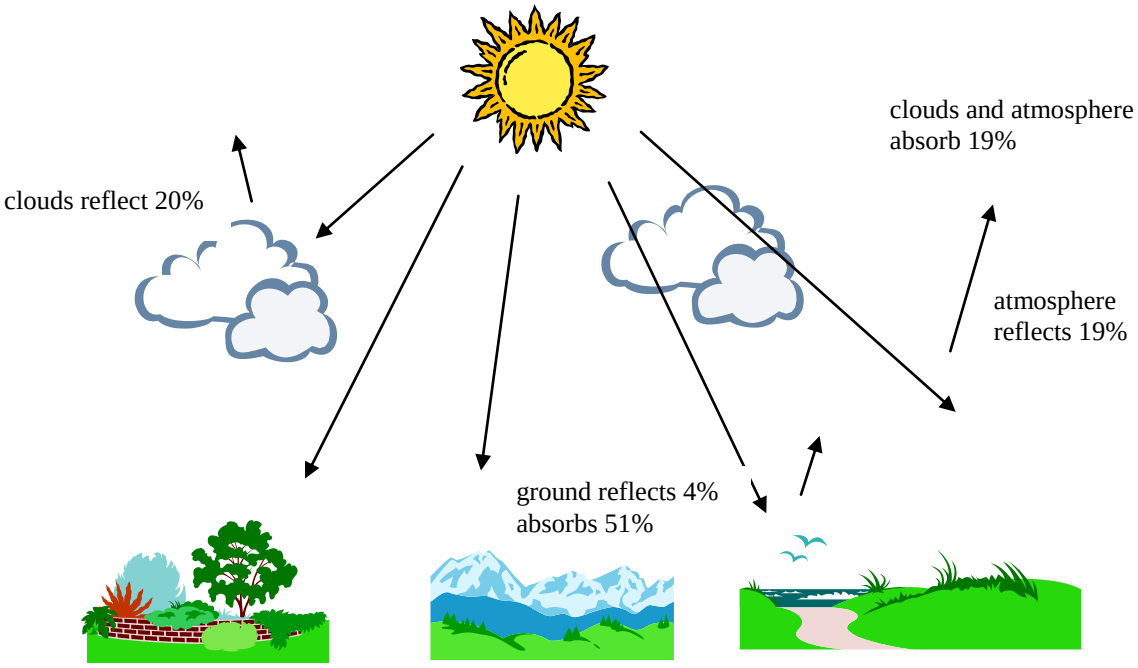
See the possibilities in your situations. Write about a difficult situation you are facing and the good and bad aspects of it. Then determine to focus on the good aspects.

Chapter 1: The Elements

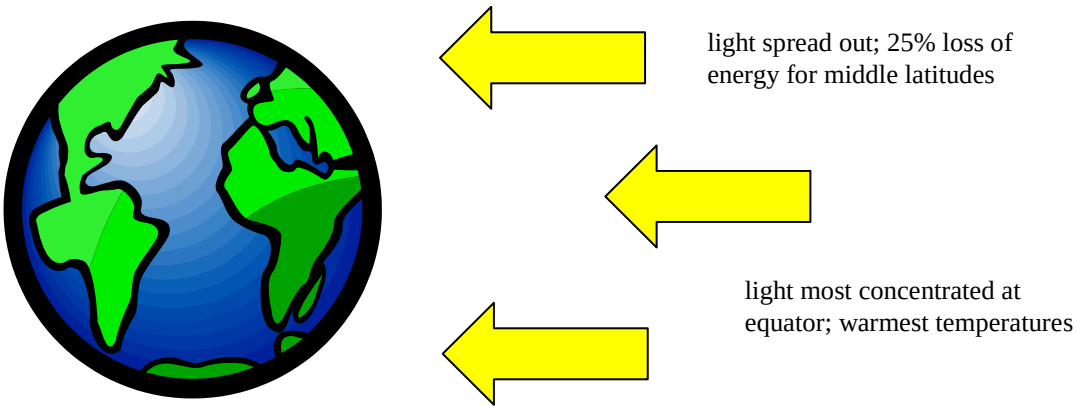
Section 1: The Sun

The weather affects us every day. We dress according to the temperature and the season. We make plans around sunny days and bring an umbrella along when it is raining. Especially in temperate climates, it may not intrude on the way people live, but it is always affecting us. In extreme regions of the globe, it will even limit what people can do. Eskimos could never sunbathe or play volleyball on the beach. Desert dwellers could not build snowmen. Our lives are changed by the amount that the weather changes.

The changes we experience in the weather start with the sun. Its effect on our weather is impressive when you consider that not all the light the sun radiates reaches the earth. In fact, only one billionth of the sun's radiated light reaches the earth. The light rays that reach our atmosphere go through still more filtering before they hit the ground. 30% of the light that hits our atmosphere is reflected back into outer space. This light can bounce off of the particles in the atmosphere, the clouds, or Earth's surface itself. The clouds absorb 19%. The remaining 51% reaches the ground and warms the earth.



The Earth continually loses the heat it absorbs. Generally, the radiation going out balances with the radiation coming in. The Earth does not only lose the heat reflected off the atmosphere but also heat from the ground. Gases in the atmosphere prevent this heat release into space from growing too high. They are called *greenhouse gases.* They permit heat from the sun to reach the ground but inhibit it from going out again. The two main greenhouse gases are water vapor (0.1 to 0.2 percent of the atmosphere) and carbon dioxide (0.035 percent of the atmosphere). Without this trapping effect, the temperature on Earth would average 60 degrees cooler than it currently does. Life would become much harder to live.



When radiation from the sun hits the earth, it does not spread evenly over the full face of the earth. It stretches out so it is thinner at the poles of the earth and more intense at the equator. The effect can be appreciated by experimenting with a flashlight. When the light is pointed directly at the ground, it makes a bright circle. When the beam is pointed diagonally to the ground, it becomes fainter and oval-shaped. In the same way, light from the sun strikes the regions near the earth's equator almost directly, causing those areas to heat up more. Places further north and south get the sun's light less directly and stay cooler. The imbalances in temperature across the globe cause the changes in our weather. This will be discussed in greater detail later.

The heat in our atmosphere cannot always be sensed. Some heat is stored when chemical processes occur and becomes part of the general energy in our atmosphere. The two forms of heat are called *sensible heat* and *latent heat.* Sensible heat is the heat you feel if you stick your finger in a pan of hot water. It is sensible because you can feel it. If you continue to heat that pan of water, it will eventually come to a boil. Then it will not grow any warmer, since the heat is released in steam. When the boiling water changes to steam and vapor, the sensible heat is converted to latent heat. It is now stored in the vapor molecules. This heat still affects the atmosphere, though we do not sense it in the same way.

Directions: Answer the following questions.

1. What is the basic reason for the changes we experience in weather? _____

_____

_____

2. What is the difference between sensible heat and latent heat? _____

_____

_____

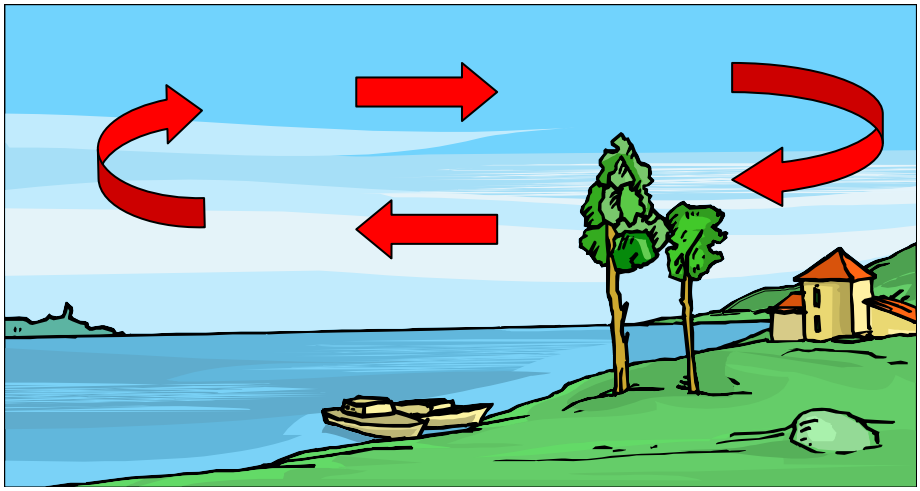
3. Which part of the earth is usually exposed to direct sunlight? _____
4. What percentage of sunlight gets absorbed by the clouds? _____
5. Name the two main greenhouse gases. _____

