TAKING THE WORLD BY STORM

Teacher Resource Manual

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Teacher Resource Manual

FORWARD

The Mad Science Group® has been providing live, interactive, exciting science experiences for children throughout the world for over 12 years. Founded in Montreal, Canada, Mad Science currently has over 120 offices throughout the world. It specializes in combining textbook theory with dazzling spectacles of sight and sound.

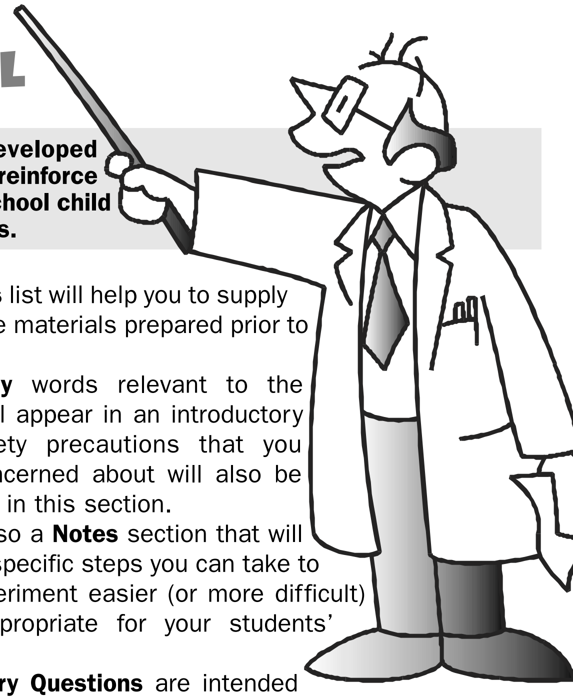
Mad Science Productions, a division of the Mad Science Group, remains faithful to the vision of advancing scientific literacy among today's youth. Our commitment to science education is what has encouraged us to provide this supplemental educator handbook.

We hope that you will find this manual a useful educational tool for you and your students. Our goal is to make our science shows a truly enriching experience.

Happy Science Teaching!

Kathy Siciliano
Marketing and Sales Coordinator
Mad Science Productions

HOW TO BEST USE THIS MANUAL



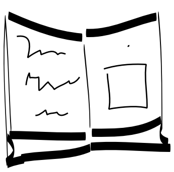
The Teacher Resource Manual is a handbook that was developed collaboratively with The Weather Network. It outlines lessons that reinforce the concepts presented in the show. Written with the elementary school child in mind, it offers theoretical science concepts and complete hands-on activities.

The Teacher Resource Manual is specifically designed to help you, the educator, enhance the teaching of a weather unit in your classroom. The experiments presented along with the ones that you saw on stage, will capture the attention of your students so that they can become genuinely interested in learning about weather and how it affects their lives and the ever-changing world around them.

Lesson Plans

In each section you will find complete lesson plans, which include introductions to the subject matter, educational objectives, vocabulary words and fun facts, experiments, explanations and background information. All of these will help you teach a thorough and well-developed lesson. These lessons are organized so that all the materials that you need are in the manual.

Educational Objectives



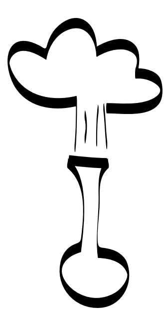
Each lesson plan outlines an educational objective, which correlates to the National Science Education Standards and the Canadian Common Frameworks of Science Learning Outcomes. They have been referenced at the end of the manual for your convenience.

Vocabulary and Fun Facts

The definitions in the vocabulary section are written so that you (the teacher), may provide background information related to weather. Adapt them as you see fit depending upon the level and ability of your students. The main vocabulary section at the beginning of the manual has vocabulary words that pertain to teach the entire weather unit. You will also find a list of vocabulary words that are relevant to each experiment.

In addition to the definitions of the technical terms, we have also provided some fun facts for specific words. These will provide additional information for your students and will make your science lessons more fun!

Experiments



You will find a series of experiments grouped with their appropriate lesson which contain the following information:

1.) Each experiment outlines the estimated **Time** the experiment will take (this can always be adapted depending on the amount of explanation you want to provide or whether you want to demonstrate the experiment or have all the children experiment).

2.) A **Materials** list will help you to supply the appropriate materials prepared prior to class.

3.) **Vocabulary** words relevant to the experiment will appear in an introductory list. Any safety precautions that you should be concerned about will also be boldly outlined in this section.

4.) There is also a **Notes** section that will inform you of specific steps you can take to make the experiment easier (or more difficult) and more appropriate for your students' abilities.

5.) **Introductory Questions** are intended to stimulate critical thinking in your students. They will also serve as a means of engaging them in the scientific process, because science is about asking questions and discovering answers.

6.) The **Procedure** will provide step-by-step instructions of how to do the experiment.

7.) **Wrap-up Questions** are intended to ensure that your students understood the experiments by identifying any concepts that were unclear.

8.) The **Simple Explanation** explains the experiment in simple and precise terminology.

9.) The **Extended Explanation** is designed to provide additional information not only about the experiment, but also for a broader understanding of the concepts presented.

10.) The **Concept Emphasis by Age** section of each experiment will help to develop age appropriate lessons by indicating activities for different grade levels.

Background Information

This section of the manual provides additional knowledge about the general subject of weather. Use the background information section as a resource to aid you in answering questions that the students, or you, may have.

Extension Ideas

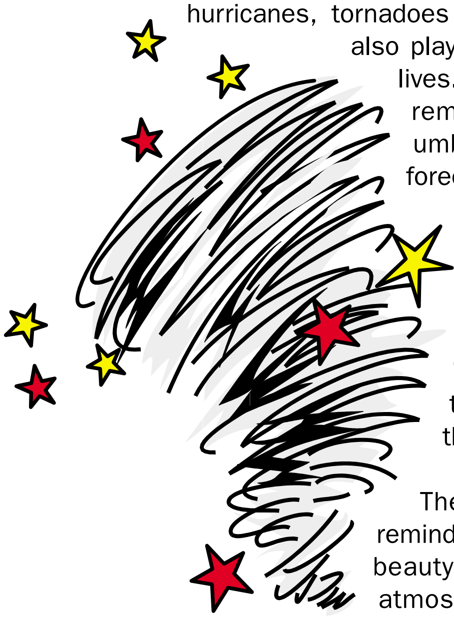
Here you will find ideas to expand a science unit on weather into other subjects such as language arts, math, art, and social studies.

Content Standards

In this section you will see how the Mad Science Productions show "Taking the World by Storm", in combination with this Teacher Resource Manual, helps you to fulfill content standards based on both the National Science Education Standards by the National Research Council in the USA and the Canadian Common Frameworks of Science Learning Outcomes by the Council of Ministers of Education in Canada. Use these lessons and the correlations to help you reach your classroom goals and objectives.

INTRODUCTION

Meteorology is the study of the Earth's atmosphere and the variations in temperature and moisture patterns that produce different weather conditions. Weather includes a complete range of events such as precipitation, including rain, sleet and snow, to storms like hurricanes, tornadoes and typhoons. Weather also plays a role in our everyday lives. It can be as simple as remembering to pack an umbrella when rain is forecasted or as complicated as predicting when a hurricane will come inland. The word "meteorology" derives from the Greek word, "meteron" which refers to any phenomenon in the sky.



The sky is a constant reminder of both the power and beauty of nature. The atmosphere that surrounds Earth is a complex weather machine that is fascinating to watch. While we have the technology to observe storms and to predict the weather, we cannot control it. Even in our advanced scientific age, tornadoes still kill more than 100 people a year in North America, and when a hurricane blows in off the Atlantic Ocean, we are powerless to prevent it from destroying homes and flooding towns. A blizzard can still shut down a city for days at a time, just as it did in New York City 50 years ago. Long droughts can destroy an entire nation's economy, leading to starvation for tens of thousands of people who can only wait helplessly for rain. Just as devastating as a drought, a flood can destroy towns and cities, flooding lands, homes, and farm crops.

The sky is more than just a place where disaster brews. It is an important part of our environment that can be studied and enjoyed as much as forests, fields, and oceans. The "day sky" is our window on the weather, where the sun is millions of times more distant than the outer edge of the Earth's atmosphere. Our atmosphere shields us from the Sun's harmful rays, acts as a buffer from the lifeless vacuum of space, and at the same time, gives us the beautiful colors of the sky.

