

Wild Weather

Please share this guide with other teachers from your school who will be joining you on this trip.

Program Description: Science will take your students by storm as we study the mysteries that can be found in our own sky. Your students will feel the crackle of lightning, see clouds form out of nowhere, and watch what causes the force that drives hurricanes, while learning about the processes that occur in our atmosphere. Become a MOSH meteorologist and learn the science that happens in our skies.

Learning Objectives: At the end of this program students should have a better understanding of the following:

- How clouds and precipitation are formed through the condensation of atomic particles and molecules
- The formation and properties of lightning
- That thunder is a vibration in the atmosphere made from the contraction and expansion of the air
- The anatomy and characteristics of hurricanes and tornadoes

Pre-Visit Activities

1. Have the students watch a weather report on the news. Discuss anything that can be learned from this experience.
2. Discuss any hurricanes that the students have experienced. Talk about preparations taken for hurricanes, and what to do if a hurricane was headed towards Jacksonville.
3. Do some cloud-watching. Observe different types and shapes of clouds and what kind of weather they seem to bring with them.
4. Look at a map of the United States. Have the students locate places where they think hurricanes, thunderstorms, and tornados occur. Ask why they picked the locations they did.

Vocabulary (see below for definitions)

weather	meteorology	meteorologist	temperature	cloud
atom	condensation	electrons	pressure	cirrus
stratus	cumulus	cumulonimbus	lightning	

Post-Visit Activities

1. Keep a weather log. Have students watch weather reports on TV or read them in a newspaper. Keep a daily log of high and low temperatures, rainfall, dew-point, sky conditions, and note if any severe weather occurred. Have students make a correlation between what they saw on the news and what they experienced.
2. Visit the National Weather Service office in your area. In Jacksonville, the National Weather Service is located at the airport.
3. Do the activities included at the end of this guide.



Wild Weather Sunshine State Standard Benchmarks

SC.2.E.7.1	<p>Compare and describe changing patterns in nature that repeat themselves, such as weather conditions including temperature and precipitation, day to day and season to season.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p>
SC.2.E.7.2	<p>Investigate by observing and measuring, that the Sun's energy directly and indirectly warms the water, land, and air.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: High</i></p>
SC.2.E.7.3	<p>Investigate, observe and describe how water left in an open container disappears (evaporates), but water in a closed container does not disappear (evaporate).</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: High</i></p>
SC.2.E.7.4	<p>Investigate that air is all around us and that moving air is wind.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: High</i></p>
SC.2.E.7.5	<p>State the importance of preparing for severe weather, lightning, and other weather related events.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Low</i></p>
SC.5.E.7.2	<p>Recognize that the ocean is an integral part of the water cycle and is connected to all of Earth's water reservoirs via evaporation and precipitation processes.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p>
SC.5.E.7.3	<p>Recognize how air temperature, barometric pressure, humidity, wind speed and direction, and precipitation determine the weather in a particular place and time.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p>
SC.5.E.7.4	<p>Distinguish among the various forms of precipitation (rain, snow, sleet, and hail), making connections to the weather in a particular place and time.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: High</i></p>
SC.5.E.7.5	<p>Recognize that some of the weather-related differences, such as temperature and humidity, are found among different environments, such as swamps, deserts, and mountains.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p>
SC.5.E.7.6	<p>Describe characteristics (temperature and precipitation) of different climate zones as they relate to latitude, elevation, and proximity to bodies of water.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: High</i></p>
SC.6.E.7.2	<p>Investigate and apply how the cycling of water between the atmosphere and hydrosphere has an effect on weather patterns and climate.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: High</i></p>
SC.6.E.7.3	<p>Describe how global patterns such as the jet stream and ocean currents influence local weather in measurable terms such as temperature, air pressure, wind direction and speed, and humidity and precipitation.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: High</i></p>
SC.6.E.7.4	<p>Differentiate and show interactions among the geosphere, hydrosphere, cryosphere, atmosphere, and biosphere.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: High</i></p>
SC.6.E.7.5	<p>Explain how energy provided by the sun influences global patterns of atmospheric movement and the temperature differences between air, water, and land.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: High</i></p>
SC.6.E.7.6	<p>Differentiate between weather and climate.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p>
SC.6.E.7.7	<p>Investigate how natural disasters have affected human life in Florida.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: High</i></p>
SC.6.E.7.8	<p>Describe ways human beings protect themselves from hazardous weather and sun exposure.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p>
SC.912.E.7.4	<p>Summarize the conditions that contribute to the climate of a geographic area, including the relationships to lakes and oceans.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p>
SC.912.E.7.5	<p>Predict future weather conditions based on present observations and conceptual models and recognize limitations and uncertainties of such predictions.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: High</i></p>
SC.912.E.7.6	<p>Relate the formation of severe weather to the various physical factors.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p>

Wild Weather Vocabulary Definitions

Atom The smallest unit; the building blocks of life.