_____

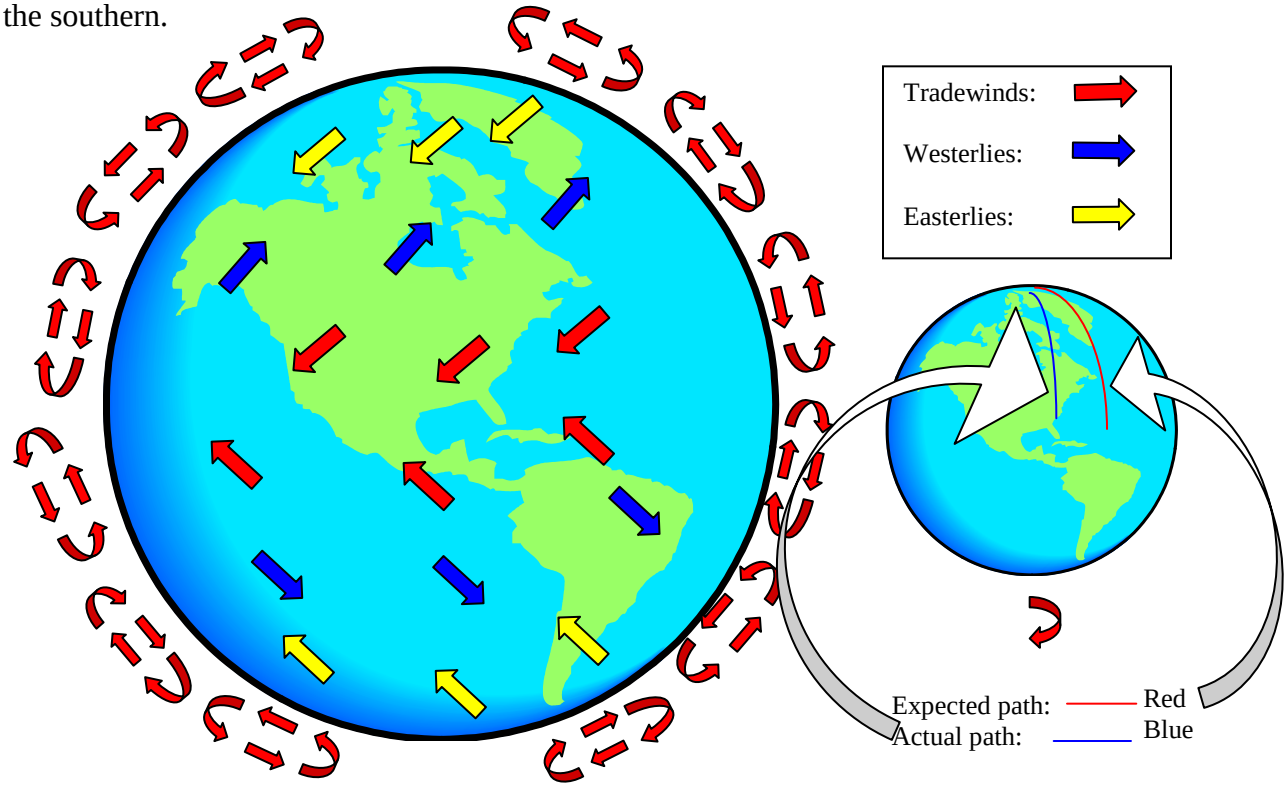
The movement of the wind is very mysterious to most people. It is hard to tell where it is going to blow from one moment to the next, yet there are causes behind the winds movements and reasons it blows in a certain way. There are also patterns in the way the wind blows, especially in certain areas of the globe.

The movement of the winds begins, again, with the heat from the sun. When air heats up, it rises, leaving a low-pressure zone behind. Air from surrounding areas is sucked into the low-pressure zone, while the hot air high in the sky is pushed away and begins to cool. It gradually sinks back to the earth, creating a high-pressure zone. Low-pressure areas act like vacuums to draw air from the high-pressure areas. The result is wind.

This is easy to experience in places where the earth's surface is heated unevenly. The coast is an excellent example. Heat is better distributed in water than it is in rock, and so the ocean warms up and cools off much more slowly than the land does. During the day, land temperatures rise quickly and air is carried up and out towards the sea at high altitudes. The low-pressure zone left behind draws air in from the sea, giving us ocean breezes. At night, the opposite effect occurs. The sea is still relatively warm, causing the air there to rise and leave a new low-pressure zone. The breezes on the surface blow out towards the sea to fill it. Wind rotating in this way due to uneven heating of the land is called a *convection cell.*



Convection cells happen on a larger scale in our atmosphere. Remember from the previous section that the earth is heated unevenly—warm at the equator and cooler at the poles. This uneven heating produces huge wind patterns called *Hadley cells* that extend 30 degrees of latitude, beginning at the equator. Since it is 90 degrees of latitude from the equator to either pole, there are three Hadley cells in the northern hemisphere and three in the southern.



The graphic above shows the Hadley cells at work. At the bottom of the northern hemisphere, hot air rises from the equator and begins to curl north in the upper atmosphere. By the time it has traveled 30 degrees in latitude, it encounters winds coming south from the North Pole, creating a downdraft. The winds then head back towards the equator in the lower atmosphere, completing the convection cell.

It may seem like the winds within the Hadley cells run a simple north-south course without variation. The winds actually blow with an east-west angle, due to the rotation of the earth. The change of an object's path due to the rotation of the earth is called the *Coriolis effect.* The alterations caused by it are shown in the small graphic above. The path of an object moving straight south from the North Pole would follow the

red line, but due to the rotation of the earth eastward, it actually follows the path of the blue line.

The rotation of the earth thus creates some of the famous wind patterns with which sailors have been familiar for centuries. To propel their vessels, Merchants sailing from Europe would use the *trade winds*, reliable belts of wind that flow towards the equator from east to west in the areas between 0 degrees and 30 degrees latitude. Christopher Columbus relied on these winds to reach the New World. The air has traveled through a warm upper atmosphere, and therefore cool dry air reaches the surface. Most of the world's deserts are within these latitudes, and the dryness of the trade winds is partly responsible.

Between the northern and southern trade winds, along the equator, lies a belt of gentle, unsteady wind called the *doldrums.* These winds do not flow along any consistent path and left early sailors without wind to help them navigate. The word doldrums has come to mean "going nowhere", the sensation travelers in these parts would often have. Between the trade winds and the westerlies lies another region of light or absent winds called the *horse latitudes.* Here, the air travels straight down from the upper atmosphere, creating no wind at all, and leaves ships stranded for dangerously long periods. Sailors would face starvation. Horses on the ship would die or get eaten, giving this area its name.

The regions between the 30 degrees and 60 degrees latitude are called the *westerlies.* The westerlies move the wind eastward. In the northern hemisphere, they are often interrupted by storms due to landmasses, but in the southern hemisphere, they flow uninterrupted. Finally, the prevailing winds beyond 60 degrees latitude are the winds flowing west and away from the poles and are called the *easterlies.* In each case, these winds are named after the direction from which they *flow from,* not the direction toward which they flow.

At the boundaries of these cells flow two primary passages of air called *jet streams.* Jet streams are high-speed, high-altitude winds that flow west to east and separate huge masses of air. They usually begin anywhere from 6 to 9 miles above the earth's surface and flow from 75 to 200 miles per hour. The *polar jet stream* flows at about 60 degrees latitude and separates warm air coming from the equator from the cool air coming from the poles. It is the most intense jet stream. It causes different air systems

to collide and separate and rush up and down between the lower and upper atmosphere, making storms develop. It has also been called the storm track. The other jet stream is called the *subtropical jet stream.* It flows at about 30 degrees latitude. It is milder by comparison with the polar jet stream and usually delivers only heavy rainfall to the areas it affects.

Directions: Answer the following questions.

1. What influence causes general wind patterns from going in a strict, north-south direction? _____
2. What kind of zone is left behind after warm air rises? _____

_____

3. What is the main reason for the movement of wind upon the earth? _____

_____

4. Where do the horse latitudes lie and why is the air calm in these areas? _____

_____

5. Which jet stream is the most powerful? _____

"An affirmation is a strong, positive statement that something is already so."

-Shakti Gawain

It can be very tempting to view life simply as something that happens to you and act as though all of life is just an outcome of fate. There is something very convenient about this formula. However, this can lead to a very passive attitude and eventually leave you unprepared for challenges down the road. Many times you must choose a vision of life that comes from your heart. Seeing things this way will change your life and the lives of others for the better.

Sometimes you have to take a risk and believe. If you tell yourself, "I have good relationships with my family and friends," you may not feel it. You may not always see it. If you declare it to yourself, though, you will. There is a power in faith that every person

has. One aspect of being positive is taking initiative in a situation and declaring the best possible outcome. Work from there.

Choose a goal or a dream in your life that you want to happen. Make it something you can realize quickly, in the next week or the next month. Tell yourself it is already so for the next several days and weeks. What changed? What were your results? Write them below. _____

_____

_____

_____

_____

_____

_____

Section 3: Clouds

Clouds begin with rising air. All air contains some amount of water vapor, but often there is not enough to sense. Special conditions must occur before the water in the air becomes something you can feel. When air reaches a certain altitude, these conditions are met. Have you ever noticed how thin the air is high up on a mountain? Higher altitudes have lower air pressure, and air rising into high altitudes expands in the low-pressure area. When air expands, it cools, and this keeps happening until the air reaches its *dew-point temperature.* Dew-point temperature is the point at which the water starts condensing into droplets or ice crystals. When water condenses out of the air, a cloud forms.

Clouds come in many types, and their general shapes and appearances often depend on the altitude. Generally, they fall in the categories *low, middle,* and *high.* There are also *vertical clouds,* however, which are clouds that stretch all the way through the regions the other clouds occupy.

Low clouds extend anywhere from the ground to 6,500 feet up. Low clouds are usually *stratus* clouds. The word stratus means "layer". Stratus clouds are a uniform, gray layer that looks like a suspended sheet of fog. They often hang low and can cover the tops

of hills and forest treetops. Usually, they produce no precipitation, unless it is a mist or a drizzle. Darker rain clouds that spread out at low altitudes are called *nimbostratus*. They block out the sun, and their outlines are often hard to see because they merge with rainfall. The precipitation they bring is gentle and moderate. The *stratocumulus* clouds also bring little or no precipitation and look puffier and less uniform than the other low clouds. They can be bunched together in rows, with breaks of blue sky and streaks of sunlight. The word cumulus means "heap", and the stratocumulus clouds look like small heaps of cotton spread out across the sky.

