



Water Matters!

Saving Your Water through Science

Southwest Florida
Water Management District



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Student Name

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Welcome to the “*Water Matters!*” curriculum developed by the Southwest Florida Water Management District (SWFWMD). The SWFWMD manages the water resources for west-central Florida as directed by state law. It was established in 1961 as a flood protection agency. Since then, its responsibilities have grown to include managing the water supply, protecting water quality and preserving natural systems that serve important water-related functions.

The “*Water Matters!*” student publication provides information to help you become a good steward of Florida’s precious water resources. When reading this publication, pay attention to vocabulary words in the text that appear both *italicized* and in **bold**.

Check out WaterMatters.org/Education for additional water-related resources.

Email WaterEducation@WaterMatters.org with questions or comments.

Introduction



Water is one of the most common and precious substances on Earth. Water is found in three forms: solid, liquid and gas. In all three forms water is essential for human life and the environment.

No matter how old we are or where we live, we need clean, fresh water to keep us alive and healthy. With a limited water supply and a growing population, it is important to use our water carefully and protect it from pollution.

As you read this publication, you will learn about the many paths water can take and how water affects weather. You will compare and contrast weather to climate and explain how the different types of extreme Florida weather impact the environment.

Section One: The Hydrologic Cycle

One of the first things each of us does every morning when we wake up is use water. We use water to brush our teeth, wash our faces and prepare breakfast. But where does this water come from?

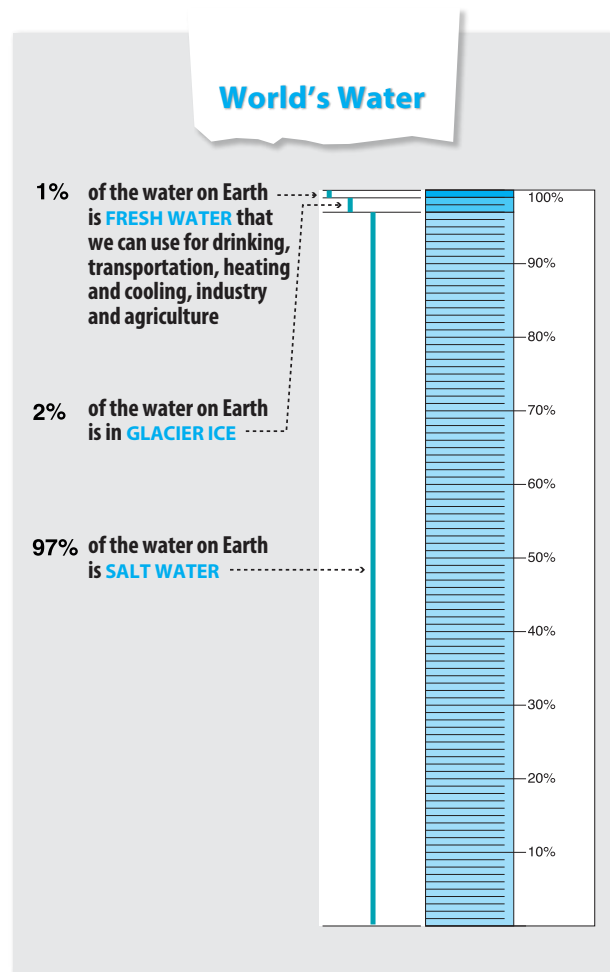
Nearly all of the water on Earth is salt water. Oceans cover 71 percent of the earth's surface and contain 97 percent of the planet's surface water — water that stays on top of the earth's surface. Less than three percent is fresh water, and most of this water is locked in frozen glaciers and polar icecaps. Less than one percent of the world's water is fresh water available for humans and nature to use.

You probably already know your body needs water to survive. More than 65 percent of your body is water. Water helps cleanse your systems and carries vital nutrients and oxygen to different parts of your body. While water is necessary for your survival, it also provides recreational opportunities and economic support for many people. Humans are not the only ones who need water. Animals and plants also need it to survive. Both humans and the environment depend on clean water.

Do you know where the water you use every day comes from? Water is always on the move. It falls from the sky as rain, hammers the coastline as waves, trickles through crevices 1,000 feet underground, vaporizes and rises slowly into the clouds. Even water buried under thousands of pounds of ice in the polar icecaps is on the move — its movement is slow, sometimes taking thousands of years to budge even a few inches.

All of the water in our environment recycles itself over and over again with no beginning and no end. This process is called the **hydrologic cycle** or **water cycle**. The amount of water that travels through the water cycle is constant. It always stays the same.

We observe the water cycle in action every day. Water disappears right before our eyes — puddles



dry up, dishes dry on a dish rack and we even dry off after swimming by standing in the hot sun. Where do you think the water goes? Even though you cannot see the water anymore, it still exists. Water molecules are constantly moving. Some move so fast they break away from other water molecules and change into an invisible gas called **water vapor**. This is the process of **evaporation**.