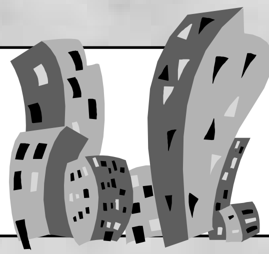
Weather of all kinds can be observed by everyone without any special equipment. We can watch storms approaching and appreciate why changes in the weather occur. We can classify clouds and interpret their meaning. We can understand rainbows and measure the distance from lightning bolts.

The weather is a constantly changing show. Blue skies and sunshine give way to a curtain of snow so thick you can barely see through it. Glowing rainbows chase thunder and lightning. Clouds shaped like dragons turn into lambs right before your eyes. But the weather is more than just entertainment. Weather shapes the way that you live. Take a look around the room… is there glass in the windows? What about a heater or radiator? You wouldn't need window glass or heat if you lived in the tropics. You would want the air to blow through your home and cool things off. How your house is built depends on the weather in your area or region. What about your clothes? You may have picked them because they are in fashion, but you would not want to pull on your favorite pair of shorts in a blizzard no matter how much you loved them. What about our food? Without weather there would be no peanuts for your peanut butter and no bread to put it on. Plants need both sun and rain to grow. Even a hamburger needs sun and rain—after all cows eat plants too! Without weather, Earth would be more like the moon—a cold, lifeless boulder barreling through space—and who wants that!?!

In the following materials you will find demonstrations and hands-on activities that will pique your students' curiosity and help them understand the science of weather.

Vocabulary And Fun Facts

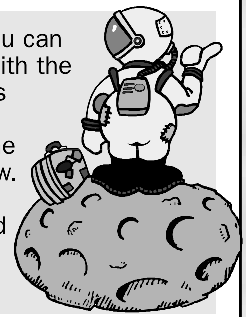
■ ***Air:*** A mixture of gases that comprise the Earth's atmosphere. Air is made up of nitrogen (78 %), carbon dioxide (0.03 %), oxygen (21 %) and other gases (0.07 %).



FF ▸▸ Many things make air rise. Mountains and tall buildings are perfect examples. Blobs of air can't go through them, so the air is forced to go over the tops.

■ ***Air Pressure:*** Pressure is exerted by air in the atmosphere on everything it touches. For weather and from a meteorologist's point of view, air pressure is usually considered to be a column of air over a standard area, like a square meter. This column extends from the ground to the top of the atmosphere, and weighs several tons. The only reason that the atmosphere doesn't crush us is because the air pressure inside your body is identical to that outside our body.

FF ▸▸ Did you know that you can boil water on planet Mars with the heat from your hand? That's because there is very little atmosphere on Mars and the air pressure is extremely low. That's also the reason why astronauts wear pressurized space suits - to keep their blood from boiling!



■ ***Air Mass:*** A large body of air that forms over land or water and that has a fairly consistent temperature and moisture level throughout the body.

FF ▸▸ Believe it or not – the Statue of Liberty weighs less than a column of air of the same size.

■ ***Barometer:*** An instrument that measures the pressure in the atmosphere, providing an indication of upcoming weather conditions. Rising pressure, translating into a higher reading on a barometer, usually means good weather whereas a falling pressure, or a lower barometer reading, usually means poor weather.

FF ▸▸ How does a barometer work?
First, an empty glass tube is placed onto a dish of mercury. Air pressure on the mercury in the dish causes mercury to move up the tube. The level to which the mercury rises is equal to the atmospheric pressure.

■ ***Barometric Pressure:*** The atmospheric pressure recorded by a barometer.

■ ***Bernoulli's Principle:*** A law of air pressure that states the faster a fluid (a gas or liquid) flows, the lower the pressure.

FF ▸▸ Bernoulli's Principle is what allows planes, birds and even Frisbees to fly. By having a stream of fast moving air and a stream of slower moving air, Bernoulli's Principle is observed and 'lift' is created.

■ ***Clear:*** A term used by meteorologists that refers to how clear the sky is. There would be very few to no clouds present on a clear day

■ ***Cloud:*** A visible mass of water particles that float in the air.

FF ▸▸ Have you ever noticed that when you breath on a very cold day, clouds come out of your mouth? That's because the moist air you breath out cools and becomes visible to you.

FF ▸▸ The exhaust pipe from a car works much the same way. When hot moist air is released from the pipe on a cold day, a little cloud will form and it will trail the car as it moves.

Altocumulus Clouds: Clouds that resemble cotton balls and are gray or white in color. They typically indicate that rain is approaching and they are found 2 to 4 miles above the Earth's surface.

Altostratus Clouds: Clouds that are blue and dark gray that cover the entire sky. They have the potential to block the light from the sun and are normally found between 2 and 4 miles above the Earth's surface.

Cirrocumulus Clouds: Clouds that look like tiny waves which indicate that a change in weather will occur in the near future. They are normally found more than 4 miles above the Earth's surface.

Cirrostratus Clouds: Clouds that resemble thin white lines. They sometimes appear to circle the moon like a hula-hoop and they normally indicate that bad weather is approaching within the next 24 hours. They can be found more than 4 miles above the Earth's surface.

Cirrus Clouds: Clouds that are thin and wispy. They indicate that a warm front is approaching. They can normally be found more than 4 miles above the Earth's surface.

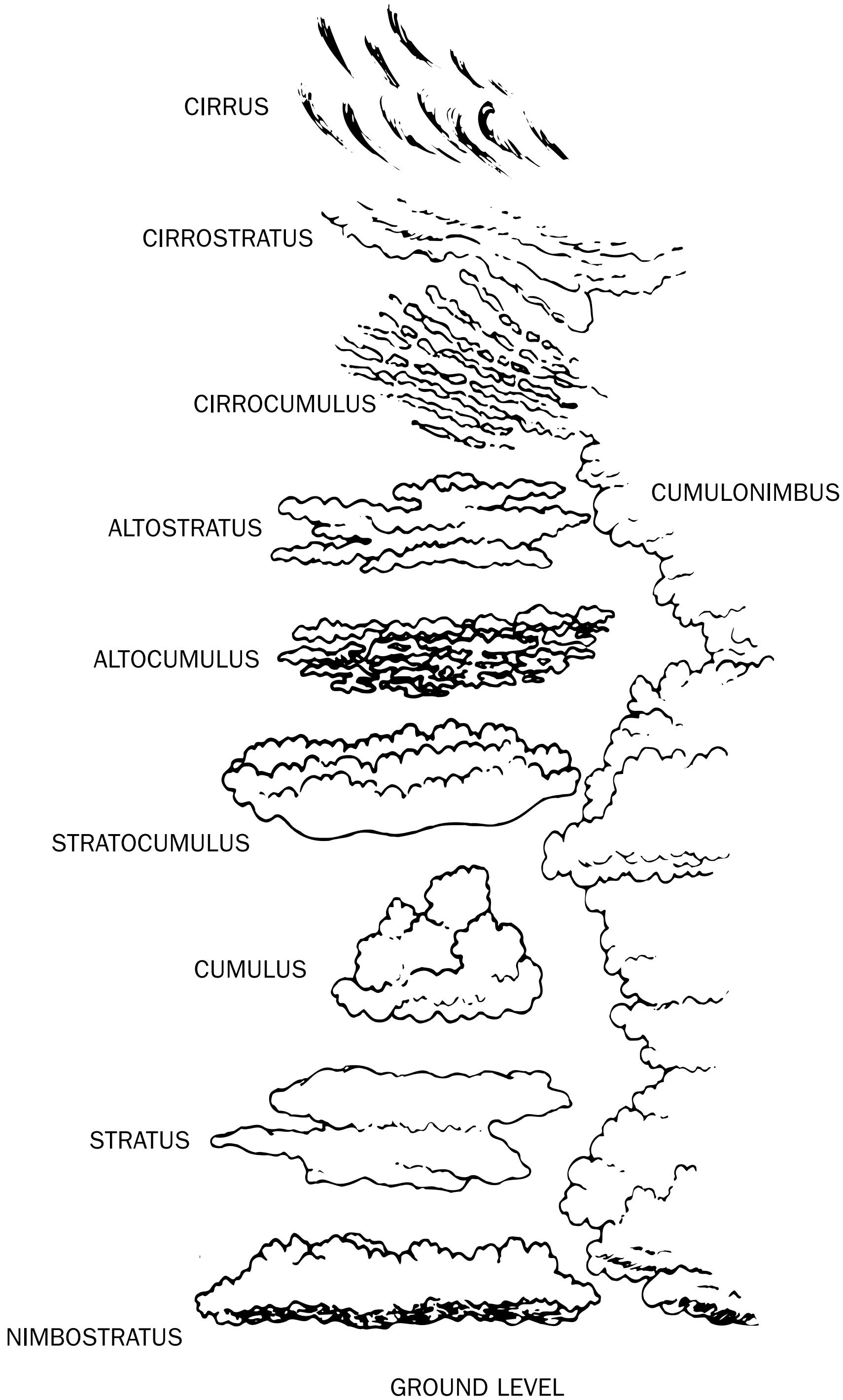
Cumulonimbus Clouds: Clouds that have a very dark base close to the Earth and billow like puffy cotton balls up to 7 miles high. They generate heavy rains and strong winds. They can be found between the Earth's surface up to 1 mile high.