Nimbostratus cloud

Middle clouds occupy the territory from 6,500 to 20,000 feet up. The main clouds in this region are the *altocumulus* and *altostratus* clouds. Altocumulus clouds are great, gray, puffy masses filled with water droplets and ice crystals. They appear in waves and rows, and can often mean the approach of rain. Altostratus clouds also come before rain or snow, many times, and spread out over the sky in a thin enough formation to allow the sun to appear as a glowing disc. They produce no shadows, unlike stratus clouds higher up. They also do not produce haloes around the sun or moon, which is a hazy circle of light often seen through a cirrostratus cloud.

Altocumulus cloud

Any cloud above 20,000 feet is a high cloud. These clouds are often composed of ice crystals, due to the temperature and pressure at these altitudes. They are mostly white during the day, though sunrises and sunsets can cause them to reflect in a beautiful array of yellow, orange, or red colors. *Cirrus* clouds are common high clouds: they are thin and wispy strands stretched out across the sky by high winds in the upper atmosphere. They may appear as a bunched-up cloud with a long tail and often accompany good weather.

More distinct than most clouds, *cirrocumulus clouds* cover the sky in rows of white puffs. They can look like a sheet of scales high up and have been called "mackerel sky" because of their scaly appearance. They are caused by changes in wind direction at different heights called *wind shear*. Wind shear comes before approaching storms, and so

cirrocumulus clouds often mean a storm is coming. *Cirrostratus* clouds form when cirrus clouds thicken together and create a layer of ice crystals in the upper atmosphere. The ice crystals create a halo effect when the sun and moon shine through, and the halo effect is the best way to be sure you are seeing a cirrostratus cloud.

Not all clouds are limited to one part of the atmosphere. A fourth category, *vertical clouds,* shoot through several regions at once. Other cloud types form out of air that rises at approximately one mile an hour, but vertical clouds form from air rushing up at 100 miles an hour. They even have an explosive appearance, looking like columns of smoke from a volcano, except that they are mostly white. *Cumulus* clouds look like piles of cotton balls with sharp outlines and a flat base. They form in updrafts and are surrounded by downdrafts of air. Ordinary heating on a sunny day can cause these clouds to form and they are sometimes called "fair weather clouds".

Cumulonimbus cloud

Cumulonimbus clouds are famous as thunderclouds. They often precede rain, snow, hail, and lightning. They can rocket up to a height of ten miles into the atmosphere, where they are pressed flat by high, racing winds and given an anvil appearance. They can bring violent weather with cool downdrafts.

Directions: Answer the following questions.

1. Which category of clouds is most likely to include ice crystals? _____

   _____

2. Which cloud is almost a form of fog? _____
3. What is an alternate name for a cirrocumulus cloud? What effect produces its appearance? _____
4. What gives cumulonimbus clouds their anvil shape? _____

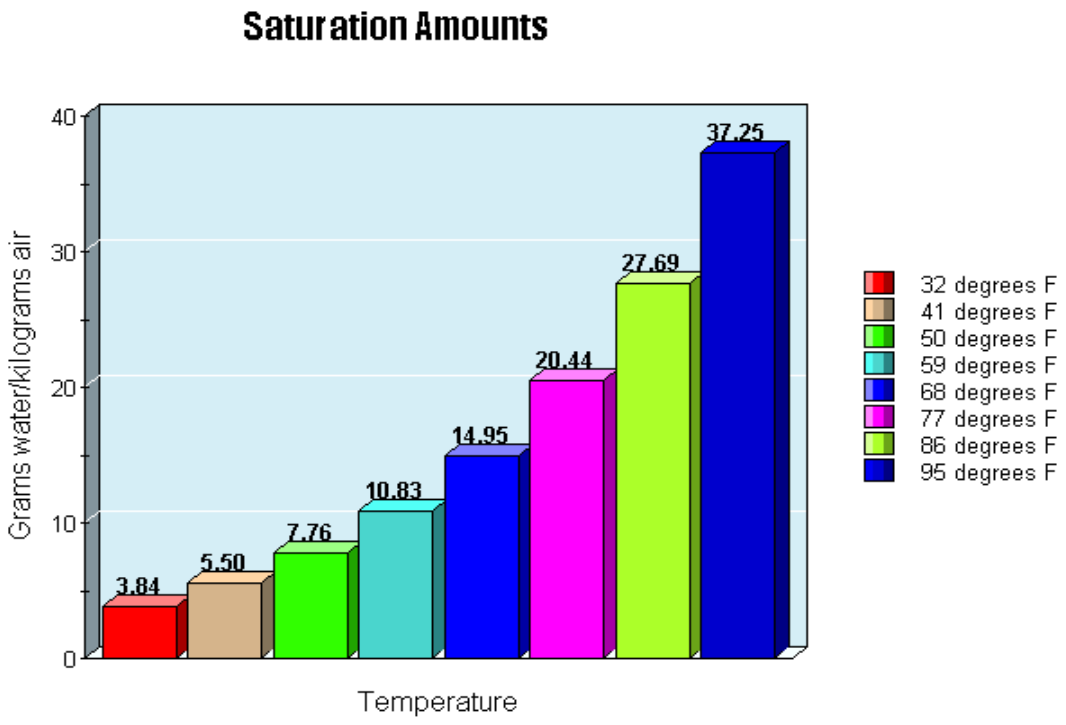
   _____

5. Why doesn't an altostratus cloud produce a halo around the sun? _____

   _____

Where does our water come from? It almost always comes from the ocean. 97% of our planet's water sits in the ocean. It is in the form of salt water, which is useless to humans because of the high salt content. However, the water we drink has gone through a lengthy purifying process called the *water cycle.* The water cycle is the journey that water takes through different phases as it travels from sea to air to land. Our whole planet depends on the presence of water and receives it from some stage of the water cycle.

To get out of the ocean, water must change phases. In the ocean, it is in a *liquid* phase. To leave, it must enter a *gaseous phase* through *evaporation.* Water molecules that are moving fast enough break free into the air. This will keep happening until the air is *saturated.* Saturated air has as many water molecules leaving it as are entering it. If one water molecule enters it, another one will leave. The saturation point of the air increases with temperature so that hotter air can hold more water vapor than cooler air. This is how clouds form, as you learned last section: warm air rises, cools in the upper atmosphere, and condenses because the saturation point has dropped. The different levels of saturation for different temperatures are shown below:



Most of the world's water comes from the tropics, where it is warmest. About 252 trillion gallons evaporate from the ocean every day. In the upper atmosphere, they form into cloud droplets, which are 20 micrometers across. A million such droplets are needed to form one rain droplet, which average 2 millimeters across. Individual water molecules travel in the atmosphere for a week on average and are usually carried 6,000 miles east or west and 600 miles north or south.

When they do fall, they usually fall as rain. 77% of Earth's rainfall falls back into the ocean, since 71% of the earth's surface is covered by the ocean. Rain falls in various forms and intensities. Rain comes in different densities, from light to heavy:

Rainfall Type	Rainfall Amount
Light	0.1 inch an hour
Moderate	0.11 to 0.3 inches an hour
Heavy	More than 0.3 inches an hour

In certain conditions, the rain will fall in other forms. *Hail* falls when a storm cloud has been unable to release rain because of intense updrafts. More droplets freeze onto the ice in the cloud until it becomes too heavy for the updrafts. Then it falls in the chunks we know as hail. Hail can ruin crops or harm livestock, and can fall at speeds up to 120 mph and as large as 3 inches in diameter. *Sleet* is falling when snow leaves a cloud and melts in the winds of a warm front but then refreezes before it reaches the ground. *Snow* falls when the temperature is uniformly freezing all the way to the ground and can reach blizzard conditions if the wind exceeds 35 mph.

Water has reached a solid state when it is in the form of ice or snow. Snow can collect on mountains, or water can collect on land, and eventually become *runoff*, which is water flowing across the surface of the earth. Other water collects in lakes and streams, but this amount is surprisingly small in comparison to other receptacles. Here is how the water distribution breaks down:

Water Location	Volume (cubic miles)
Oceans	317,000,000
Lakes	30,000
Rivers	300
Icecaps	6,980,000
Atmosphere	3,100
Groundwater	2,000,000

Directions: Answer the following questions.

1. Besides the oceans, where is most of our Earth's water residing? _____

_____

2. Why can hail grow so large? _____

_____

3. Is there more water in saturated air at 55 degrees or at 75 degrees? _____

4. Name the three phases of water: _____

_____

5. What is the furthest distance the rain that falls on your face has probably traveled?

_____

IMPORTANT

Before you start your Chapter Review, go over all your work, make sure all the sections are scored, and make sure they are corrected. Review all you have learned. Answer all the questions in the Chapter Review without looking back.

CHAPTER 1 REVIEW

Directions: Read each of the following statements and decide whether each is true or false. If it is true, put T *in the blank, and if it is false, put* F *in the blank.*

1. _____ Convective cells often form along the coast
2. _____ Earth continually loses the heat it absorbs

3. _____ Water changes phases during the water cycle
4. _____ All the sunlight that enters our atmosphere reaches the ground
5. _____ Middle clouds are over 6,500 feet
6. _____ Greenhouse gases cause heat to escape the earth's atmosphere more quickly
7. _____ Hotter air can contain more water
8. _____ Jet streams are high-powered air flowing along the ocean surface
9. _____ Stratus clouds are puffy, white clouds
10. _____ Cumulonimbus clouds are famously high clouds

Directions: Choose the best answer for each of the following questions. Put the letter beside the answer in the blank.