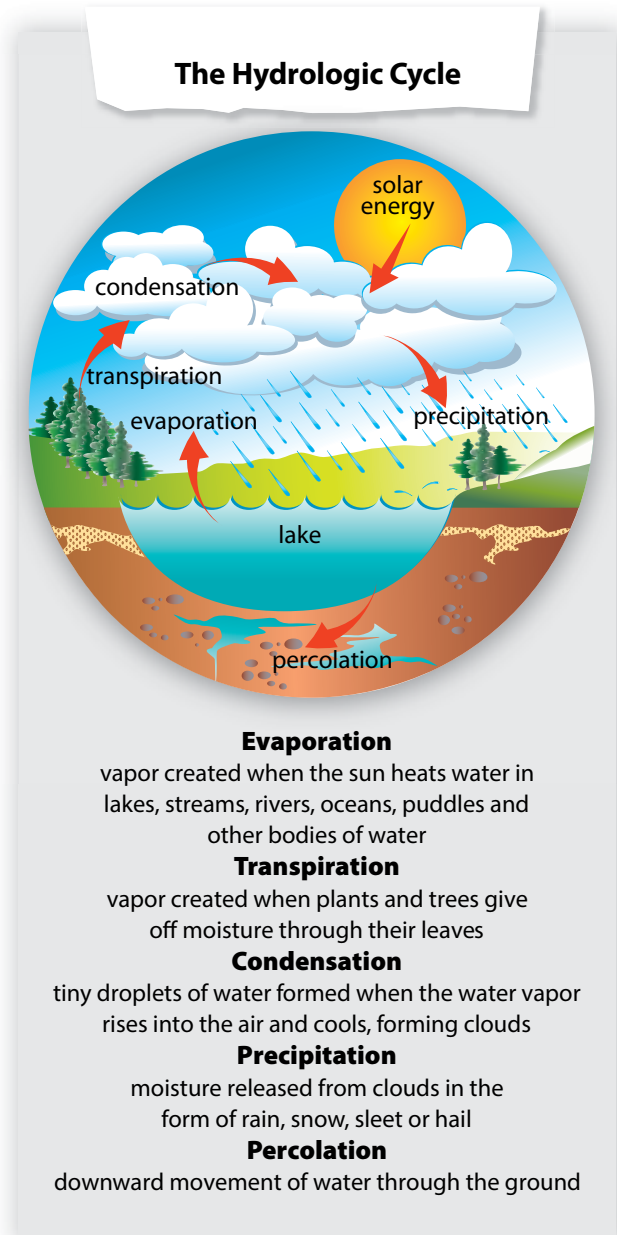
Heat from the sun, or solar energy, is the driving force of the water cycle. When the sun warms surface waters in rivers, lakes and oceans, some of the water evaporates. This water is released into

the air and takes the form of vapor. Water also is released into the air by plants through **transpiration**. Transpiration is a plant's way of cooling itself, much like how humans sweat to cool the surface of the skin.

When water vapor from evaporation and transpiration mix with air, we refer to it as **humidity**. Humidity can make a hot day feel even hotter! The amount of humidity in the air affects evaporation. When the air is dry, water evaporates faster than when it is humid. Temperature also affects the rate of evaporation. As water warms on hot days, water molecules move faster, making water evaporate faster. On cold days, water molecules move slower; therefore, the rate of evaporation is slower.

When water vapors meet the colder air higher in the sky, they form tiny water drops that stick together to make clouds. This process is called **condensation**. When clouds become full and heavy, they release the water back to Earth through **precipitation**. In Florida, precipitation is most often in the form of rain, but precipitation can also be snow, sleet or hail.

As water returns to Earth, some of it may end up in oceans, rivers and lakes. Holding so much of the world's water, oceans are an important part of the hydrologic cycle and are connected to all surface waters through precipitation and evaporation. Other precipitation returning to Earth may evaporate quickly, be absorbed by plants, or soak into the ground in a process called **percolation**. Water that percolates into the ground is called groundwater, and groundwater supplies more than 80 percent of the drinking water in west-central Florida.



Humidity

Humidity plays an important role in weather and climate. The formation of clouds and the start of rain are affected by humidity. Warmer air contains more water vapor. When the air cools, the water vapor in it condenses to form clouds, fog or dew.



The Hydrologic Cycle Vocabulary Review

Choose one of your new vocabulary words to complete the following graphic organizer.
Share with your group.

NEW WORD:

Definition

Picture

Synonyms

Antonyms

Context

Sentence

The graphic organizer consists of several sections: a grey box for the new word, a blue box for the definition, a light blue box for a picture, a light blue lined box for synonyms, a grey lined box for antonyms, a light blue box for context with a paperclip icon, and a grey box for a sentence with a paperclip icon.