Cumulus Clouds: Clouds that look like shaving cream or a puffy poodle. They are typically less than 1 mile in depth and shift shape frequently.

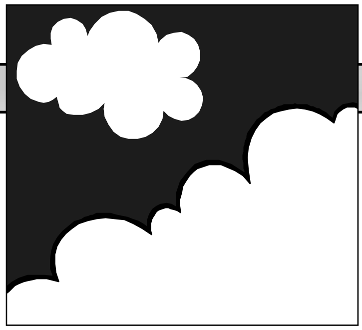
Nimbostratus Clouds: Clouds that develop in warm fronts and are heavy layered and dark gray. They generate rain, snow, and sleet.

Stratocumulus Clouds: Clouds that are typically seen in the wintertime. They are accompanied by light rain or snow and can develop into nimbostratus rain clouds. They can be found between up to 1 mile high above the Earth's surface.

Stratus Clouds: Clouds that are typically less than 1 mile deep. They make the sky appear gray and they stretch from 6 miles to 600 miles across the sky.



■ ***Cloudy:*** A term used by meteorologists that refers to the fact that 75 % of the sky has clouds in it.



■ ***Cold Front:*** A cold air mass that overpowers the air space occupied by a warm air mass. Usually sudden weather changes occur when a cold front comes in. Examples include thunderstorms and lightning. The cold air is denser than the warm air and it rushes in and pushes a warm mass of air up quickly. The warm air cools off quickly as the cool air pushes against it. As a result, the warm air condenses, causing some form of precipitation to fall – rain, snow, hail, sleet, etc. After this sudden turbulent weather, the skies normally clear and the sun comes out.

■ ***Condensation:*** The process by which a vapor changes into a liquid, which requires the removal of heat energy.

FF ⏩ Condensation rates are determined by the speed of water molecules. Molecules will move faster in gaseous states and slower in a solid.

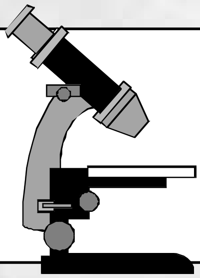
■ ***Convection:*** A method by which heat flows through a liquid or gas. When liquids or gases are heated, the hot parts expand and rise to the top and the cooler parts take their place. This process continues until all the liquid or gas is the same temperature.

FF ⏩ Some breezes are caused by convection current. The air that is close to the Earth's surface is heated up and expands and is forced upward as the surrounding cooler air sinks. Some ovens use convection to cook food.

■ ***Dew Point:*** The temperature at which condensation occurs.

■ ***East Wind:*** A moving air mass that comes from the east.

■ ***Electron:*** The outermost part of an atom that has a negative charge.



FF ⏩ Electrons can be used in microscopes to display images in a microscope. This would be called an electron microscope – these microscopes help us look for signs of disease when looking at cell structures or can even find flaws in computer chips.

■ ***Friction:*** A force that occurs between two objects when their surfaces are in contact with each other.

FF ⏩ Sometimes a sudden warming will melt some snow on a mountain. The water that is formed by the melted snow will act as a lubricant. Remaining snow will glide down hurriedly over the melted snow causing what is called an avalanche.

■ ***High Pressure:*** A system (usually comprised of cool air) that exerts a high pressure.

■ ***Insulation:*** A material that does not allow heat to flow through it easily.

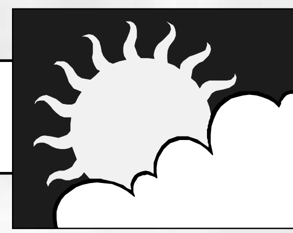
■ ***Lightning:*** A visible flash of light that is caused by a discharge of static electricity in the atmosphere.

FF ▸▸ Did you know that you could use thunder to determine how far away lightning will strike? To do so you need to first look for the flash. Then you must count the number of seconds until you hear thunder. Divide the seconds that you've just counted by five (5). That's how far away (in kilometers) the lightning will be!

■ ***Low Pressure:*** A system (usually comprised of warm air) that exerts a low pressure.

■ ***North Wind:*** A moving air mass that comes from the north.

■ ***Partly Cloudy:*** A term used by meteorologists that represents the fact that the sky has 25 to 75 % clouds in it.



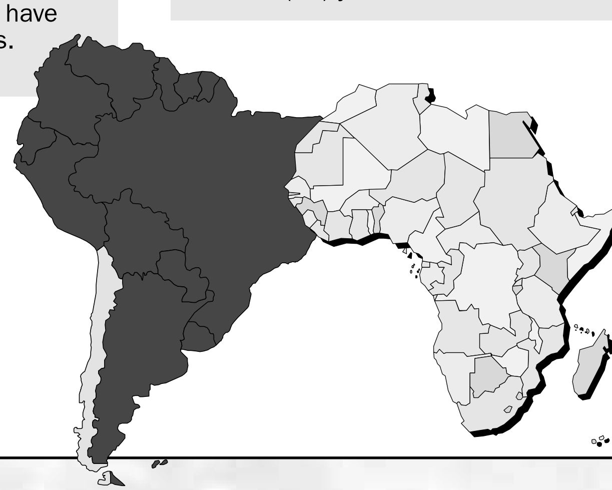
■ ***Precipitation:*** Liquid or solid particles that form in the atmosphere and then fall to the surface of the Earth.

FF ▸▸ A blending of different processes causing air to rise is what produces most precipitation.

■ ***Rain:*** A liquid form of precipitation.

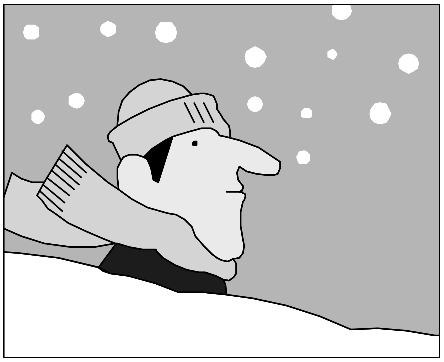
FF ▸▸ On July 4th, 1956 Unionville, Maryland received 31 mm (1.22 inches) of rain in one minute! If the rain had continued to fall at that rate for an hour, the water would have reached over peoples' heads.

FF ▸▸ Can you imagine going through an entire year without rain? Well, Africa and Chile can. They once went fourteen (14) years without rain!



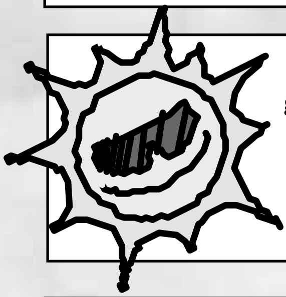
Shower: Rain falling down from the sky at the same rate.

Snow: A form of precipitation whereby water crystallizes in a cloud before falling to the Earth's surface.



FF ▸▸ Have you ever noticed how sometimes snow squeaks when you walk on it? That's because when snow gets really cold, the snow crystals become dry and solid. When you walk on the snow, the crystals rub together and make a squeaking sound.