11. _____ Cumulus clouds are an example of:
    a. vertical clouds
    b. low clouds
    c. high clouds

12. _____ The trade winds flow between:
    a. 0 to 30 degrees latitude
    b. 30 to 60 degrees latitude
    c. 60 to 90 degrees latitude

13. _____ Which of the following is a high cloud:
    a. altocumulus
    b. nimbostratus
    c. cirrostratus

14. _____ _____ gallons of water evaporate from the ocean each day
    a. 114 million
    b. 56 billion
    c. 252 trillion

15. _____ The word *doldrums* basically means:

a. frothy and unpredictable

b. going nowhere

c. warm and bearing down

16. _____ Water in the atmosphere is usually in a:

a. liquid phase

b. solid phase

c. gaseous phase

17. _____ _____ of sunlight entering the atmosphere reaches the ground

a. 19 %

b. 51 %

c. 30 %

18. _____ Snow that melts and refreezes before it hits the ground is called:

a. hail

b. dew

c. sleet

19. _____ The change of an object's path due to the rotation of the earth is called:

a. the Coriolis effect

b. evaporation

c. the greenhouse effect

20. _____ Which of the following could also be referred to as "stored heat":

a. tangible heat

b. sensible heat

c. latent heat

Chapter 2: Storms

Section 1: Hurricanes

Hurricanes are among nature's worst destroyers. Moving through the atmosphere with the power of 500,000 atom bombs, they deserve the care people in tropical climates take to avoid them. They have left dark blots on history. In 1900, the island town of Galveston, Texas, almost disappeared under the force of a hurricane, which smashed a steamship through three bridges connecting the island to the mainland, battering the town with 125 mph winds. Seas rose by 20 feet, forcing inhabitants to the second and third floors of their houses.

Many spent the night clinging to their houses to avoid getting swept away, and in the end, 6,000 had died. Hurricane Hugo swept boats from the harbor onto the road, sent gusts of 160 mph barreling through South Carolina, and caused 1 billion dollars in property damage. Hurricane Andrew in 1992 ripped through Florida and destroyed 126,000 homes and caused the evacuation of 700,000 people.

Hurricanes are still hard to predict, though stormwatchers have determined that an average of 5 hurricanes occur per year in the Caribbean basin, with about two of them being major. They are confined to regions near the equator, where certain conditions in the weather must be met before they can grow to full potential. The ocean surface in the tropics often stays around 80 degrees, which causes plenty of evaporation into the atmosphere, as well as heavy cloud formation. Rain-heavy thunderstorms cluster and trap heat, which causes a huge updraft. The region beneath the updraft becomes a low-pressure zone that draws wind from surrounding areas into it. By this time, the storm is called a *tropical disturbance.*

The rotation of the earth begins to work on the cluster of storm clouds. The Coriolis effect causes the clouds to start turning. The system becomes a *tropical*

depression when the winds reach 23 mph. At wind speeds of 39 mph or more, it becomes a *tropical storm.* Then, to become a hurricane, the storm needs something extra. It must have a high-pressure system on top of the clouds and light winds. This sucks air out of the top and draws more in at the bottom, creating a funnel of rising winds. It must also avoid strong horizontal winds, which cut into the clouds and do not let them grow to full strength.

When the hurricane has grown to full size, it has many parts. The least violent is the *eye,* the deceptive low-pressure area in the middle. It can be anywhere from 15 miles to 50 miles across, allowing a period of complete calm as a hurricane travels through. Then one encounters the *eye wall,* a towering bank of clouds with severe updrafts and winds reaching at least 74 miles an hour. The clouds spin around the eye, with strips of clouds spiraling toward it called *rainbands.* These cloud formations fill out the body of the hurricane and carry a massive 15 to 25 inches of rainfall. A canopy of clouds mushrooms out of the top of the hurricane, driven by outflowing warm air carried by high-altitude winds. This part is called the *outflow shield.*

The damage of hurricane winds can be severe. Some reach speeds of 125 mph, with eddies inside the hurricane spinning off the eye wall and reaching 200 mph. Despite this threat, the real danger is from a phenomenon called the *storm surge.* The storm surge is an actual rise in sea level resulting from the low pressure in the eye of the storm. Wind speed and depth of the water also affect it. The hurricane sucks up a mound of water 50 to 100 miles wide and anywhere from 1 to 25 feet high. It causes intense flooding and property damage near the shore. Waves 5 to 10 feet high can ride on top of the surge and become an unstoppable wall of water if they flow into a narrow passage.

Hurricanes usually measure 200-500 miles across. They can travel as slow as 10 mph or as fast as 50 mph. In the northwestern Pacific Ocean, they are called *typhoons,*

and in the Indian Ocean and south of the equator, they are called *cyclones.* If they hit crowded areas, the tolls on human life can be enormous. A typhoon hit China in 1881 and killed 300,000 people, and a cyclone in 1876 killed 100,000 people in India. A 1973 cyclone lifted up a 23-foot storm surge and killed 300,000 people in Bangladesh. Scientists in the U.S.A. work hard to predict hurricanes and prevent loss of life or property, but many countries in other parts of the world do not have the same benefit.

Hurricanes are classified to a rating called the Saffir-Simpson scale. They are ranked from 1 to 5, according to the severity and the symptoms of the storm. The scale is shown below.

Category	Wind Speed	Storm Surge	Damage
1	74-95 mph	4-5 ft. above normal	Mobile homes, trees, shrubs, and signs
2	96-110 mph	6-8 ft. above	Roofs, doors, and windows damaged. Trees blown over, small ships break moorings
3	111-130 mph	9-12 ft. above	Evacuation required. Mobile homes destroyed, leaves blown off trees, flooding
4	131-155 mph	13-18 ft. above	Shrubs, trees, signs, and mobile homes destroyed. Lower floors of structures damaged. Evacuation to 6 miles inland
5	More than 155 mph	More than 18 ft.	Roof and building failure on many buildings. Massive evacuation within 10 miles of shore

Directions: Choose the best answer for each of the following questions. Put the letter beside the answer in the blank.

1. _____ Which of the following is the *outflow shield:*
    a. a rise in sea level from 1 to 25 feet
    b. a canopy of clouds above the hurricane
    c. a strip of clouds with heavy rainfall

2. _____ South of the equator, hurricanes are called:
    a. hurricanes
    b. typhoons
    c. cyclones

3. _____ What could prevent a tropical storm from growing into a hurricane?
    a. light, high-altitude winds
    b. a low-pressure zone at the bottom
    c. strong horizontal winds

4. _____ What causes a hurricane to start rotating?
    a. encounter with land mass
    b. the Coriolis effect
    c. the storm surge

5. _____ Hurricanes must form near:
    a. the equator
    b. polar regions
    c. in freshwater regions

"A strong, positive mental attitude will create more miracles than any wonder drug."

-Patricia Neal

Especially at your age, the condition of your body can make a big difference in how much you enjoy life. You are going through many changes, growing at a rapid rate, and the better you feed your body, the better you will feel. You body does not respond to food alone but also to the state of your emotions. What have you been feeding your emotions? What have you been telling yourself about your life?

Write down the way you have been feeling physically recently. Write down some things you have been telling yourself about your situations. Is there a connection? How can you improve on the things you tell yourself about your life? _____

_____

_____

_____

_____

_____

_____

Section 2: Tornadoes

Hurricanes always form in the ocean and move landward, giving weather officials time to notify the public about approaching danger. It is harder to predict weather disasters that start on land, especially ones that can form in the space of minutes and usually end in a similar amount of time. *Tornadoes* fit this profile. The average tornado lasts fifteen minutes and may only travel a few miles. At the same time, larger ones can generate winds of up to 300 mph and lift whole houses from their foundations and leave them in splinters.

Weather officials cannot precisely predict where a tornado is going to strike, and so they focus on

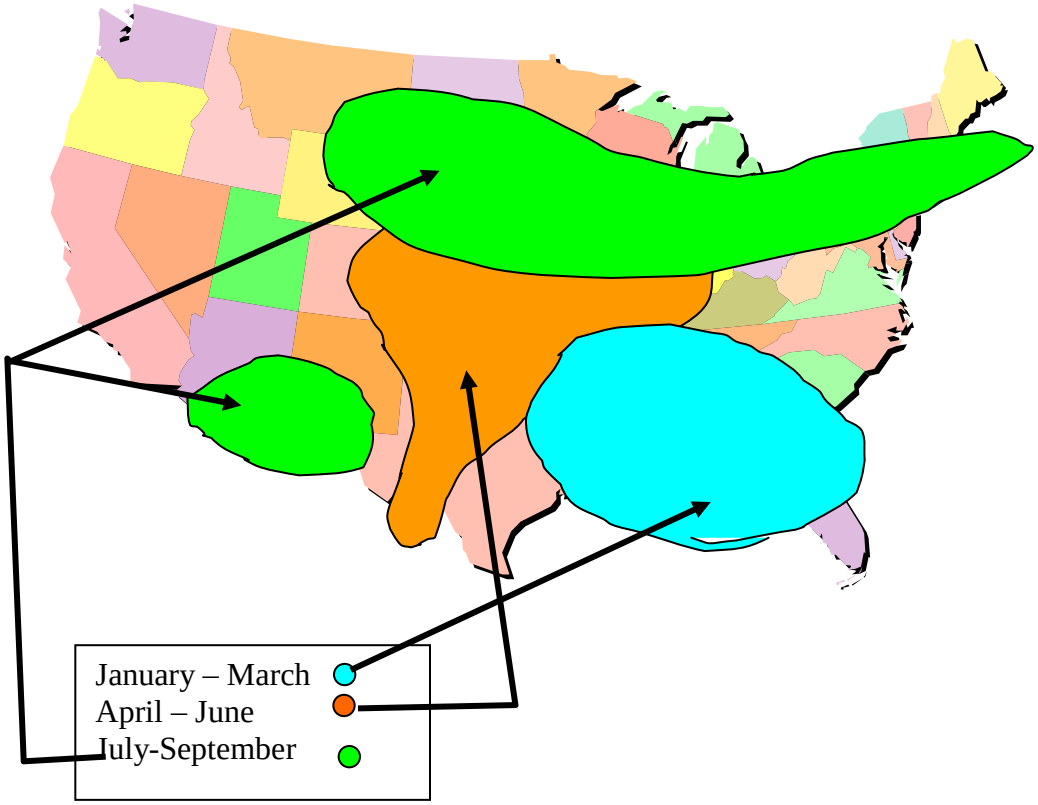
weather that presents ideal conditions for tornadoes. Tornadoes often form out of storm systems called *supercells,* which are thunderstorms with deep, rotating updrafts. They are often born like this: high up, storm clouds form out of updrafts, which are warm, rising, humid air. They mature in the upper atmosphere, with ice crystals and condensed waters overcoming the updraft and dropping. They melt on the way down and create a cool downdraft. Therefore, mature stormclouds have both updrafts and downdrafts happening at the same time. *Then,* they encounter a warm, humid layer of air near the ground sitting under cool, drier air higher in the atmosphere. Wind shear causes a rolling tunnel of air as the two layers tumble over each other. This is called a *mesocyclone.* Updrafts from the storm pick up the mesocyclone until it stands vertically and connects with the thundercloud. It picks up water, vapor, dust, and debris and becomes a visible tornado.