Section One: Questions

1. Using what you know about the hydrologic cycle, how would pollution be a problem to the public?

2. What can affect the rate of evaporation?

3. Your breath contains water vapor. Why can you sometimes see your breath when it is cold outside?

4. How are oceans connected to other surface waters on Earth?

Section Two: Weather and Climate

Weather

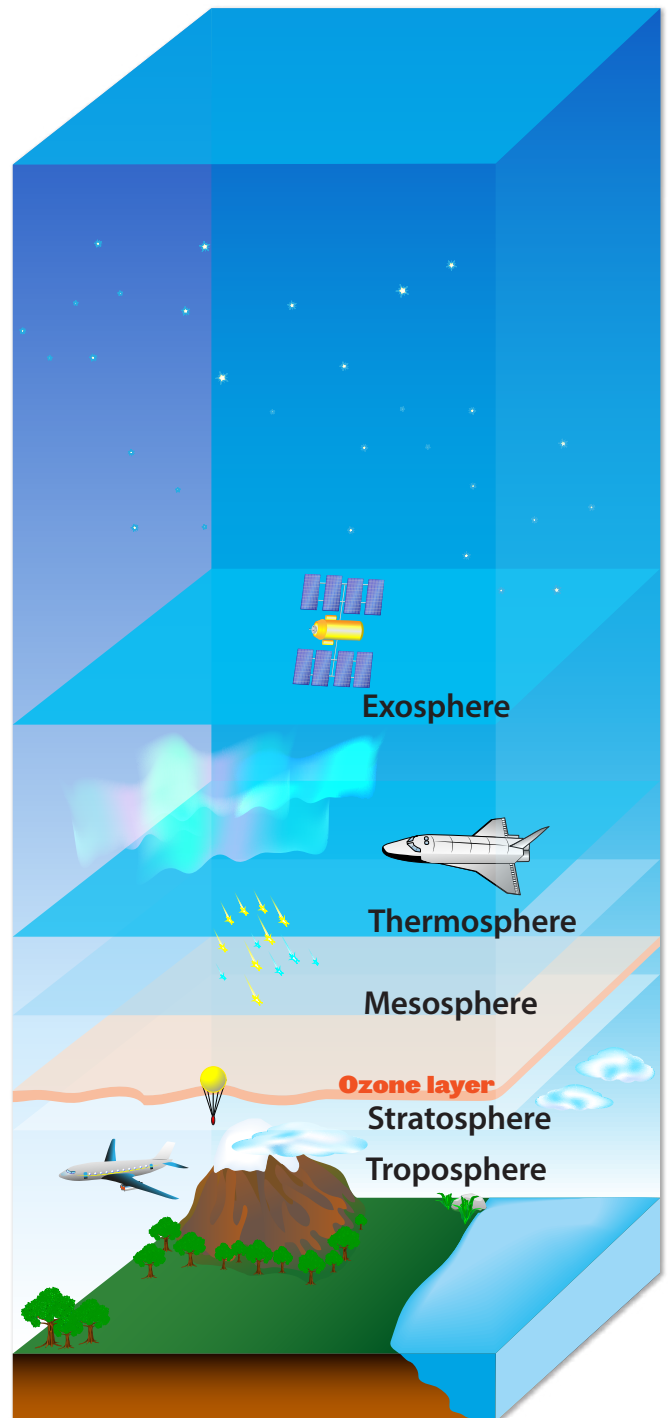
In Florida, we experience some of the wildest weather in the world! Although snowy blizzards are very unlikely, Florida does have hurricanes, tornadoes, waterspouts, heavy rain showers and numerous lightning strikes. What exactly is weather? **Weather** is what it is like outside on any day at any moment. Weather in a particular location depends on air temperature, air pressure, fog, humidity, cloud cover, precipitation, and wind speed and direction.