Stratus A sheet-like cloud low in the sky.

Meteorology The study of weather.

Condensation The liquid formed by lowering the temperature of a gas.

Cumulus Puffy, cotton ball-like clouds that we see on sunny clear days.

Meteorologist A person who studies weather.

Electrons Particles that have a negative charge.

Cumulonimbus A large storm cloud capable of producing lightning. These clouds extend from low to high in the sky.

Temperature The measurement of the energy of the particles in matter.

Pressure A drop in atmospheric pressure produces stormy weather; measured with a barometer.

Lightning A release of energy in the form of static electricity between a cloud and the ground.

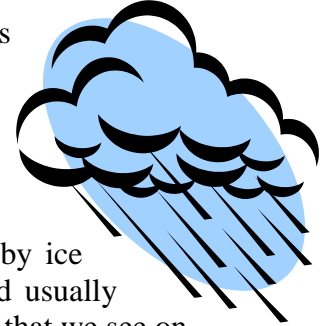
Cloud A dense body of gases, water vapor and dust that is affected by temperature, pressure and humidity.

Cirrus Whispy, feathery-like clouds that are high in the sky.

Below is a guide to the experiments performed in the Wild Weather program. At the end of this guide you will find several experiments, activities, and a list of resources to use in your classroom.

Clouds

A cloud is a huge grouping of ice crystals and water droplets, dust, and gas particles. Clouds hold so much water vapor that when there is too much and the droplets become too heavy they fall in the form of precipitation. There are many different types of clouds that can be seen during different weather phenomena.



Cirrus clouds are very high, wispy, feathery-like clouds usually formed by ice crystals. *Stratus* clouds are like big grayish sheets that cross the sky and usually signal that precipitation is coming. *Cumulus* clouds are large fluffy clouds that we see on beautiful, blue sky days. *Cumulonimbus* clouds are large “anvil-like” storm clouds – attaching “nimbus” to any cloud type will turn it into a storm cloud.

Precipitation



Since we could not make rain in the JEA Science Theater at MOSH, the students helped to describe the four main types of precipitation that fall due to the water cycle: rain, sleet, hail and snow. Temperature and other atmospheric conditions are the main factors in determining which kinds will fall, but most types of precipitation begin as ice crystals which melt as they fall through warmer air.

When water droplets inside of clouds grow too large, they fall in the form of rain. Florida’s average rain fall is 50-55 inches per year, making it one of the wettest states in the country. Sleet is rather unique in that it is frozen raindrops that bounce when they hit the ground; it is difficult to predict when sleet will fall as very specific atmospheric conditions produce it. Hail is a frozen raindrop that can be very small or as large as a grapefruit. Strong thunderstorms produce hail because their updrafts continue to suck the raindrops back up into the system, whereby adding more and more layers of frozen water that will eventually fall when too heavy. Snow is just a huge group of ice crystals that clump together as it falls. It requires that temperatures fall below 32°F in order for the water droplets to freeze and turn into crystals. The last time it snowed in Jacksonville was 1989.



Lightning



Gas, dust and water particles within the cloud bounce around and rub off electrons to create static electricity. The electrons settle to the bottom of the cloud and the protons float to the top; this causes a separation of charge within the cloud enabling static electricity to form. Lightning can occur within the cloud, between clouds or between cloud and ground. Although it seems like lightning strikes the ground, it actually comes from the ground! The positive charges from the ground, trees, buildings, etc. attract the negative charges from the clouds generating huge releases of stored energy in the form of lightning.

Our Van de Graaff Electrostatic Generator (Sparky) creates high voltage static electricity demonstrating the power of lightning. The shock circle is a good example of the speed that static can travel (about 31,000 miles/second) and how our bodies react to the shock. We feel our arms tense because the shock contracts our muscles. If a real bolt of lightning were to strike us, our whole body would contract and our heart may even stop beating due to the high voltage and amperage.