Fortunately, most tornadoes only last a few minutes. They have diameters of about five hundred feet and travel just a few miles with winds of less than 112 mph. Their potential is enormous though. Some measure a mile wide and travel two hundred miles, with winds of 300 mph and a lifespan of a couple of hours. Since conditions are optimum before a tornado ever starts up, many can break out at one time. The worst outbreak in history happened in the eastern United States in 1974, when 148 tornadoes touched down over the course of two days. 330 people were killed and property damage hovered around $600 million.

Just like hurricanes, tornadoes also have a scale for their severity. Drawn up by a famous tornado pioneer, the Fujita scale is shown on the following page:

Category	Intensity	Wind Speed	Damage Description
F0	Gale tornado	40-72 mph	Light damage: Chimneys and signs damaged; tree branches broken
F1	Moderate	73-112 mph	Peels roofs; mobile homes overturned; moving autos pushed off road
F2	Significant	113-157 mph	Considerable damage: roofs torn off frame houses; mobile homes destroyed; large trees snapped or uprooted
F3	Severe	158-206 mph	Severe damage: roofs and walls torn off, trains overturned
F4	Devastating	207-260 mph	Devastating damage: well-constructed houses leveled and cars thrown; large missiles generated.
F5	Incredible	261-318 mph	Incredible damage: frame houses carried long distances; car-sized missiles fly over 100 yards; trees de-barked

Like hurricanes, tornadoes are limited to where they appear. The vast majority happens in the United States. They usually appear in a small section of the country between Iowa and Texas called *Tornado Alley* during the spring and summer months. 1,200 are reported per year and cause an average of 80 deaths. Other areas of concentration are shown on the following page:



Along with tornadoes of different severity, tornadoes come in different shapes and sizes. They form under so many different conditions that they naturally have a variety of appearances. Some of them are listed below:

Tornado Type	Description
Cone-shaped tornado	These are the most famous tornadoes. They have a wide top which narrows to a small base.
Dust devil	Dust devils do not need clouds to form and develop over hot sands that get overheated during the day. The winds are usually less than 70 mph
Elephant trunk tornado	These tornadoes are long and curved and barely bigger at the top than at the bottom. They form in an S-shape.
Gustnado	Gustnados form at the front of thunderstorms and feature a spinning dust cloud and minor damage, such as breaking windows and branches. They do not need a cloud overhead and are not full-blown tornadoes

Multiple vortex tornado	These have systems of smaller whirls within them that can add 100 mph of wind to the basic ground circulation. They can leave a path with major damage near areas of minor damage.
Rope tornado	These have long, thin, rope-like appearance and spin more quickly at the top than at the bottom. This stretches them out until they separate and disappear.
Satellite tornado	A small tornado orbiting a larger one.
Waterspout	These tornadoes form over water and are usually completely white in their appearance, due to the water vapor. They seldom reach the highest wind speeds.
Wedge tornado	These tornadoes are fatter than they are tall.

Directions: Answer the following questions.

1. In what kind of thunderclouds do tornadoes often form? _____

_____

2. The early form of a tornado, a horizontal, rolling tunnel of warm humid air and cool dry air, is called what? _____
3. What is the average lifespan of a tornado? _____
4. Which seasons do tornadoes usually favor? _____

_____

5. Which type of tornado is most likely to be all white, and why? _____

_____

Section 3: Lightning

How does lightning make you feel? Does it scare you or fill you with awe? It is hard to feel casual when those bright bolts begin shooting through the sky. Thunderstorms are famous for scaring cattle and other animals, and their reactions are based on good sense. Bolts of lightning carry millions of volts within them and are

responsible for as many as 100 deaths a year in the United States alone. They are also very common. Satellite research shows 100 flashes per second happening all over the earth. That is 3 million per day.

How lightning happens is somewhat of a mystery to scientists, but some of the basic processes are understood. It begins before a thundercloud even arrives, with a drawn-out, invisible exchange between the earth surface and the atmosphere. As you learned in an earlier unit, part of the atmosphere is filled with negatively charged particles called *ions.* Opposites attract in the world of electricity, and so these negatively charged ions produce a positively charged surface on the earth. This area is called a *fair weather field.* No storm has happened yet.

When a thundercloud does move in, it begins to react with the atmosphere. The negatively charged ions in the ionosphere draw positively charged particles to the top of the cloud, and the negatively charged particles are drawn to the bottom. With the electricity between molecules, like repels like, and so the negatively charged particles at the bottom of a storm cloud drive out even more negatively charged particles from the area around the earth's surface. Remember that this surface already has a positive charge as a fair weather field.

An electrical current begins to build between the storm cloud and the earth. When the charge becomes powerful enough, a bolt of electricity jumps out. As many as ten lightning bolts happen in less than a second, though our eye only registers one bolt. The bolt heats the air around it to 54,000 degrees, five times the heat on the surface of the sun. The air violently expands around it, producing the huge, cracking sound we know as thunder. Since light travels at 186,000 miles a second and sound travels at just 1,100 feet per second, we see the lightning before the thunderclap. Basically, it takes thunder 5 seconds to travel a mile.

What is happening at the instant the bolt flies out? A current of electricity called a *stepped leader* shoots out of the cloud and arcs its way down towards the earth. As it descends, it changes direction towards the strongest electrical fields in the atmosphere. This can happen many times before hitting the ground, giving it a forked appearance. At each turn, it stops for a few microseconds. Before it hits the ground, it may branch into several bolts and cause bolts of lightning to jump up from the ground to meet it.

Lightning that hits the ground in a bolt is called *fork lightning.* Not all lightning that occurs makes it to the ground. In fact, only twenty percent of lightning hits the ground. The rest leaps from cloud to cloud, and we see only the bright flash in the cloud, reflecting the bolt. This is called *sheet lightning.*

Other weird electrical phenomena can accompany a storm. The charged atmosphere happening on the ground does not always result in a bolt of lightning. Sometimes a strange green glow will form around tall objects such as the masts of ships and flagpoles, called *St. Elmo's fire* after the patron saint of sailors. It is made of charged plasma, or electrically charged gas. Many people have also spotted *ball lightning*, which is a luminescent ball of electricity, which floats along the ground during a thunderstorm. These eerie objects can be as small as a baseball and up to a few feet in diameter and have a furry exterior. None have ever been photographed.

Lately, space shuttle astronauts have spotted interesting activity above storm clouds. These are large red puffs that rise above a cloud just as lightning strikes below. They rise 60 miles above the earth's surface before dissipating and look like huge red jellyfish with blue-green tentacles coming out of them. Scientists call them *sprites.* People have also spotted jets of blue light traveling as high as 30 miles above the clouds and moving at 60 miles a second. These can be seen by observers below and are called *blue jets.*

Directions: Answer the following questions.

1. What precisely is the cause of a thunderclap? _____

_____

2. Describe a fair weather field. _____

_____

_____

3. Why does a lightning bolt give a forked appearance? _____

_____

_____

4. What percentage of lightning never makes it to the ground? _____

5. How long would it take to hear thunder from a lightning bolt 3 miles away? ____

"The positive thinker sees the invisible, feels the intangible, and achieves the impossible."

-Anonymous

How limited do you feel by circumstances? Are you too short or too young for something you want? When you see the good in each situation, you use your imagination for a positive outcome. You take a block of marble, and you see the statue of David within it. Without using your imagination, you will never get all you can out of life. When a challenge comes, the chances are good that they will overpower you. Every day, you have many opportunities to make life better for yourselves and others. Use your imagination.

Write about something you want that doesn't seem possible right now. Then write of some realistic ways that circumstances could change for you to achieve that dream. Ponder those possibilities for a while. _____

_____

_____

_____

_____

_____

_____

IMPORTANT

Before you start your Chapter Review, go over all your work, make sure all the sections are scored, and make sure they are corrected. Review all you have learned. Answer all the questions in the Chapter Review without looking back.

CHAPTER 2 REVIEW

Directions: Read the following statements and decide whether each is true or false. If it is true, put T *in the blank for true, and if it is false, put* F *in the blank.*

1. _____ Hurricanes always begin somewhere near the equator
2. _____ Most lightning makes it to the ground
3. _____ Tornadoes are most active during the winter months
4. _____ 100 flashes of lightning occur every second around the earth
5. _____ The conditions for lightning begin before a thundercloud even arrives
6. _____ Tornadoes begin as a horizontal tunnel of air called a mesocyclone
7. _____ Tornado Alley lies in the northwestern United States
8. _____ The average tornado lasts 1 hour
9. _____ A lightning bolt heats the air around it to 24,000 degrees F
10. _____ The eye wall is the most damaging part of a hurricane

Directions: Match the correct term from the following list to the definitions below. You do not need to use every word from the list.