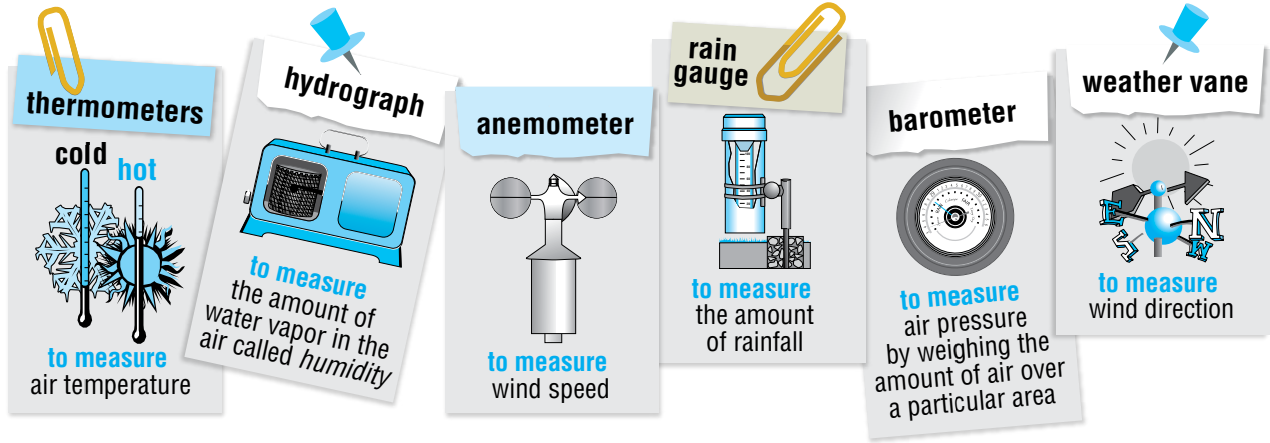
Weather can change rapidly. Weather changes are caused when different kinds of air masses meet. When air masses of different temperatures and densities meet, they do not mix well and a **front** is formed. A weather front may bring precipitation in the form of rain, snow, sleet or hail. In west-central Florida, precipitation will most likely be rain showers. Weather patterns affect how much and how frequently water returns to Earth. Therefore, weather patterns affect the availability of water for our use.

The hydrologic cycle plays an important role in weather. As the sun heats the earth's surface, water evaporates into the atmosphere where it condenses to form clouds. Eventually, some form of precipitation is created, which then returns to the earth. Nearly all weather develops within the **troposphere**, an eight-mile atmospheric layer surrounding the Earth. Changes in the weather are caused when different kinds of air masses meet.

Meteorologists, or scientists who study and forecast weather, use basic instruments such as **thermometers**, **hydrographs**, **weather vanes**, **anemometers**, **barometers** and **rain gauges**. See the table on the next page to learn more about these. Meteorologists also use high-powered computer systems to monitor weather patterns. High-tech tools such as satellites and Doppler radar systems are used with weather balloons, ocean buoys and other instruments. The weather updates that we receive on our cell phones, computers, radios and televisions are accurate and up to date because of these powerful advances in technology.

The Atmosphere





Climate

Although almost anything can happen with the weather, climate is more predictable. **Climate** refers to the weather patterns that take place in an area over a long period of time.

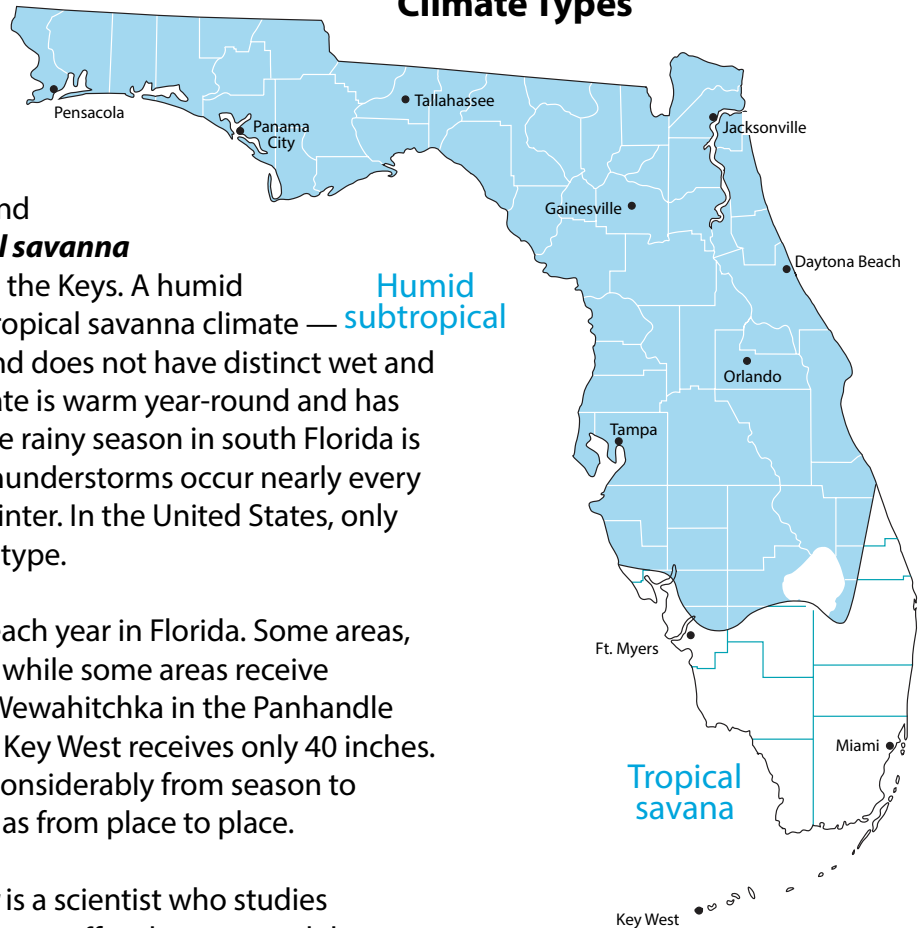
Florida has two types of climate:

humid subtropical in the northern and central parts of the state and **tropical savanna** in the southern part of Florida and in the Keys. A humid subtropical climate is cooler than a tropical savanna climate — especially in the winter months — and does not have distinct wet and dry seasons. A tropical savanna climate is warm year-round and has very distinct wet and dry seasons. The rainy season in south Florida is in the summer and early fall, when thunderstorms occur nearly every afternoon. The dry season is in the winter. In the United States, only portions of Hawaii share this climate type.