FF ▸▸ Mt. Rainier, Washington received 25.4 m (83 feet) of snow the winter of 1955-56. That's enough to cover a four-story building!



Solar Energy: A form of energy that is generated by the Sun.

FF ▸▸ Did you know that the earliest known record of solar energy conversion belongs to Auguste Mouchout for his solar work in 1860? The inventor laid out the groundwork for modern understanding of converting solar radiation into mechanical steam power.

South Wind: A moving air mass that comes from the south.

Static Electricity: A form of energy that occurs when two objects rub together to make electrons move from one atom to another

FF ▸▸ Have you ever gotten a shock from touching a metallic object? That's static electricity! The sparks that you see and feel are caused when two (2) objects with opposite electrical charges are brought close together. The electric charges try to jump across the gap between them because they want to be distributed evenly. That's what happens when your hand reaches for the door handle!

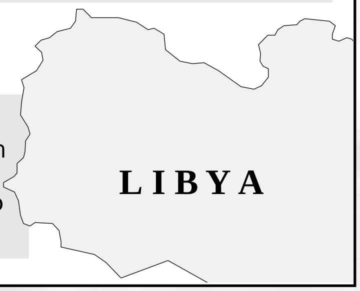
Temperature: The measure of the average kinetic energy of the air. A measure of the amount of warmth or coldness.

Stationary Front: The boundary between two non-moving fronts.

FF ▸▸ The highest recorded temperature in North America was in Death Valley, USA at 56.7°C (134.0°F) on July 10th, 1913. The lowest recorded temperature in North America was in Snag, Canada at –63.0°C (-81.4°F) on February 3rd, 1947.

FF ▸▸ Did you know that some plant buds can measure temperature? That's how the plant knows it's warm enough to open its leaves.

FF ▸▸ The hottest spot in the world is Al' Aziziyah, Libya where it hit 58°C (136.4°F) on September 13th, 1922.The coldest spot is Vostok, Antarctica where temperatures fall to –88.3°C (-126.9°F).

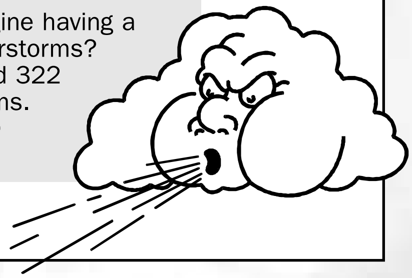


■ ***Thermometer:*** An instrument that measures temperature.

■ ***Thunderstorm:*** When a cold front moves into an area and causes turbulent and violent storms. This normally occurs when two air masses that have different temperatures collide.

FF ▸▸ Nearly 1,800 thunderstorms strike Earth at every moment of every day! That's 16 million hits a year.

FF ▸▸ Can you imagine having a month full of thunderstorms? Bogor, Indonesia had 322 days of thunderstorms. That's more than 10 months!

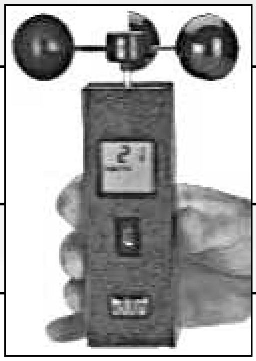


■ ***Warm Front:*** A warm air mass that overtakes a cold air mass. It normally brings about a slow, gradual change in the weather that lasts several days.

■ ***West Wind:*** A moving air mass that comes from the west.

■ ***Wind:*** Air that moves parallel to the ground. It is a result of differences in air pressure.

FF ▸▸ Jan Mayen Island has had winds measure up to 303 km/h (188mph). Wind at the speed is fast enough to tear your clothes off!



■ ***Wind Direction:*** The direction or area from which an air mass is coming from.

■ ***Wind Speed:*** How fast an air mass is moving.

Lesson One: Air, Air Pressure and Temperature

Educational Objective: **The experiments in Section 1: "Air, Air Pressure and Temperature" introduce children to the concept of what air is and how it affects their daily lives. Students will notice that air pressure has much more to do with our lives than weather. Through a hands-on approach, students will learn and observe the physical properties of air, that as temperature changes so does the air pressure, and how to measure temperature and barometric pressure by making some of their very own weather instruments. This lesson provides an opportunity to develop scientific skills through inquiry based instructional methods.**

Experiment 1: Heavy Air

Time: 5 minutes

Materials: wooden dowel
2 balloons
scotch tape

Vocabulary: Air
Air pressure
Mass

Notes: Encourage students to make as many observations as they can throughout this demonstration.

Safety Warnings: None

Introductory Questions:

Do you think that air pressure is around us all the time? Does anyone have any ideas about how we could test to see if air pressure really is all around us?

Procedure:

1. Take out your dowel and balance it on your index finger at the center point. This stick is going to help us determine if air pressure is all around us. Ask, "when I put it on my finger like this, what happens?"
2. Attach a balloon to each end of the dowel.
3. Ask the class what has just happened. Give them a couple of minutes to answer, and hopefully they will tell you that it stayed the same or balanced.
4. Remove one of the balloons, inflate it and reattach it.
5. Balance the dowel on your finger. The side with the inflated balloon will tip because it is heavier than the deflated balloon. Although both balloons have equal mass when they are deflated, when we filled one balloon with air it tipped the scale. This means that air has mass and takes up space.

Wrap-up Questions:

The following questions are intended to ensure that your students understood the experiment by identifying any concepts that were unclear. Ask these types of questions; What did we discover about air pressure by experimenting with two balloons? What do you think life would be like without air pressure?

Explanation:

Simple Explanation:

Make sure that you do not say that air has weight. It has mass. Though this is difficult to explain to youngsters because they cannot differentiate between the two concepts, it is important to be scientifically accurate. If you keep using the word mass rather than weight they will become accustomed to the term. For your own information, mass is a measurement of the amount of matter of an object. This measurement remains constant irrespective of location. For instance, an object's mass on the moon and Earth is the same. Weight, on the other hand, is an object's mass multiplied by the force of gravity. Therefore, when there is little or no gravitational pull, like on the Moon, astronauts have no weight but their mass is the same as it is on Earth.

Extended Explanation:

This demonstration is used to show that air does indeed have mass and take up space. This is an important fundamental concept to get across in order to understand how the heaviness of air is involved in the production of different types of weather systems and precipitation. The reason we have to know about air when we study weather is because when the air changes, so does our weather.

Concept Emphasis by Age:

K-2:
- Air is all around us.
- Air has mass and takes up space.

3-6:
- Air has mass and takes up space.
- Mass is constant but weight can change.

Experiment 2 - Air Power

Time: 5 minutes

Materials: balloons
books

Vocabulary: Air
Pressure

Notes: **K-2:** For students in Kindergarten to Grade 2 this activity would be most beneficial if done as a demonstration.
3-6: Students in grades 3 – 6 should be able to do this activity in groups. Ask them to predict if they will be able to lift the books without using their hands. Have them hypothesize if they will be able to lift more than one book and ask them to test out their hypotheses.

Safety Warnings: None

Introductory Questions:

? Do you think I will be able to lift up a book without using my hands? Do you think that any of you can lift up a book without using your hands? What about if you used air pressure? Does anyone have any ideas about how you could use air pressure to lift the book? Direct their attention to the materials you provided and challenge the class to experiment.

Procedure:

1. Distribute several balloons to each group.
2. Instruct them to place their balloons underneath 1-2 books.
3. Have them blow up their balloons. Their books will be lifted up!

Wrap-up Questions:

What did we use to lift up the balloon? Can you think of any ways that we could use air pressure to do other things in our daily lives?