St. Elmo's fire	blue jets	cyclone
sprites	fork lightning	satellite tornado
supercell	rope tornado	tropical storm
rainbands	outflow shield	gustnado
wedge tornado	sheet lightning	mesocyclone
fair weather field	stepped leader	tropical depression

11. _____ A small tornado orbiting around a larger one
12. _____ Bright flashes within a cloud
13. _____ A system of storm clouds near the equator with winds between 23-39 mph
14. _____ A strange, green glow that attaches to tall objects during a storm
15. _____ Red puffs of light rising above a lightning cloud
16. _____ A tornado that is fatter than it is tall
17. _____ A storm system with a deep rotating updraft
18. _____ A name for a hurricane south of the equator
19. _____ A bank of clouds rushing out of the top of a hurricane
20. _____ A negatively charged atmosphere over a positively charged ground

Chapter 3: Measuring Weather

Section 1: Weather Instruments

Now you know something about how the weather works. But how do we find out what it is doing or will do? It is not enough to test the breeze and hope for the best anymore. Over the years, science has developed many instruments for measuring and observing the weather. Some of them are basic items you could hold in your hand and place in your home. Others depend on sophisticated technology and include satellites circling the earth.

The most basic instrument is the *thermometer*, which measures the temperature of the air. Heat causes substances to expand, and as they expand, the liquid inside them rises. First created by Galileo, it was later improved by Daniel Fahrenheit, who made a thermometer with alcohol and assigned degrees to it. Today, meteorologists (those who work with the weather) place sensitive thermometers in shelters and place them out in the open to gauge the temperature of the day.

Second, after knowing air temperature, it is important to know air pressure. As you have seen, changes in air pressure dramatically affect the weather or at least signal what changes are happening. Air pressure is measured with a *barometer*. Many types exist, including a mercury and an electronic barometer. One type called an *aneroid barometer* uses a spring. Usually, a fall in pressure means that bad weather is coming, while a rise in pressure means fair weather.

Wind direction matters as well. It tells you the direction from which weather systems are approaching, and which winds are prevailing. Wind is often measured with a primitive tool—the *weather vane,* which is classically seen in the form of a rooster on the tops of barns. Windsocks have also been used in recent years. Wind speed is measured with an *anemometer,* a spinning wheel of cup-shaped blades. A recording device measures how many times the blades spin within a set time, and this gives a reading of how hard the wind is blowing. When the wind speed is combined with the air temperature, it is possible to determine the *wind chill factor*, as shown below:

Temperature (F)

Wind (mph)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
	5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
	10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
	15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
	20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
	25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
	30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
	35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
	40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
	45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
	50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
	55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
	60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

(Provided by the National Weather Service)

Humidity affects the rate of cloud formation and levels of human comfort. Instruments measuring humidity have developed from the original one, called a *hygrometer*. Its power is based on the fact that human hair gets longer when the air is humid and shorter when it is dry. Hygrometers have levers attached to human hair that show the degree of change. Since these were somewhat inaccurate, a device called a *sling psychrometer* is now used. It places two thermometers next to each other, with one having a wick that is moist. Evaporation from the wick cools that thermometer, and the rate of evaporation depends on the dryness of the air. The difference in temperature between the two tells the humidity.

Rain gauges measure the rainfall and consist of two types. One includes an outer cylinder, a measuring tube, and a funnel. It gives accurate measurements but has to be maintained by an observer. The other kind has a series of tipping buckets that measure .01 inches of rain apiece. It is more automatic than the first type but might be too slow to accurately measure downpours.

As you may have guessed, professional forecasting is not limited to these simple instruments. More is required to put together a weather broadcast. Readings under a variety of conditions are necessary. To meet their needs for information, the following devices are used:

1. *Doppler radar:* these are used to identify possible tornado formation. Emitting microwave pulses at storm clouds, they can detect the movement of winds within it. When some winds are moving away and some are moving closer, winds are rotating and a tornado may be forming.

2. *Automated weather stations*: these monitor the climate, temperature, precipitation, wind speed, and other factors listed above.

3. *Satellites:* many satellites take pictures of cloud cover and the movement of weather fronts and global climate changes. Satellites can give up-to-the-minute

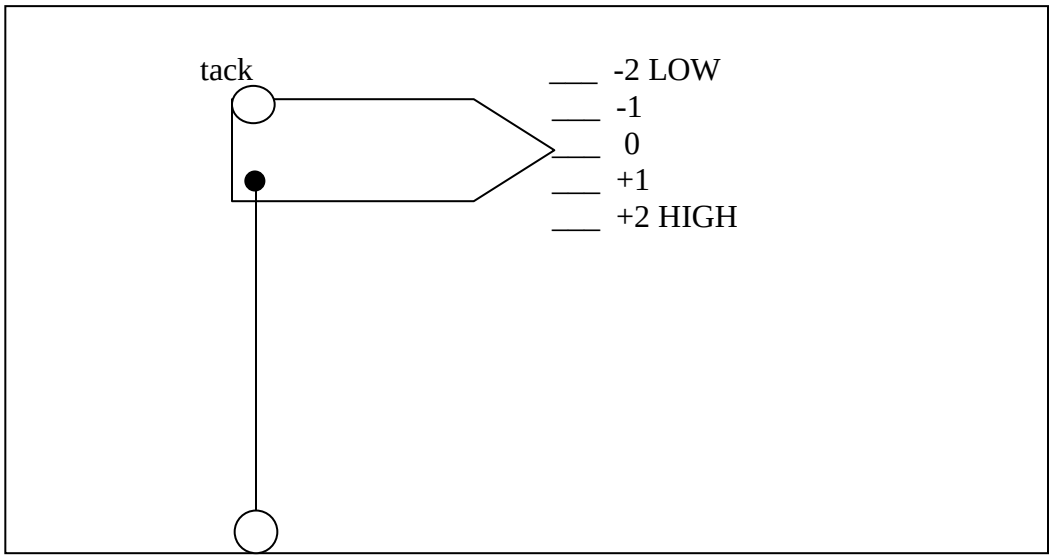
information. They also take infrared images that trace cloud height and nighttime weather activities. Five satellites called *geostationary satellites* rotate with the earth so that they always photograph the same area.

4. *Ocean buoys:* these units send information of weather conditions in the ocean and can provide advance warning for hurricanes

5. *Weather balloons:* released twice a day, these vehicles carry weather instruments high into the atmosphere. The instruments take measurements until the balloons pop, and then they parachute back to Earth.

Directions: Create your own hair hygrometer. Assemble some pieces of cardboard, two thumbtacks, and a ten-inch strand of human hair. Make a 6-inch arrow from one piece of cardboard, and punch two small holes on either side of the flat end. Tack the arrow to another large, flat piece of cardboard through the far hole. Tie the nearer hole with the hair and tie the other end of the hair with the tack. Stretch out the hair until the arrow is perpendicular to it, and place the tack in the cardboard. Write the word "LOW" above the pointer end of the arrow, and the word "HIGH" below it. Make at least five markers for degrees (-2, -1, 0, +1, +2). Take measurements over five days. As humidity increases, the hair will stretch and the pointer will dip. The opposite will happen on dry days. Compare your results with a friend. Were they similar? Write down your results below.

The hygrometer should look like the picture below:



Readings:

Day 1: _____

Day 2: _____

Day 3: _____

Day 4: _____

Day 5: _____

Comparison with friends: _____

_____

_____

"Few things in the world are more powerful than a positive push, a smile, a word of optimism and hope, a 'you can do it' when things are tough."

-Richard M. DeVos

Being positive is not just something you think, it is something you do. It is not just something you do for yourself; it is something you do for others. Unless you encourage others, it is very hard to be encouraged yourself. What are some challenges the people around you are facing? What puzzles do they have in their lives? Choose two people close to you and think about their lives. Write down the situations they are facing and the good in each one of them, even if it is only an encouragement about their ability to overcome it. Then go tell them about it.