An average of 53 inches of rain falls each year in Florida. Some areas, however, receive considerably more, while some areas receive considerably less than this amount. Wewahitchka in the Panhandle receives an average of 69 inches and Key West receives only 40 inches. Rainfall throughout the state varies considerably from season to season and from year to year, as well as from place to place.

Like a meteorologist, a **climatologist** is a scientist who studies weather patterns and how these patterns affect humans and the environment. However, a meteorologist focuses on short-term weather conditions such as predicting if it will rain in the next day or two. A climatologist predicts whether climate patterns will cause more or less rainfall in the next year. One topic of interest that climatologists discuss is **global warming**. Global warming, which is caused by human activities such as burning fossil fuels, is the increase in the earth's temperature. This increase causes climate changes.

Climate Types



Source: Henry 1998

Weather and Climate Vocabulary Review

Use the chart to write your new vocabulary words in Morse Code.



Morse Code Alphabet

| | |
|------------|-----------|
| A | · · · |
| Ā | · · · · · |
| B | · · · · · |
| C | · · · · · |
| D | · · · · · |
| E | · |
| E | · · · · · |
| F | · · · · · |
| G | · · · · · |
| H | · · · · · |
| I | · · |
| J | · · · · · |
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| 0 | · · · · · |



weather _____

front _____

troposphere _____

meteorologists _____

thermometers _____

hydrographs _____

weather vanes _____

anemometers _____

barometers _____

rain gauges _____

climate _____

humid subtropical _____

tropical savana _____

climatologist _____

global warming _____

Section Two: Questions

1. Pretend your school has decided to set up its own weather station. What equipment and supplies would be needed to monitor weather conditions in your area? Explain your reasons for your choices. Include what each piece of equipment measures?

2. What is the difference between weather and climate?

3. Explain the importance of understanding the weather and the climate as you plan for a family vacation.

4. How does the hydrologic cycle affect weather and climate?

5. What are the two types of climates in Florida and how are they different? Which of the two types of climates does our area of Florida have?

Section Three:

Extreme Weather

Droughts, hurricanes, tornadoes and thunderstorms are extreme weather events well recognized in Florida. Thunder and lightning are so frequent in our region that Florida is considered the thunderstorm capital of North America! Thunder is the sound lightning makes as it suddenly heats the air. We can determine how far away a storm is by counting the seconds between seeing the flash and hearing the thunder. For every five seconds counted, a storm is one mile away. This counting method may give you enough warning to head for cover in a storm.

Droughts

Florida is dependent upon rainfall, but rainfall amounts vary a great deal between seasons. Approximately 60 to 65 percent of our annual precipitation occurs between June and September.

But what happens when there is not enough rain? A **drought** occurs. A drought is a period of time during which precipitation is much lower than average for that time of year at that particular place. A drought may cause water tables in the aquifer and the water levels in streams and rivers to decrease, and it may cause soil to become dry.

Droughts have a serious impact on the environment. Plants and crops suffer from the unusually dry weather. Wildlife are challenged with finding enough water to survive. In extremely dry conditions, wild fires ignite more easily and spread quickly.

Droughts are a challenge for people, too. We all use water every day. During drought conditions, it is especially important that all water users, not just businesses and farmers, understand and practice water conservation. Residents may be asked to reduce their daily water use. Sometimes, rules are even established to limit water use such as reduced lawn watering.

When rain does fall, people may stop conserving water because they think the drought is over. However, a serious drought could still be in effect, and water levels in the aquifer could still be low. Remember, groundwater held in aquifers supplies more than 80 percent of the drinking water in west-central Florida.

Much rainfall is lost to evaporation and transpiration, which are phases of the hydrologic cycle. Often, the remaining precipitation that percolates into the ground is not enough to recharge aquifers. Continued conservation is important when water levels remain lower than average. It's best to make water conservation a habit no matter what the weather conditions.



Drought

Hurricanes

Florida's subtropical climate and location make it especially attractive for many types of weather disturbances. Florida is almost completely surrounded by warm water, which makes it especially vulnerable to **hurricanes**. In fact, more hurricanes have occurred in Florida than any other state.