Explanation:

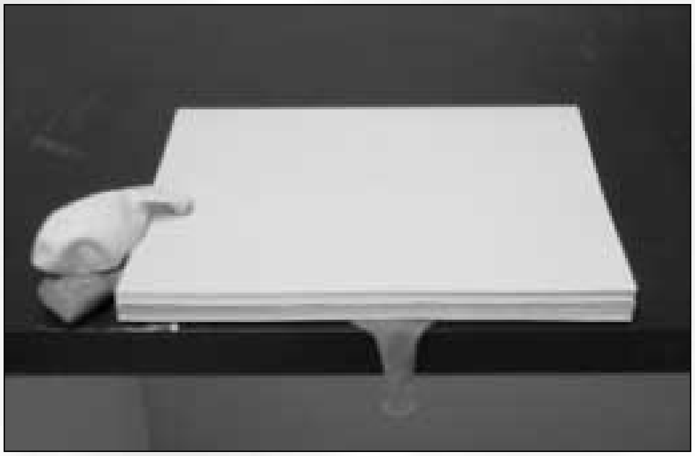
Simple Explanation:

Air pressure can be an extremely strong force. As this activity illustrates, a balloon filled with air is able to displace and physically lift heavy books. It is important to understand what changes in air pressure mean when we talk about weather.

Concept Emphasis by Age:

K-2:
- Air can be used to do work and lift objects.
- Air pressure is important in weather.

3-6:
- Air can be used to do work and lift objects.
- Air pressure plays an important role in the creation of different weather conditions.



Experiment 3 - Pressure Drop

Time: 10 minutes

Materials: 2 ping-pong balls
2 pieces of string (30 cm / 12 inches each)
tape
table

Vocabulary: Barometer
Barometric pressure
Bernoulli's principle

Notes: This demonstration can also be done as an activity with larger balls for a greater visual impact.

Safety Warnings: None

Introductory Questions:

? Have you ever seen wind do amazing things? (They will most likely mention that winds have lifted heavy objects, caused trees to fall down, and created tornadoes). Do you think that wind can do any other unusual things?

Procedure:

1. Tape 30 cm (12 inch) lengths of string to each ping-pong ball.
2. Choose a place where all the students can see and hang the ping-pong balls at the same height, about 1 cm (1/2 inch) apart.
3. Ask your students what they think would happen if you were to blow on the ping-pong balls? Use this opportunity to explain the concept of hypothesis (which are their best guesses) if you have not yet introduced it.
4. Have the students come up to test their hypotheses. After each attempt, steady the ping-pong balls so that they are ready for the next student.
5. Suggest that a student blow directly between the ping-pong balls and ask them to observe what happens.

Wrap-up Questions:

What did you observe? Did the ping pong balls move in the way that you thought they would? Why did they move in the way that they did?

Explanation:

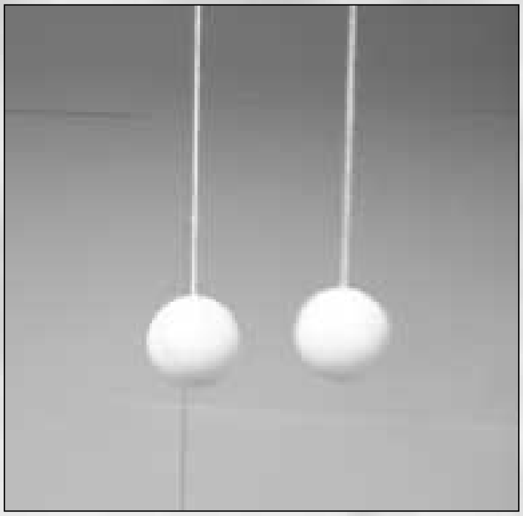
Simple Explanation:

Moving air has a lower pressure. This concept is known as Bernoulli's principle (named after Daniel Bernoulli who discovered that the faster a fluid moves, the lower its pressure is). This principle applies to weather because wind is moving air. When the wind blows, the barometric pressure drops. Barometric pressure is how hard air is pressing down on a particular location. What is happening with the ping-pong balls? When you blow directly on them, the moving air causes a pressure drop between the two balls and the higher pressure air surrounding them moves inward, pushing the balls together.

Concept Emphasis by Age:

K-2:
- Moving air has a lower pressure.
- On windy days, the barometric pressure drops.

3-6:
- Moving air has a lower pressure.
- Bernoulli's principle states that as a fluid moves faster, its pressure drops.
- The barometric pressure is usually lower on windy days.



Experiment 4 - You Made It - Barometer

Time: 30 minutes

Materials: coffee can or empty peanut butter jar
balloon
rubber band
glue
straight pin
straw
piece of paper
tape
pencil

Vocabulary: Air pressure
Barometer
Barometric pressure

Notes: **K-2:** Students in these grades may have difficulties constructing their own individual barometers so it is recommended to assemble a class barometer and students will be involved in marking the movements of the pin.
3-6: Depending on the maturity and capabilities of your students they may or may not be able to construct their own barometers. Students in Grade 3 and 4 should be able to work in groups of three or four to construct their own barometers. Grade 5 and 6 students should be able to assemble their own barometers or you can have them work in pairs or groups.

Safety Warnings: The children should be careful when working with the pin and you should advise them that it is sharp and they should not play with it. Also, once the barometer has been constructed it should be set up in a location that is out of the reach of little hands. Otherwise there is the potential for them to play with the pin.

Introductory Questions:

? Explain to the class that air pressure is all around us all the time and provide some background information. Ask the class; Do you think there is any way that we could measure air pressure? Does anyone have any suggestions? How would you measure air pressure?

Procedure:

1. Take the balloon and cut off the section that you blow into, then discard this part of the balloon.
2. Place the top of the balloon over the opening of the coffee can. Stretch the balloon so that it completely covers and seals the top of the can. Use the elastic to keep the balloon in place on the top of the can.
3. Take the pin and attach it to the end of the straw by taping it to the top of the end of the straw.
4. Secure the other end of the straw to the middle of the balloon with glue. You now have made your very own barometer.
5. Now it is time to put your barometer to work. Tape a sheet of paper on a wall or box at the same level as the barometer. Place the barometer so the pin is almost touching the middle of the paper.
6. With your pencil, mark a line on the paper at the level of the pin so you will be able to record where you started.
7. Two times a day check your barometer and draw a mark if the pin has moved. Date each line to track the changes of air pressure.
8. It is possible to include the barometric pressure provided with weather reports, however you need to ensure that the barometric pressure was recorded at the same time as when you recorded the air pressure measured by your barometer.

Wrap-up Questions:

What have we learned about air pressure by constructing our own barometers?
Why do you think the pin moved over the week (or longer)?

Explanation:

Simple Explanation:

The air pressure changes daily due to the heating and cooling of the earth's surface. When air gets warm it expands or spreads out, becoming less dense thereby exerting less pressure. We can measure changes in atmospheric pressure by using a barometer. Some barometers use long glass tubes filled with mercury inverted in a dish. Air pressing down on the surface of the dish forces the mercury up the tube. When atmospheric pressure drops, the force of the air pushing on the dish is not as great, so the column of liquid falls and we have a "falling barometer." When the atmospheric pressure increases, the mercury rises, thus a "rising barometer."

Extended Explanation:

Differences in air pressure give us a glimpse of what our weather may be like. Remember, we measure changes in air pressure with our barometer. Cool air brings on a high pressure system which usually means good weather. Warm air causes a low pressure system, and usually brings with it bad weather and strong winds. When a barometer falls it usually means that a storm is approaching. If the barometer falls fast, we will have strong, harsh winds. If the barometer falls slowly, we will have gentle breezes.

We use air pressure all the time when we breathe. When our diaphragm moves down, our chest cavity is increased and becomes larger. Because the volume is increased the pressure is decreased and air from outside is drawn into the low-pressure area. The diaphragm doesn't pull air in; it expands the volume of our lungs, and the air pressure fills the volume.

Concept Emphasis by Age:

K-2:
- It is important to emphasize to children of this age that even though we cannot see air, it is all around us all the time. This experiment will be one way that we can determine the amount of air pressure that is all around us.

3-6:
- Children in these grades should be more comfortable with the concept of air pressure and should be able to understand it, even though they cannot see it. Emphasize the fact that as scientists, it is important to ensure that the measurements they take are accurate. This means the barometer should not be moved and they should be as precise as possible when drawing their lines. This lesson is an excellent way to introduce both air and barometric pressure but also to help develop their scientific skills.

Experiment 5 - What Materials are the Best insulators?