Thunder

The Hydrogen balloon experiment simulates how lightning makes thunder by heating the air to create sound waves. Hydrogen is a highly flammable gas that when close to fire will make a huge explosion. Hot air expands and cold air contracts; therefore, the fire from the balloon exploding will make the air surrounding it hot enough to make a sound wave. The temperature of lightning is around 55,000°F, so it is definitely hot enough to make the air around it quickly expand and contract to generate the shockwave we know as thunder.



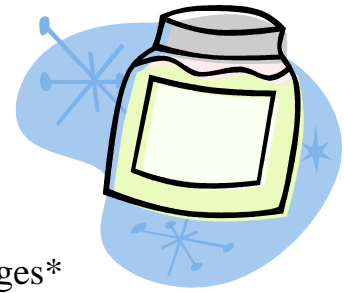
Hurricanes/Tornadoes

The chair and weights help us to discuss the conservation of angular momentum principle that Sir Isaac Newton proposed, which is very useful in understanding circular storms like hurricanes and tornadoes. It states that a rotating object tends to stay in motion until acted upon by an outside. A hurricane can reach top speeds of 130-150 mph because there is more weight distributed to the outside of the storm, whereas a tornado can move much faster and reach speeds 200-300 mph. The more compact the storm is, the faster the vortex will spin and the more organization it will have. As the volunteer is spinning, if he/she brings their arms out to the side, they will noticeably slow down and disorganize; however, keeping their arms close to their chest will allow the speed to continue, proving Newton's law correct.



These storms are very dangerous and cause tremendous amounts of destruction. Hurricanes and tornadoes have a lot in common; they both are violent, cyclonic storms that have an "eye". However, there are more differences as shown in the table below.

	Hurricane	Tornado
Develop?	Ocean	Water or land
Size?	>100 miles across	>100 yards across
Eye?	Calm	Dangerous
Damage?	Water/flood related	Wind related
Lifespan?	5-7 days	3 hours max



The Leyden Jar

A device for collecting and storing charges

BACKGROUND:

The Leyden Jar was invented independently by EG Von Kleist and Professor van Musschenbroek of Leyden University in 1745. At that time it was believed that electricity was an invisible fluid. Kleist attempted to get a glass of electricity by connecting a static generator to a wire that ran into an empty glass. After running the generator, Kleist disconnected the glass and found that it was still empty. He then thought that perhaps electricity dissolved in water and so he repeated the experiment with the glass filled with water. Once again he did not achieve the desired results and considered the experiment a failure. When he went to remove the wire from the glass, there was a spark and he received a large shock. The idea was born.

In Holland, Professor van Musschenbroek was trying to do the same thing. After repeated failures, his assistant Cuneus tried charging the water while holding the glass in his hand. This also led to a spark and a large shock. Professor van Musschenbroek wrote of the experiment and was given credit for the invention of the Leyden Jar, the forerunner of the modern capacitor.

Leyden Jars played a large part in early experiments with electricity, including many done by Benjamin Franklin. He used them for a variety of experiments, including his famous experiment using a kite to show that lightning was actually static electricity.

Make Your Own Leyden Jar:

Materials needed: glass or plastic drinking glass, aluminum foil, charging device (television)

Procedure:

1. Cut two squares of foil, each a little taller than your glass and long enough to reach around it with about an inch of overlap.
2. Take one piece and wrap it around the glass, leaving about half an inch of the glass bare above the foil
3. Crush the bottom of the foil to cover the bottom of the glass
4. Shape and smooth the foil until it fits around the glass as smoothly as possible.
5. After smoothing the foil, carefully remove it from the outside of the glass and place it inside. There should still be a bare gap above the top of the foil.
6. Repeat steps 1-4 with the second piece of foil, making the foil as smooth as possible. Don't worry about small tears, just push the foil back together and smooth it down.
7. Cut a third strip of foil about an inch wide and 10-12 inches long. Crumple one end into a ball.
8. Remove the inner foil from the glass and insert the small foil strip with the ball above the edge of the glass.
9. Place the inner foil back into place making sure that the ball of foil is still above the edge of the glass. Your Leyden Jar is now complete.