In 2004, hurricanes Charley, Frances, Ivan and Jeanne produced widespread wind and flooding damage estimated at more than \$20 billion. Florida has had a long and harsh hurricane history. Over the centuries, thousands of its residents have perished from the deadly effects of hurricane winds and flooding.

A storm is considered a hurricane when it can sustain wind speeds of 74 miles per hour or higher. For more than 50 years, hurricanes have been assigned names to allow everyone to communicate information about a particular storm more easily. There are six alphabetical lists of names that are rotated each year and recycled every six years. Influential hurricanes have their names retired.

Like all other winds, hurricane winds are caused by differences in **atmospheric pressure**. A hurricane is a low-pressure system that forms in the tropics. It begins with a storm developing over warm surface waters. As warm air rises within the center of a storm, it creates an updraft. The surrounding air is attracted to the storm's center, where it rises and causes the pressure to drop. The updraft continues to spin and strengthen as more air is drawn in from larger and larger areas surrounding the storm system.

A hurricane can span from 200–500 miles over a body of water! As the column of air turns faster and faster, it becomes a tropical revolving storm and can potentially develop into a hurricane with various levels of intensity (see chart below). When a powerful hurricane approaches coastal areas, violent winds and heavy rains pound everything in its path.

Also, a huge wall of water known as a **storm surge** may cause extensive flooding inland. The hurricane eventually loses its energy as it passes over land. Almost all hurricanes making landfall in the United States spawn at least one tornado.

Categories of Hurricanes Using the Saffir-Simpson Scale

CATEGORY 1

Wind Speed Above Normal 74–95 mph
Height of Tide 4–5 ft
Damaging Effects: *shrubs, mobile homes, docks, small boats damaged*

CATEGORY 2

Wind Speed Above Normal 96–110 mph
Height of Tide 6–8 ft
Damaging Effects: *small trees uprooted; roofs and mobile homes damaged; coastal roads flooded*

CATEGORY 3

Wind Speed Above Normal 111–130 mph
Height of Tide 9–12 ft
Damaging Effects: *large trees uprooted; mobile homes destroyed; roofs and parts of homes damaged; coastal areas flooded*

CATEGORY 4

Wind Speed Above Normal 131–155 mph
Height of Tide 13–18 ft
Damaging Effects: *roofs, windows and parts of homes seriously damaged; beach erosion; inland flooding*

CATEGORY 5

Wind Speed Above Normal More than 155 mph
Height of Tide More than 18 ft
Damaging Effects: *some buildings destroyed, many homes damaged; massive evacuations*



Most Floridians are familiar with the hurricane season, which runs each year from the beginning of June until the end of November. Unlike some other weather patterns, hurricanes can last for several days or even weeks. It is no surprise that hurricanes cause more destruction than any other type of storm on Earth, but did you know that hurricanes can also have a positive effect on the environment? A hurricane can provide much-needed rain to an area. It can also play an important role in transferring heat from one region to another. As a hurricane system gradually moves forward, it draws heat and energy away from the equator and pushes it toward cooler areas.

In Section Two, you learned about meteorologists and climatologists. Have you ever heard of **Hurricane Hunters**. Hurricane Hunters are people who fly into the middle of a hurricane, and they work for the National Oceanic and Atmospheric Administration (NOAA). Every time the crews pass through the hurricane, they measure temperature, air pressure and wind speed, using sophisticated computers and instruments. Using the data collected, Hurricane Hunters can warn everyone in the hurricane’s path.

Tornadoes

A **tornado** is a rapidly spinning tube of air that touches both the ground and a cloud at the same time. This spinning tube of air is called a vortex and may be as narrow as a rope or as large as a shopping mall. Tornadoes form when warm and cold air masses collide. Tornadoes, also called twisters, can occur all over the world. If a tornado occurs over water, it is called a waterspout.

Like hurricanes, tornados can have a negative effect on the environment and our water supply. Tornadoes result in habitat loss for species as trees are uprooted and vegetation is destroyed. One of the most dangerous man-made materials used in the construction industry was asbestos. If a tornado destroys an older home that has asbestos, this toxic material can spread over great distances and pollute the soil and water supply. Hazardous household materials and chemicals also can contaminate our water supply as they are washed into stormwater

drains and surface water bodies creating a toxic environment for flora (plants) and fauna (animals).

Tornadoes are classified according to the destruction they leave in their paths. The Fujita Tornado Intensity Scale, or F-scale, is used to describe the various levels of destructive power produced by these violent twisters. The most common types of tornadoes rank F0–F2 on the scale. No tornado has ever been reported on an F6 level.