Time: Set up: 15 minutes, Activity: 10 minutes

Materials:
6 small jars the same size with lids
newspaper
large rubber bands
cotton T-shirt or fabric piece
thick hand towel
1 cardboard box large enough to hold the jar
piece of fiberglass insulation wrapped in a sealed envelope large enough to surround the jar
6 thermometers that can be submerged in water
cold water
safety gloves (vinyl)
solar temperature chart

Vocabulary:
Solar energy
Insulation
Temperature
Thermometer

Notes: If you need to, you can set this activity up prior to the beginning of the program.

Safety Warnings: Do not touch insulation with bare hands! Use gloves and a facemask to prevent inhaling the fiberglass fibers

Introductory Questions:

? Have you ever worn a dark colored T-shirt on a very sunny day? What was it like? Have you ever gone to the beach during the summer? What did you bring your lunch in? Why did you put it in a container like that?

Procedure:

1. Prepare the jars by securing the wrap around the jars with rubber bands.
   A) Wrap one jar in a thick layer of newspaper.
   B) Wrap one jar in a folded up T-shirt.
   C) Wrap one jar in the thick towel.
   D) Put one jar in the box and surround it with crumpled newspaper.
   E) Wrap one jar in the envelope filled with fiberglass insulation.
   F) Leave one jar with nothing around it.
2. Measure the temperature of the water and record it.
3. Fill each jar with cold water and insert a thermometer. Cover the jars and cover the lid with the same insulation that surrounds the jar. Place all jars in the sun in the same area.
4. After about 30 minutes, open each jar and record the temperatures in each jar on the chart. Close the jars again and repeat the temperature check every 30 minutes.

Wrap-up Questions:

Ask the following types of questions: What did you observe? Why were there differences in the temperatures? Can you think of any other materials that we could use to insulate (or surround) the jars? Can you think of any ways we can use what we learned about insulators to make our lives better (or easier)? (Relate this back to something they experience in their lives, such as insulated lunch bags or insulated mittens). Which jar kept the water coldest for the longest? Which type of insulation do you think works best for your house? You might try to do this experiment at home with your winter gloves as insulation. Do different types of gloves work better than others?

Explanation:

Simple Explanation:
Insulation works by creating a layer of air between the warm outside and the cold inside or the other way around. The insulation helped keep the cold from escaping. The same principle works to conserve heat.

Extended Explanation
Whales have blubber and many animals have fur coats to keep them warm. Birds have a natural oil on their feathers to keep out the water. Some birds line their nests with paper for insulation and rabbits line their burrows with moss for warmth. Trees can also help to insulate homes. Trees and vines can help to shade your home in the summer and reduce cooling costs. In the winter the trees lose their leaves and let the sun shine into your home, adding warmth while cutting down your heating costs.

Concept Emphasis by Age:

K-2: ■ Insulation helps to keep things cool or warm.

3-6: ■ Insulation acts as a barrier to help keep cold air or warm air from escaping.

LESSON TWO: CLOUDS

Educational Objective: **The experiments in Section 2: "Clouds" introduce children to the concept of water vapor, and expands on their knowledge of how air pressure, temperature and clouds are related. Through a hands-on approach, students will learn and observe the various types of clouds and how they are formed. This lesson provides an opportunity to develop scientific skills through inquiry based instructional methods.**

Experiment 6 - Cloud in a Bottle

Time: 10 minutes

Materials: clear glass soda bottle
matches
modeling clay
drinking straw
cold water

Vocabulary: Cloud
Condensation
Dew point

Notes: Do this activity as a demonstration.

Safety Warnings: Warn students about the dangers of playing with fire as you are using matches during this demonstration. Keep unused matches away from children.

Introductory Questions:

? What do you think a cloud would look like if we could closely examine it? Can anyone describe the characteristics of a cloud to me?

Procedure:

1. Take a drinking straw and mold a ball of modeling clay around the center of the straw. The ball of clay needs to be large enough to fit over the top of the clear glass bottle so that it can plug up the opening.

2. Pour a small amount of cold water (it must be cold or this demonstration will not work) in the clear glass soda bottle and then pour it out.
NOTE: Do steps 3 and 4 as quickly as possible.

3. Light a match, quickly blow it out and then hold it just inside the neck of the glass bottle. Drop it in. There should just be a small amount of smoke from the smoldering match.

4. Put one end of the drinking straw into the bottle and plug up the opening with the modeling clay.

5. Have your students observe the inside of the bottle as you blow through the straw.

6. Keep your mouth over the straw but pinch it shut to close the opening. Stop blowing and then let go of the straw. What happens?

Wrap-up Questions:

What did you observe in the bottle? Do you think that this demonstration was an accurate presentation of how clouds are formed? What did you learn about clouds by having the opportunity to see the cloud we created in the bottle?

Explanation:

Simple Explanation:

Clouds form as water vapor cools and condenses around particles like pollen, smoke or pollution in the air. The bottle demonstration shows how warm air from your lungs cools and condenses around the smoke particles introduced by the smoldering matches. This is a small, limited model of how clouds form in nature as a result of upward moving humid air (air filled with moisture).

Extended Explanation:

Clouds are comprised of water vapor and dust particles. There is an abundant amount of particulate matter suspended in the air to which water vapor can stick. In the colder air of the upper atmosphere, air loses its ability to retain water vapor, and excess water condenses onto these suspended particles. The formation of many of these particles results in clouds.

Concept Emphasis by Age:

K-2:
- Water vapor condenses around particles like smoke in the air.
- Clouds form because of this condensation.

3-6:
- Water vapor condenses around solid particles like smoke, pollen or pollution to form clouds.
- The temperature at which water condenses is called the dew point.

Experiment 7 - Cloud Watchers

Time: 20 to 30 minutes

Materials:
information about cloud types
blue construction paper
white chalk
cotton balls
black chalk
glue

Vocabulary:
Clouds
Cumulus
Stratus
Cirrus
Cirrocumulus
Cirrostratus
Altostratus
Altocumulus
Stratocumulus
Nimbostratus
Cumulonimbus

Notes: **K-2:** This activity could be adapted to meet the abilities of Kindergarten and Grade 1 students. Rather than a model you could have them make a picture of clouds that they see in the sky or in the photographs you provided.
3-6: Students in Grades 3-6 should be encouraged to be as accurate as possible in their models. You could have them develop projects and research the different types of clouds if you wished.

Safety Warnings: None

Introductory Questions:

? Have you ever lay down on the ground on a nice sunny day and looked up at the clouds in the sky? What did you notice about them? Did they all look the same, or were some a little different? What about on a rainy day, did you notice anything different about the clouds?
These types of questions are intended to get the students to start thinking about the various types of clouds. By thinking about the variety of clouds that exist they will begin to see that clouds can be classified and you can begin talking about the various classification systems that are used by meteorologists.

Procedure:

1. Ensure that the students understand the descriptions of the various types of clouds. If you have pictures of clouds that illustrate the various types it will further enhance their understanding.
2. Present each student (or group) with the materials listed above and challenge them to create a model of a cloud.
3. You could also provide them with modeling clay and they could develop 3 dimensional models of clouds.

Wrap-up Questions:

Why would it be helpful to create models of clouds? How would meteorologists use these models?

Background Information on Clouds

Clouds – Classified by Type

1. Cumulus Clouds:
- Look like shaving cream or a puffy poodle
- Gaps between the clouds
- Typically less than 1 mile in depth
- Shift in shape frequently

2. Stratus Clouds
- Typically less than 1 mile in depth
- Gray skies result from these clouds
- Vary from 6 to 600 miles from end to end

Clouds – Classified by Altitude

High Clouds ***(4 miles or more above the Earth)***

1. Cirrus
- Thin and wispy
- Indicate a warm front is on its way

2. Cirrocumulus
- Tiny waves
- Indicate a change in the weather in the near future

3. Cirrostratus
- Slim line of clouds that resembles a thin white line
- Circles the sun or moon like a hula hoop
- Indicates bad weather approaching within 24 hours

Middle Clouds **(2 to 4 miles above the Earth)**

1. Altostratus
- Blue and dark gray cover the entire sky
- Have the potential to block the light from the sun

2. Altocumulus
- Resemble cotton balls and are gray or white in color
- Typically indicate rain is approaching

Low Clouds **(From the surface of the Earth to 1 mile high)**

1. Stratocumulus
- Typical in the winter
- Accompanied by light rain or snow
- Can develop into nimbostratus rain clouds

2. Nimbostratus
- Heavy layer of dark gray
- Develop in warm fronts
- Generate rain, snow or sleet

3. Cumulonimbus
- Dark base close to the Earth
- Can stretch for up 7 miles high
- Generate heavy rains and strong winds

Concept Emphasis by Age:

K-2: ■ Students in Kindergarten to Grade 2 should understand that there are various types of clouds but will not be able to identify the various elements that distinguish them from one another.