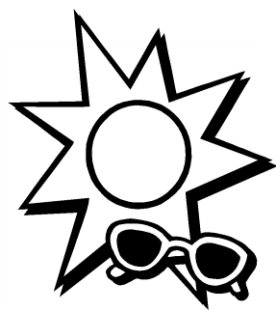
To charge your Leyden Jar, turn on a tube television, hold the jar in your hand and move the ball of foil back and forth across the screen to collect the charge. You could also rub a balloon on your hair and bring the charged balloon close to the top of the jar. After 30-40 repetitions, you should be able to get a spark to be felt easily.

WHY?? As the spark jumps to the ball, it tries to spread evenly over the foil. Due to the “skin effect”, all of the charge moves to the outer surface of the inner foil and the top of the foil ball, leaving the inner side with no charge. The buildup of charge next to the non-conducting glass has a polarizing effect. Like charges are pushed away, and opposite charges are attracted. Excess charges on the outside of the glass are drained away by the outer foil and conducted to the ground by way of the hand and body. If the outside foil is not grounded, very little charge will accumulate in the jar.

Because the foil ball extends beyond the foil liner, it will have a charge equal to the outer surface of the inner foil. As you bring your knuckle close to the ball, a spark will jump. This drains the charge from the ball and the foil.

Problems?? If you have problems getting a spark from your Leyden Jar, try drying it with a hair dryer. You may need to collect several sparks before trying to draw a spark to your knuckle. Also check to be sure that the foil liners are as smooth as possible. Be sure that there is at least a one inch gap between the foil and the top of the glass on the inside and outside. This will prevent the charge from arching over the top.

Adapted from “The Science Education Book of the Van de Graaff” by Robert Kramph. 1991. The Science Education Company.



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Recommended Reading

Gibson, Gary. *Understanding Electricity*. Copper Beech Books: Brookfield, 1995

Graf, Michael. *Weather Wise: Hands on Activities for Understanding the Weather*. Judy/Instructo: Torrance, CA, 1998.

Jones, Lorraine. *Super Science Projects about Weather and Natural Forces*. Rosen Group Publishing Group, Inc.: New York, 2000.

Kahl, Jonathan D.W. *Weather Watch: Forecasting the Weather*. Lerner Publications: Minneapolis, 1996.

Lyons, Walter A. *The Handy Weather Answer Book*. Accord Publishing: 1997.

Michaels, Pat. *W is for Wind: A Weather Alphabet*. Thompson Gale: 2005.

Parker, Steve. *Eyewitness Books: Electricity*. Dorling Kindersley: New York, 2000.

Roza, Greg. *It's Electric*. The Rosen Publishing Group: New York, 2003.

Wilmore, Kathy. *Exploring Weather*. Kidsbooks, Inc.: Chicago, 2000.

Recommended Websites

www.weatherkidz.com

<http://home.howstuffworks.com/weather-experiments-for-kids.htm>

<http://eo.ucar.edu/webweather/activities.htm>

www.theweatherchannelkids.com

Static Activities

Principles of Static

Make your own static

Place a tin tray on a polyethylene bag and use clay as a handle to rub the tray around. Don't touch the tray-use the handle to lift it. Hold a fork near the edge. A spark of static electricity will jump from the tray to the fork.

Making static electricity

You do not need a laboratory or special equipment to make static electricity. Your experiment can be as simple as combing your hair. Run a plastic comb through your hair a few times or rub it hard with a piece of woolen fabric. Then hold the comb near some tiny scraps of tissue paper. Rubbing the plastic builds up a static charge in the comb that attracts the tissue scraps. Try the same experiment with different plastic items. It works with pens, straws, and balloons.



Sticky balloons

This is a very easy investigation that shows static electricity in action. Blow up some balloons and rub them hard on a wool sweater. Hold the balloons against a wall. The balloons seem to stick on the wall as if by magic. What is happening is that the static charges on the balloons is different from the static charge on the wall, and opposite charges attract one another. The balloons are held against the wall until the charge gradually leaks away and the balloons slip to the floor.



Bending water

Use you balloon once more, but this time charge up your balloon by rubbing it hard on a wool sweater, then hold it near a running tap. The water is attracted towards the charged balloon and you can see the flow of water bending towards it.