_____

_____

_____

_____

_____

_____

_____

_____

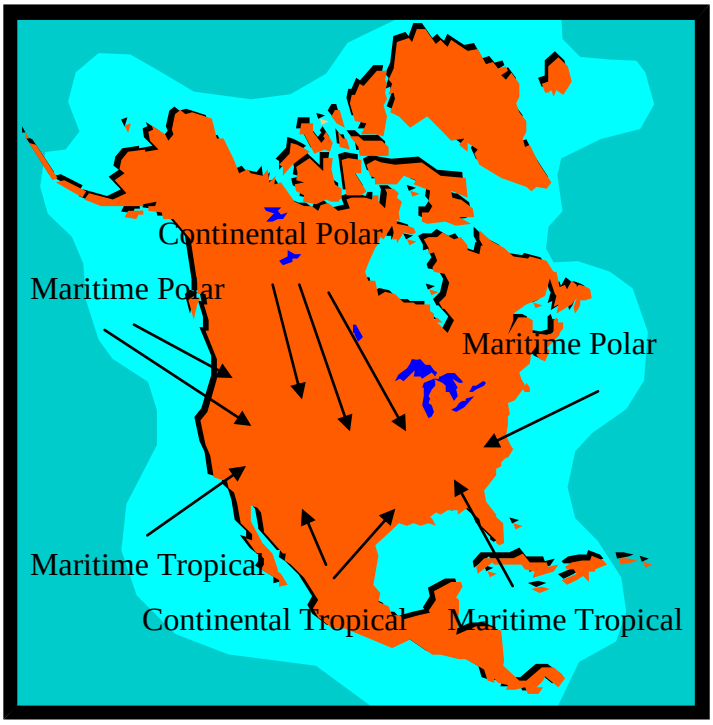
_____

When air hangs over a specific area, whether its land or sea, it develops the traits of that area. The air over the polar regions of the sea will become cold and moist. Air over barren, desert areas becomes hot and dry. If the air hangs in a defined region for long enough, it becomes an *air mass.* An air mass is *large body of air with uniform characteristics.* Air masses are assessed according to their temperature and their moisture level. Therefore, an air mass can have qualities like warm and dry, or cold and moist. It depends upon where it comes from. Four specific regions include:

- *Continental:* these air masses form over land. They are dry, and they are abbreviated with a lower case *c*.
- *Maritime:* these air masses form over the sea, and they are moist. They are abbreviated with a lower case *m.*
- *Polar:* polar air masses form near the poles and are cold. They are abbreviated with a capital *P.*
- *Tropical:* tropical air masses form near the equator and are warm. They are abbreviated with a capital *T.*

All of these titles are usually used in combination. An air mass can be maritime polar (mP). They might blow into shore with fog, low clouds, and cool air. They do not usually bring much precipitation. Another example might be continental tropical air masses (cT). These air masses form over deserts. They bring clear skies and a high-pressure system with them and can produce drought conditions if they come too early in the year.

The United States is affected by different air masses continually. Below are some examples of the air masses entering our atmosphere, the paths they take, and the direction from which they originate:



When you are watching a weather report on the news, you will often hear the weather person talking about *fronts.* A front is *the weather that occurs along the edges of air masses.* Since air masses tend to be very different in their characteristics, the weather along fronts can be extreme. They can be cloudy and windy, even stormy.

There are several kinds of fronts. The most basic kinds are *cold* and *warm.* A cold front occurs when a colder or drier air mass overtakes a warmer, moister air mass. Whenever this happens, the cold air drives a wedge under the warm air and lifts it up. Since it is lifted rapidly, the warm air forms clouds as it rises. Cold fronts are filled with denser air than warm fronts and can move more rapidly. They move at 40 to 50 mph.

Warm fronts come up from the tropics. In a warm air mass, the lighter, warmer air mass gently rises over a cold air mass. The warm fronts must push against denser air, so they move more slowly than cold fronts, traveling at only 20 to 30 mph. Since the warm front rises over a cold air mass, clouds arise hundreds of miles ahead of the surface edge. The weather is usually clear by the time the surface edge of a warm front reaches an area.

Since cold fronts travel faster than warm fronts, sometimes a cold front can overtake a warm front. When this happens, the warm air is lifted off the earth's surface as

the cold air drives underneath it. Meteorologists call this an *occluded front.* It is a mixture of cold and warm fronts. Other times, the air mass loses momentum and stops moving, producing what is called a *stationary front.* A stationary front is simply a front that is standing still.

Directions: Answer the following questions.

1. Why do warm fronts move more slowly than cold fronts? _____

_____

2. What characteristics would a front pushing in from the Caribbean probably have?

_____

3. Give the full names for a mT and a cP. _____

_____

4. What is an occluded front? Why is it possible? _____

_____

_____

5. Do warm fronts always bring sunny weather? Explain. _____

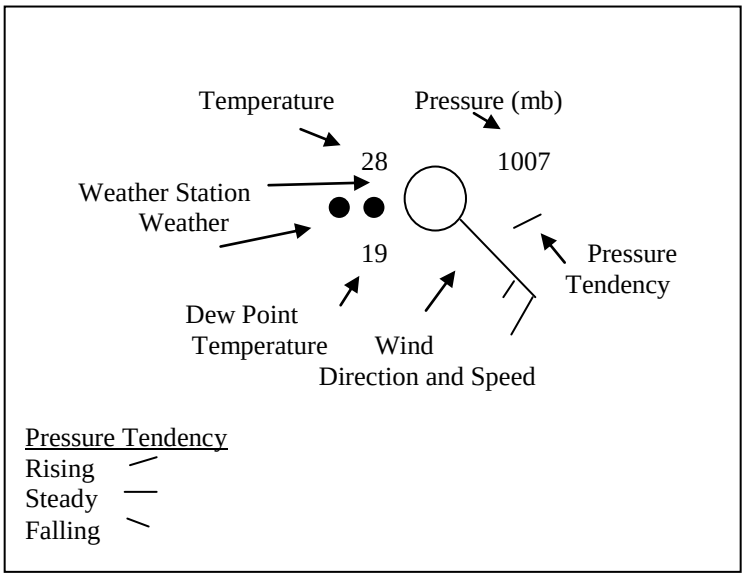
_____

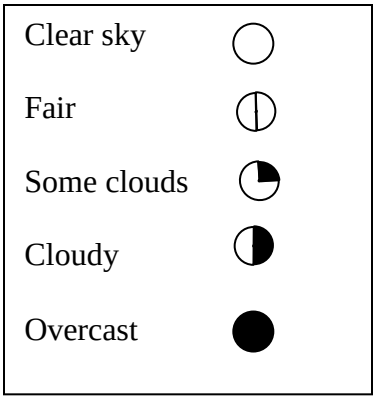
_____

Section 3: Reading Weather Maps

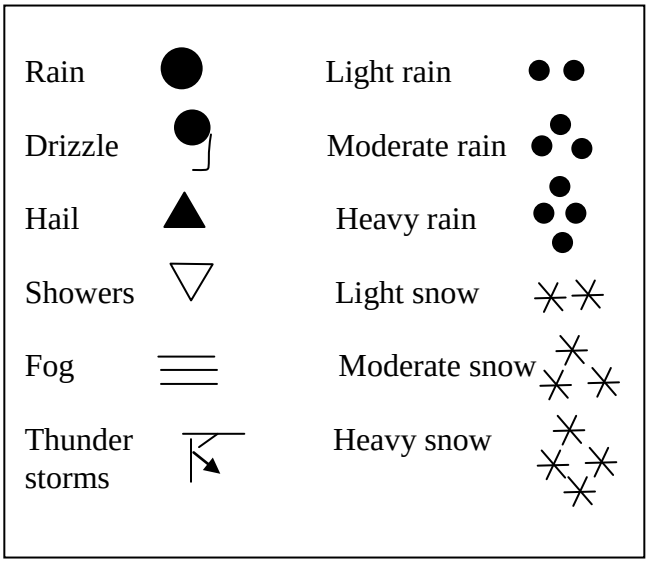
Meteorologists use maps all the time to track the changes in weather and present the information to the public. To gather information efficiently, they must have a shorthand code that tells them all the data they need in the time they have. To do this, they have developed a code showing all the weather conditions. Each group of symbols on a map centers on a certain weather station and the information they are getting from that location.

In this section, you will learn the symbols for reading weather maps and how to convert some information yourself. The main character on a weather map is the *station model*, which is a small tadpole figure with a group of numbers around it. Each figure represents a place on the map where a weather station sits. If the figure is over Arizona, there is a weather station sending information from Arizona. The different numbers tell specific weather information about that location.





The circle in the center of the station model tells the condition of the clouds in the sky—whether it is partly cloudy, cloudy, or completely overcast. See the cloud table for keys to the possible symbols. To the left of the station model is a symbol that tells the basic weather condition for that area. This symbol will say whether it is raining, snowing, hailing, and so on. Glance at the precipitation table for the keys to that symbol.

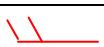


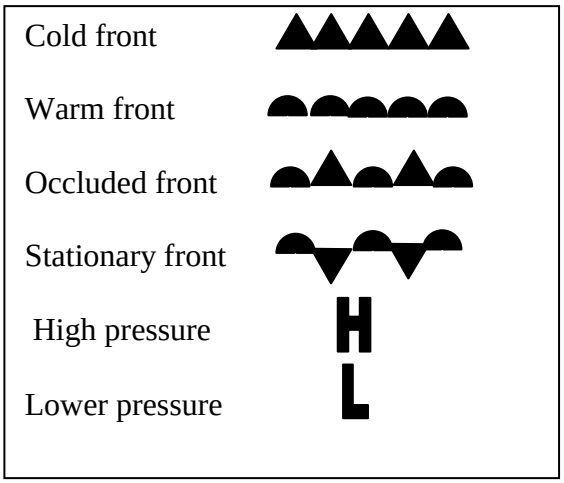
The temperature and the dew-point temperature explain themselves. The pressure in the atmosphere is