3-6: ■ Students in Grade 3 to 6 should be able to distinguish between and describe each of the clouds. This activity will provide an opportunity for them to ensure that they have understood the differences and similarities between clouds.

Lesson Three: Precipitation

Educational Objective: **The experiments in Section 3: "Precipitation" introduce children to the forms of precipitation and the air pressure and temperature conditions that must be present in order for particular types of precipitation to occur. Through a hands-on approach, students will learn and observe how air masses and fronts create the various types of precipitation and will build on their knowledge of cloud formation and what occurs when there is excess water vapor in the clouds. This lesson provides an opportunity to develop scientific skills through inquiry based instructional methods.**

Experiment 8 - Cloudy Skies

Time: 5 minutes

Materials:
- electric kettle
- aluminum pie plate
- extension cord
- water
- bucket or bowl (to catch the water)

Vocabulary:
- Cloud
- Condensation
- Cumulus cloud

Notes: This activity is most appropriate for students in grades K-2.

Safety Warnings: Steam can burn the skin! Make sure that the heated kettle is kept away from students.

Introductory Questions:

? Think about a day when it rains. Picture it in your mind. What do you notice about the sky? Is it nice and blue? Why is it the way that it is? Where exactly does rain come from? (This is not appropriate for older classes). Why does it rain (beside the fact that we need the water for plants and flowers)?

Procedure:

1. Plug in a full kettle of water and discuss cloud formations as it boils.
2. When it starts to boil, hold the pie plate directly in the steam. Be careful not too hold your hand in the steam as it can burn you.
3. As the water boils, a whitish "cloud" forms above the spout. When you hold the pie plate in the "cloud," drops of water form on it.

Wrap-up Questions:

How did I make it rain in the classroom? What did you see happening? Can you think of any things that you do at home or school that produce the same amount of rain? (If they are unsure provide examples of taking a bath, or a cool drink that "sweats" on a hot summer day).

Explanation:

Simple Explanation:
Warm air rising from the Earth carries lots of water vapor molecules. As the air rises, it cools down. The water condenses in the air and forms clouds. Clouds are made up of millions of tiny water droplets. On a sunny, summer day, the Sun heats up the ground quickly. The ground heats the air next to it. Because warm air is less dense than cold air, it rises high enough and becomes cool enough to condense and turns into water droplets. Millions of these droplets together make up one of the fluffy clouds we see in the sky. These fluffy clouds are known as cumulus clouds.

Extended Explanation: Refer to the Extended Explanation for "Move on Over" for more information on chemical reactions.

Concept Emphasis by Age:

K-2:
- Cloudy skies sometimes bring rain.
- Rain forms when water vapor molecules rise into the air, cool off and condense into water droplets which fall back to the Earth as rain.

3-6:
- Condensation occurs when water vapor in warm air cools on a surface and forms water droplets.
- Rain forms when water vapor molecules rise into the air, cool off, condense into water droplets, and finally fall back to Earth as rain.

Experiment 9 - Making it Rain Inside a Jar

Time: 30 minutes

Materials: large empty Pyrex jar
very hot water
tin lid for the jar
(you can use the one that came with the jar or get an extra large one so you can lift it off during the demonstration)
empty tin can filled with ice cubes
flashlight

Vocabulary: Rain
Cloud
Condensation
Precipitate

Notes: **K-2:** This activity would be best presented as a demonstration for Kindergarten to Grade 2 students because of the hot water and the ice cubes, which have the potential to get messy.
3-6: This activity would be best presented as a demonstration for Grades 3 and 4. Grade 5 and 6 students could attempt to create their own clouds and rain in jars provided they are mature enough not to play with the water and ice cubes.

Safety Warnings: The students should be instructed to be careful with both the hot water and the ice cubes.

Introductory Questions:

? Think about a day when it rains. Picture it in your mind. What do you notice about the sky? Is it nice and blue? Why is it the way that it is? Where exactly does rain come from? (This is not appropriate for older classes). Why does it rain (beside the fact that we need the water for plants and flowers)?

Procedure:

1. Take the very hot water and pour it into the large jar. About half a cup should suffice.
2. Place the lid on the jar (you can either use the lid that the jar came with or you can use a larger lid and place it on top – it does not need to be secured) and the empty tin can full of ice cubes on the lid.
3. Observe the jar closely so you can see how rain forms.
4. You can shine the flashlight through the jar to see what it would look like with sunlight. It will be another way for the students to try out their observation skills.

Wrap-up Questions:

What did you observe inside the jar? How was the rain created? Was anything else formed along with the rain? Does anyone have any idea how clouds and rain are created in the atmosphere?

Explanation:

Simple Explanation:

Explain to the class that inside the jar it is possible to produce a cloud. The cloud will become very heavy because of the great amount of moisture required to form the cloud. Eventually the moisture from the cloud will condense on the sides of the jar and the lid. After enough droplets have accumulated it will begin to rain!!!

Extended Explanation:

The hot water heats up the air inside the jar. The air, which is moist because of the water inside the jar, begins to look steamy just like the steam that forms in the bathroom when you take a very hot shower. The air particles get so warm they begin to condense on the lid of the jar. The condensation occurs on small pieces of dust and accumulates into droplets that form a cloud. The cloud is now nice and warm and begins to rise to the top of the jar. When it hits the lid, which is cold because of the ice cubes, the air mass becomes cooler. The effect of the mass becoming cooler is that it begins to form water droplets on the lid of the jar. If you lift up the lid of the jar, you will be able to see the accumulation of water droplets. When these droplets become large enough they begin to fall to the bottom of the jar, and you have made it rain!!!

Concept Emphasis by Age:

K-2: ■ This is an excellent way to illustrate to younger students how and why clouds are formed. Make sure you emphasize that the ice cubes represent air in the upper atmosphere that is colder than the air close to the Earth.

3-6: ■ To ensure that the students have understood the process of how rain is formed it might be a good idea to have them illustrate the water cycle and how the cloud formed in their jar. This will also provide them with an opportunity to develop their observation and recording skills.

Experiment 10 - The Zapper

Time: 10 minutes

Materials:
1 Styrofoam dinner plate
1 Styrofoam cup
1 piece of wool cloth (wool works the best but you can try other fabrics too)
1 aluminum pie plate
Scotch tape

Vocabulary:
Static electricity
Electron
Lightning
Friction

Notes: This activity works best in a darkened room so that the spark can be seen easily.

Safety Warnings: None

Introductory Questions:

? Have you ever taken a sweater out of the dryer and it was "static-y" and made your hair stand up? Have you ever rubbed a balloon on your hair and then attached it to the wall? Have you ever felt a shock when you turned on a light? What caused all these things to happen?

Procedure:

1. Rub the Styrofoam plate with the wool cloth for a full minute. Place this charged plate upside down on a table or the floor.
2. Tape the Styrofoam cup to the middle of the aluminum pie plate.
3. Place the pie pan on top of the charged Styrofoam plate using the cup as a handle.
4. Bring your finger near the pie plate and you will feel a little shock and hear a "snap." If the room is dark, you should see a little spark.

Wrap-up Questions:

What did you observe during the experiment? Have you ever seen the same thing happen in the sky? Can you describe it for me?

Explanation:

Simple Explanation:

When you rub the Styrofoam plate with a wool cloth, you charge it up! The Styrofoam attracts the electrons from the cloth due to the friction created by rubbing them together. The electrons cannot leave the pie plate because it is completely surrounded by insulating air and Styrofoam. If you touch the pie plate while it is near the Styrofoam, the moving electrons will be "pushed" off the pan and onto you causing you to feel a little shock, hear a snapping sound and maybe even see a spark of electricity.