Log Rolling

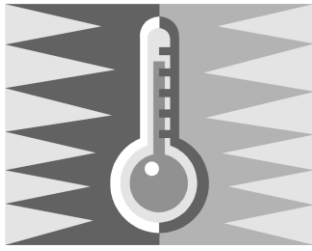
Put some drinking straws on a table. Charge a plastic pen with static by rubbing it with a wool cloth. Hold the pen close to the straws and watch them roll away. The straws and pen are both plastic and have the same static charge. Things with the same charge repel each other, so the pen pushes the straws away.



Weather Chart

Name _____

Date					
Time					
Guess High Temperature (F)					
Guess Low Temperature (F)					
Actual High Temperature (F)					
Actual Low Temperature (F)					
Current Temperature (F)					
Cloud Type					
Air Pressure					
Relative Humidity: Morning					
Relative Humidity: Afternoon					
Wind Direction					
Wind Speed					
Daily Rain					
Total Rain					
Prediction					



Make a Thermometer

Purpose: To make a thermometer and observe how it works

Materials:

small plastic film canister	ice	pencil
modeling clay	small bowl	oil
clear plastic straw	thermometer	tape
scissors	index card	medicine dropper
food coloring	timer	markers
water		

Method:

1. Fill the film canister 2/3 full with water and add food coloring.
2. Carefully poke a hole into the canister's lid, using pointed scissors
3. Put the straw through the lid's hole.
4. Put the lid on the canister, making sure that the straw does not touch the bottom of the canister.
5. Use clay to seal the lid and straw.
6. The colored water should rise up about an inch above the lid in the straw. If it doesn't, add a few drops of water into the straw until it is an inch above the lid.
7. Add some oil on top of the water in the straw to keep it from evaporating.
8. Tape an index card to the straw. Draw a line at the water level mark and label this "Room Temperature".
9. Use a regular thermometer to measure the room's temperature and record it on the index card.
10. Put both thermometers on a window sill in the sun for an hour.
11. After about an hour, make a red line on the index card to mark where the water in the straw has risen to and label it "Sun". Using the regular thermometer record the temperature on the index card.
12. Put both thermometers in a bowl of small water. Wait 30 minutes.
13. After 30 minutes, make a blue line on the index card to mark the level of the water in the straw and label it "Cold Water". Record the temperature of the cold water based on the regular thermometer's reading.

Why:

Why did the water rise and fall? Liquid expands in warmer temperatures and contracts in cooler temperatures.



Fahrenheit and Celsius



Name _____

To change from Fahrenheit to Celsius degrees:

Subtract 32

Multiply by 5

Divide by 9

$$100 - 32 = 68$$

$$68 \times 5 = 340$$

$$340 / 9 = 37.78$$

Now you try it! Use the steps above to change from Fahrenheit to Celsius degrees:

$$56^{\circ}\text{F} = \underline{\hspace{2cm}}$$

$$21^{\circ}\text{F} = \underline{\hspace{2cm}}$$

$$0^{\circ}\text{F} = \underline{\hspace{2cm}}$$

$$92^{\circ}\text{F} = \underline{\hspace{2cm}}$$

$$48^{\circ}\text{F} = \underline{\hspace{2cm}}$$

$$75^{\circ}\text{F} = \underline{\hspace{2cm}}$$

$$60^{\circ}\text{F} = \underline{\hspace{2cm}}$$

$$14^{\circ}\text{F} = \underline{\hspace{2cm}}$$

$$82^{\circ}\text{F} = \underline{\hspace{2cm}}$$

To change from Celsius to Fahrenheit degrees:

Multiply by 9

Divide by 5

Add 32

$$0 \times 9 = 0$$

$$0 / 5 = 0$$

$$0 + 32 = 32$$

Now you try it! Use the steps above to change from Celsius to Fahrenheit degrees:

$$65^{\circ}\text{C} = \underline{\hspace{2cm}}$$

$$15^{\circ}\text{C} = \underline{\hspace{2cm}}$$

$$100^{\circ}\text{C} = \underline{\hspace{2cm}}$$

$$29^{\circ}\text{C} = \underline{\hspace{2cm}}$$

$$84^{\circ}\text{C} = \underline{\hspace{2cm}}$$

$$52^{\circ}\text{C} = \underline{\hspace{2cm}}$$

$$77^{\circ}\text{C} = \underline{\hspace{2cm}}$$

$$38^{\circ}\text{C} = \underline{\hspace{2cm}}$$

$$-9^{\circ}\text{C} = \underline{\hspace{2cm}}$$