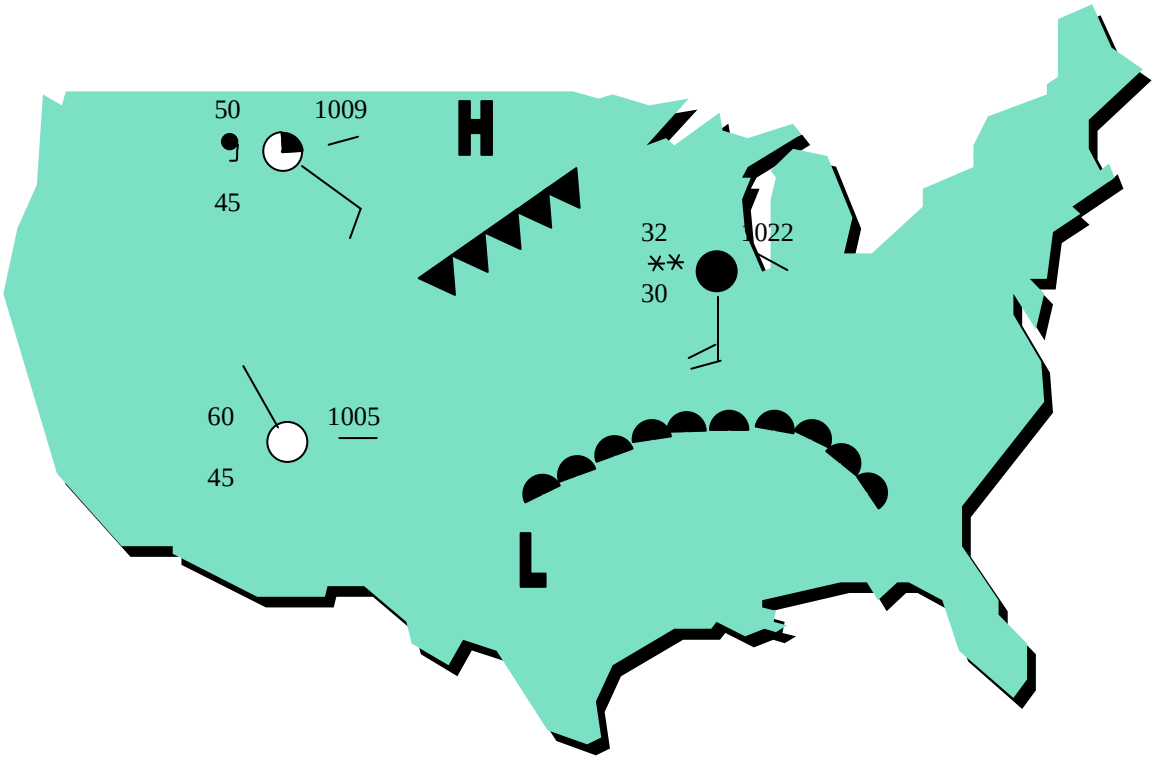
calculated in terms of millibars, which is a unit of air pressure. Air pressure at sea level is 1,013 millibars. The symbol beneath it indicates whether pressure is rising, falling, or staying the same.

The station symbol has a tail that tells the wind direction and speed. The direction it is pointing is the direction from which the wind is coming. If it is pointing South, the wind is coming from the South. The number of flags and the length tells the wind speed. See the wind speed table for the key to the wind speed.

Finally, the front table gives the symbols for the various kinds of fronts. These are spread out on maps according to the location of the fronts. The large "H" shows where a high-pressure zone is located, and a large "L" shows where a low pressure zone is located. The map below the tables gives an example of a complete weather map.

Symbol	Wind Speed
	0-4 km/h
	5-13 km/h
	14-22 km/h
	23-32 km/h
	33-41 km/h
	42-50 km/h
	51-59 km/h
	60-69 km/h
	70-78 km/h
	79-87 km/h
	88-96 km/h
	97-100 km/h





Directions: Answer the following questions. Most refer to the U.S. map above.

1. What is the dew-point temperature for the weather station in the southwest United States? _____
2. What are the weather conditions for the weather station in the northeast United States? _____
3. Is there an occluded front on the map? _____
4. What is the wind speed for a tail with 3 full-length flags on it? _____
5. Is the high-pressure zone on the north or south end of the map? _____

IMPORTANT

Before you start your Chapter Review, go over all your work, make sure all the sections are scored, and make sure they are corrected. Review all you have learned. Answer all the questions in the Chapter Review without looking back.

CHAPTER 3 REVIEW

Directions: Read the following statements and decide whether each is true or false. If it is true, put T *in the blank, and if it is false, put* F *in the blank.*

1. _____ A cold front moves at 40 to 50 mph
2. _____ A Doppler radar can detect the movement of winds within a cloud
3. _____ Weather maps give air pressure in millibars
4. _____ Satellites send information on a weekly basis
5. _____ A barometer measures air pressure
6. _____ Ocean buoys can send in weather information
7. _____ A continental polar air mass would be cold and moist
8. _____ An occluded front is a front that is standing still
9. _____ Warm fronts always rise above cold fronts
10. _____ The thermometer was first invented by Aristotle

Directions: Give the correct meaning for each of the following weather map symbols.

11.  _____
12.  _____
13.  _____
14.  _____
15.  _____

Directions: Choose the best answer for the following questions. Put the letter beside the answer in the blank. Consult the table in this chapter for the question on wind chill factor.

16. _____ A warm, moist air mass is probably a _____ air mass.
    a. maritime polar
    b. maritime tropical
    c. continental tropical

17. _____ The wind chill factor for a 35 degree day with 35 mph winds is:
    a. 15 degrees
    b. 21 degrees
    c. 26 degrees

18. _____ Geostationary satellites are satellites that:
    a. send pictures back minute by minute
    b. go up twice a day
    c. rotate with the earth

19. _____ Human hair length changes with the:
    a. humidity
    b. wind chill factor
    c. temperature

20. _____ Weather balloons go up:
    a. twice monthly
    b. twice weekly
    c. twice daily

Unit Review

Directions: Read the following statements and decide whether each is true or false. If it is true, put T *in the blank. If it is false, put* F *in the blank.*

1. _____ A tornado begins with a horizontal tunnel of air called a mesocyclone
2. _____ 30% of the sunlight that hits our atmosphere is reflected back into outer space
3. _____ The easterlies are high altitude winds that blow between Hadley cells
4. _____ Most of the earth's water lies in the ocean
5. _____ Warm fronts move at 40 to 50 mph
6. _____ Tornadoes generate winds up to 300 mph
7. _____ Alto clouds are common high clouds
8. _____ Hail forms by melting on the way down, and then refreezing
9. _____ A front that has stopped moving is a stationary front
10. _____ Water passes through 5 phases during the water cycle

Directions: Fill in the blank to complete each of the following statements, using the list of terms below. You do not need to use every term in the list.

Hadley cells	cirrostratus	sprites
altocumulus	storm surge	air mass
evaporation	St. Elmo's fire	outflow shield
convection cells	tornadoes	mesocyclone
runoff	greenhouse gases	condensation
supercell	cirrostratus	humidity

11. Parts of the atmosphere that prevent heat from escaping Earth are called _____.
12. _____ is water flowing across the earth's surface.
13. A front is weather that occurs along the edge of an _____.

14. Strange glows attaching to high objects during storms are called _____.
15. Water enters a gaseous phase through _____.
16. _____ are large 30 degree wind patterns.
17. The Coriolis effect starts _____ rotating.
18. The most dangerous part of a hurricane is the _____.
19. The latest instrument to measure _____ is the sling psychrometer.
20. _____ clouds produces a halo effect around the sun and moon.

SCIENCE 803 TEST

Name _____

Date _____

Score _____

Directions: Read the following statements and decide whether each is true or false. If it is true, put T *in the blank, and if it false, put* F *in the blank.*

1. _____ Water in the atmosphere condenses directly into rain droplets
2. _____ Geostationary satellites are satellites that rotate with the Earth
3. _____ The easterlies flow towards the East
4. _____ All lightning is forked lightning
5. _____ Hurricanes have the power of 500,000 atom bombs
6. _____ Cold fronts move more slowly than warm fronts
7. _____ The doldrums are places where ships can get stranded
8. _____ The Coriolis effect makes a tornado start to rotate
9. _____ Mackerel skies are caused by a phenomenon called wind shear
10. _____ Hurricanes begin in a fair weather field

Directions: Match the term from the list below to the correct description. You do not need to use all the words in the list.

easterlies	hail	occluded front
tropical storm	convection cell	runoff
cumulus clouds	greenhouse gases	vertical clouds
fair weather field	altostratus clouds	Coriolis effect
westerlies	storm surge	gustnado
stationary front	low clouds	sleet

11. _____ A spinning dust cloud at the front of thunderstorms
12. _____ A mixture of warm and cold fronts

13. _____ Clouds that rise at a speed of 100 mph
14. _____ Parts of the atmosphere that prevent heat from escaping it
15. _____ Wind blowing in a circular way due to the uneven heating of the land
16. _____ Clouds that look like piles of cotton balls with flat bases
17. _____ Rise in sea level during a hurricane
18. _____ A positively charged surface and a negatively charged atmosphere
19. _____ Winds around the polar regions of the Earth
20. _____ Ice kept in a cloud by intense updrafts

Directions: Choose the best answer for each of the following questions. Put the letter beside the answer in the blank.

21. _____ Lightning that only occurs inside a cloud is called:
    a. a sprite
    b. sheet lightning
    c. heat lightning

22. _____ Wind speed is measured by an:
    a. hygrometer
    b. weather vane
    c. anemometer

23. _____ A cold, moist air mass is probably a _____ air mass.
    a. maritime polar
    b. maritime tropical
    c. continental polar

24. _____ Latent heat could also be called:

a. invisible heat
b. stored heat
c. tangible heat

25. _____ Huge wind patterns that extend 30 degrees in latitude are called:
a. Hadley cells
b. jet streams
c. cold fronts

26. _____ _____ of Earth's rainfall falls back into the ocean.
a. 23%
b. 55%
c. 77%

27. _____ The word *stratus* means:
a. puffy
b. layer
c. moist

28. _____ Hurricanes usually measure _____ across.
a. 200-500 miles
b. 100-300 miles
c. 20-50 miles

29. _____ Air that has as much water vapor leaving it as going in is:
a. evaporated
b. occluded
c. saturated

30. _____ A high altitude, strong passage of air at the boundary of Hadley cells is called:

a. a westerly

b. a jet stream

c. a low pressure gust

Directions: Draw the weather map symbol for each of the following weather conditions.

31. overcast _____

32. drizzle _____

33. stationary front _____

34. fog _____

35. fair sky _____