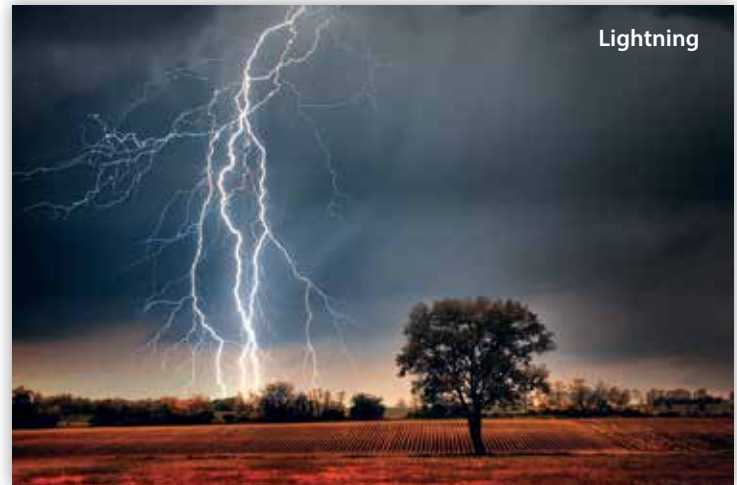
| Wind Estimated Scales | |
|------------------------------|--|
| F0 | |
| Wind Estimate | <73 mph |
| Light Damage: | <i>some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.</i> |
| F1 | |
| Wind Estimate | 73-112 mph |
| Moderate Damage: | <i>Peels surface off roofs; mobile homes pushed off foundations or overturned; moving cars blown off roads.</i> |
| F2 | |
| Wind Estimate | 113-157 mph |
| Considerable Damage: | <i>Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</i> |
| F3 | |
| Wind Estimate | 158-206 mph |
| Severe Damage: | <i>Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.</i> |
| F4 | |
| Wind Estimate | 207-260 mph |
| Devastating Damage: | <i>Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.</i> |
| F5 | |
| Wind Estimate | 261-318 mph |
| Incredible Damage: | <i>Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yds); trees debarked; incredible phenomena will occur.</i> |

Thunderstorms and Lightning

A **thunderstorm** is a storm where you see lightning and hear thunder. Most of the time there is heavy rain in a thunderstorm. These storms are formed when air has become very warm and heavy with water vapor. This heated air expands, rises and forms cumulonimbus clouds. When the cloud can hold no more water, the rain falls.

Every thunderstorm has lightning. Every second, about 100 lightning bolts strike different places around the world. Air rising to the top of thunderclouds carries a negative charge of electricity, while raindrops falling to the bottom of the cloud carry a positive charge. When these charges meet, electricity is sparked in the form of **lightning**. Lightning is one of the deadliest forces in nature. Throughout the United States, approximately 100 people are killed by lightning strikes every year.

A flash of lightning has heat that causes air to expand and contract. The sound of this expansion and contraction is the sound of thunder. Thunder is heard after lightning is seen because lightning causes thunder. It's also because light travels through air faster than sound does.



| Lightning Fiction or Fact | |
|---------------------------|---|
| FICTION: | If it is not raining, then there is no danger from lightning. |
| FACT: | Lightning often strikes outside of heavy rain and may occur as far as 10 miles away from any rainfall. This is especially true in the western United States where thunderstorms sometimes produce very little rain. |
| FICTION: | The rubber soles of shoes or rubber tires on a car will protect you from being struck by lightning. |
| FACT: | Rubber-soled shoes and rubber tires provide NO protection from lightning. The steel frame of a hard-topped vehicle provides increased protection if you are not touching metal. Although you may be injured if lightning strikes your car, you are much safer inside a vehicle than outside. |
| FICTION: | People struck by lightning should not be touched because they carry an electrical charge. |
| FACT: | Lightning-strike victims carry no electrical charge and should be helped immediately. Anyone who has been hit by lightning requires immediate professional medical care. Call 9-1-1 and begin CPR immediately if the person has stopped breathing. Use an Automatic External Defibrillator if one is available. Contact your local American Red Cross chapter for information on CPR and first aid classes. |
| FICTION: | "Heat lightning" occurs after very hot summer days and poses no threat. |
| FACT: | "Heat lightning" is a term used to describe lightning. |

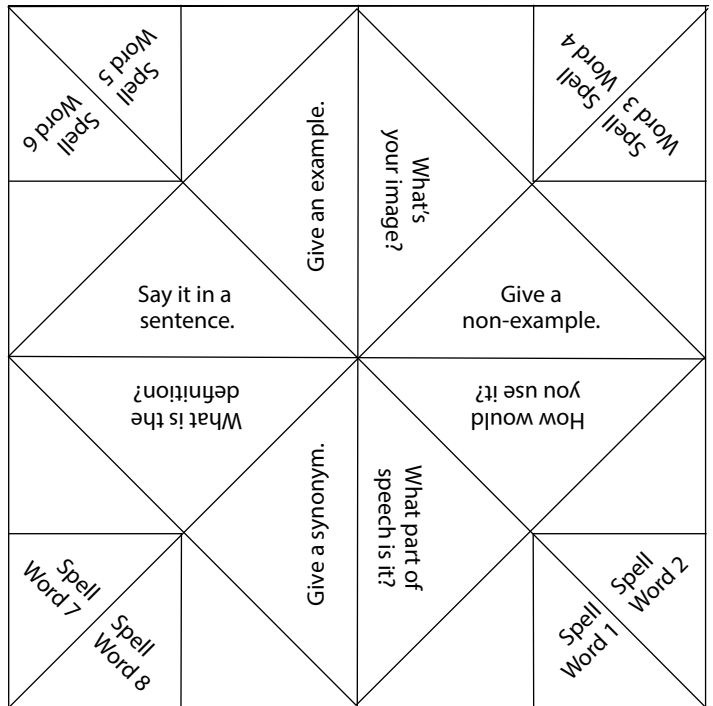
Source: [LightningSafety.NOAA.gov/Resources/tt16-10.pdf](https://www.lightningsafety.noaa.gov/Resources/tt16-10.pdf)

Extreme Weather Vocabulary Review

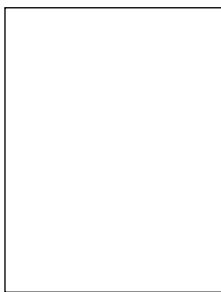
Vocabulary Cootie Catcher

Follow the folding instructions below to make a cootie catcher. Then use the template to the right to complete your cootie catcher and learn more about the vocabulary words from Section Three.

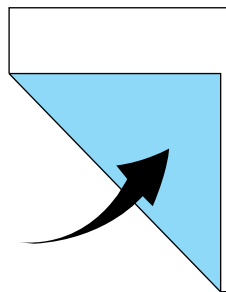
1. Drought
2. Hurricane
3. Atmospheric Pressure
4. Storm Surge
5. Hurricane Hunters
6. Tornado
7. Thunderstorm
8. Lightning



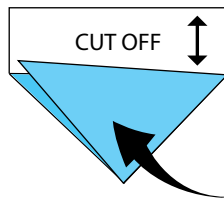
Cootie Catcher Folding Instructions



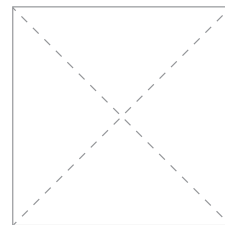
Use an 8.5" x 11" sheet of paper



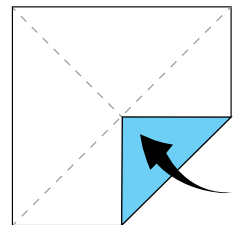
Fold corner up till it meets the side of the paper



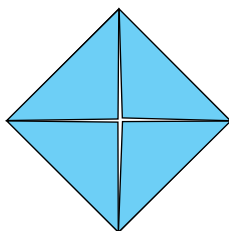
Fold the other corner up till it meets the other side – then cut off the the rectangle at the top



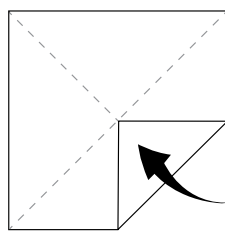
Unfold and you should now have an 8.5" x 8.5" piece.



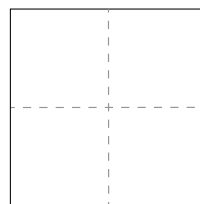
Fold up all four corners so that the points meet in the middle.



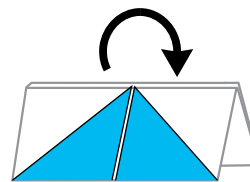
This is what it should look like.



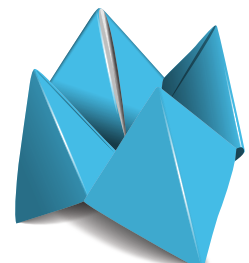
Flip it over. Fold up all four corners so that the points meet in the middle.



It should look like this now.



Now fold the top back.



Work your fingers into the four corners from the fold side. Work the creases to form the four points.

Section Three:

Questions

1. What are three examples of ways droughts can cause problems for Florida's residents?

2. Hurricanes are formed by warm tropical waters. What part does the sun play in the formation of hurricanes?

3. Do you hear thunder before you see lightning, or do you see lightning before you hear the thunder? Explain your answer.

4. Have you ever heard the saying, "The calm before the storm." What do you think this saying means?

Extension Activities

1. In a few paragraphs, describe how a drought can affect the hydrologic (or water) cycle, and then explain why it is important that water users understand and practice water conservation, especially during drought conditions. What would you do if you were in charge of making sure people have enough water to drink?

2. Design a new weather forecasting instrument that will be able to predict the weather faster and more accurately. How will your new instrument work?

3. Imagine you are a raindrop falling through the atmosphere. Write and describe your journey. Include the five phases of the hydrologic cycle in your writing as well as three or more vocabulary words found in this publication.