Extended Explanation:

These shocks and sounds are caused by static electricity. Static electricity is produced by friction. To help explain the phenomenon, scientists have an idea called the Atomic Theory. The Atomic Theory states that all things are made up of very small particles called atoms, and groups of combined atoms called molecules. Did you know that atoms are so small that a layer of billions and billions of them would be needed to cover the head of a common straight pin?!!

Each atom contains a number of different kinds of particles. We only need to know about two of these particles: protons and electrons. Protons and electrons are thought to be electrically charged particles. Protons are thought to be positively charged; electrons, negatively charged.

Protons are in the nucleus, or center, of the atom. Electrons are thought to be moving around the nucleus in shells, or rings. When it comes to understanding electricity, to get to the heart of the matter you must literally get to the heart of matter - the atom. Atoms are the building blocks of matter and they are composed of three particle types. The central core of the atom is called the nucleus and it contains positively charged particles called protons and neutral particles called neutrons. The movement of many negatively charged particles, called electrons, in the same direction is called an electric current.

Lightning occurs most commonly in thunderstorms. It develops because the thunderstorms create a separation of positive and negative charges. Clouds in the sky form temporary negative charges. Objects on the ground, buildings, trees, people, etc., form temporary positive charges. Opposites attract, therefore the positive and the negative charges attract each other and an electrical current is formed between the two. This electrical current occurs so quickly that we view it as a flash of lightning.

About a hundred times every second the earth is struck by lightning, which streams down in belts 1000 to 9000 feet long. A single belt can develop 3750 million kilowatts, which is more electricity than every single power plant in North America combined!

A flash of lightning heats the air so that it expands very suddenly. This sends a powerful sound wave through the air. We hear this as a clap of thunder. The faster the air expands, the noisier the sound. This rushes through the air toward you and you hear it as a bang.

Concept Emphasis by Age:

K-2:
- Electrons have a negative charge and protons have a positive charge.
- The movement of electrons creates the spark of electricity.

3-6:
- Electrons are negatively charged particles that build up on the Styrofoam plate as it is moved back and forth on the wool cloth.
- Protons are positively charged particles that are being pulled away from the aluminum pie plate.
- "Free" electrons are able to move from one object to another.
- The quick movement of these free electrons can create a spark.
- The process of electrons leaping from one object to another is similar to lightning but on a much smaller scale.

Lesson Four: Wind

Educational Objective: **The experiments in Section 4: "Wind" demonstrate the results of differing air pressures. The children will obtain a thorough understanding that when two different air masses with different temperatures meet, wind occurs. This is a continual expansion of knowledge that allows them to apply their newfound understanding of air pressure and temperature. Through a hands-on approach, the children will also create their own wind speed instrument that will enable them to track and record the speeds of wind over a period of time. This lesson provides an opportunity to develop scientific skills through inquiry based instructional methods.**

Experiment 11 - Winding Up With the Wind

Time: 20 minutes

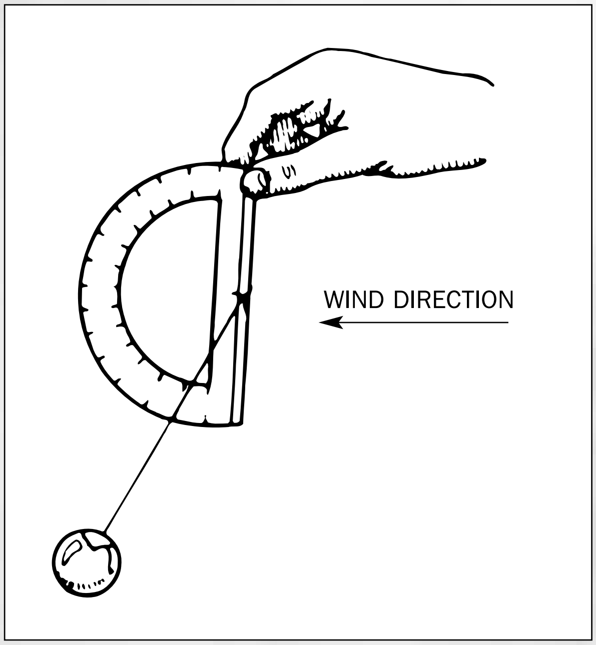
Materials:
protractor
ping-pong ball
lightweight string (6 inches/15 cm)
cellophane tape
compass
scissors
wind speed conversion handout

Vocabulary:
Wind
Wind Direction
Wind Speed

Notes: K-2: Children in Kindergarten and Grade 1 may have difficulty holding the protractor still and then looking at the movement of the string. It may work if you have the children work in pairs, one partner holding the protractor and the other looking at and recording the angle of the string. Otherwise it could be used as a demonstration and you can hold it up and have a volunteer "read" the angle of the string.
3-6: Students in these classes could work in pairs or even in groups of three. One can hold the protractor, another "read" the angle of the string and the other student can determine the location of the wind with the compass.

Safety Warnings: None

Angular Degrees	Wind Speed (mph)
0	0
5	9
10	13
15	16
20	19
25	21
30	24
35	26
40	29
45	31
50	34
55	37
60	41
65	46
70	53



Introductory Questions:

? Have you ever wanted to fly a kite but it just would not lift up off the ground. Why do you think it would it not fly?

If you live in a cold climate you can start your discussion in this way: Have you ever heard in the wintertime about the wind chill factor? What do you think it means? Does it make the temperature outside feel different?

Has anyone ever seen a tree that has split in two? How do you think trees fall over if they are not cut down by human beings?

Procedure:

1. Ensure that the string has been cut to measure 6-inches/15 cm in length.
2. Attach one end with a piece of tape to the middle, or center point, of the protractor. Tape the other end of the string to the ping-pong ball.
3. Go outside and determine where you would like to take a wind speed measurement. Hold the protractor vertically so that the string is hanging along the straight edge of the protractor and the ping-pong ball is hanging below the protractor.
4. Ensure that you are not blocking the wind with your body, hold out the protractor, and determine the direction of the wind. You will need to use the compass to determine the direction from which the wind is coming.
5. Keep the protractor vertical and hold it with the straight side facing the direction of the wind. Observe the string as the wind moves the ping-pong ball. The string will indicate a certain angle on the protractor- record this angle. If a strong gust of wind changes the angle, write down the largest angle that you observed.
6. Before returning to the classroom, take note of any other observations that can be made about the wind. What types of objects is it moving, if any? Does it feel like a warm or a cool wind? Are trees or poles swaying or shaking? This is an opportunity for students to make interesting observations about their environment and the wind.
7. Once you return to the classroom, use the Wind Speed Conversion handout to convert your measurement of the wind into the actual speed of the wind in miles per hour (mph).
8. This activity can be extended over a week or month as you see fit to record and observe the variations in wind speed over a few days or weeks.

Wrap-up Questions:

What do you think would happen if we did not have the wind to blow the leaves off the trees in autumn? What do you think would happen if we did not have any wind? How would our lives change?

Explanation:

Simple Explanation:

Wind is a current of air. It is air moving in one direction. You can not see air and so you can not see wind, but you can see what it does to things. Some days there is almost no wind and the air seems to be calm. But if you wet your finger and hold it up, pointing to the sky, one side will feel colder than the other. That is because the air is moving from that direction. Have you ever seen a hot air balloon floating overhead? A heater in the basket of the balloon warms the air, and the balloon goes up into the sky. If you open the refrigerator door, the cold air tumbles out. You will notice that it is colder near the floor than it is above the refrigerator. Heat makes air expand, and so warm air is lighter than cold air and rises above it. When you blow up a balloon, the pressure of the air inside the balloon is greater than the air outside of the balloon. When you untie the balloon, the high pressure escapes, forcing its way into the area of lower pressure air. This creates wind and that is what we are going to explore today

Concept Emphasis by Age:

K-2:

- Wind is a difficult concept for younger children to understand because it is something that they cannot see or tangibly manipulate. Consequently, it is imperative that you provide them with examples they have experienced – kites, what they feel when a fan is on, trees and leaves that move in the wind. All of these examples will make it easier for them to understand the concept of wind speed and direction. Emphasize how we know and can observe there is wind, the variations that occur from day to day and that we record these variations in miles per hour (which means the speed at which the wind is moving).

3-6:

- Older children are better at understanding concepts that they cannot see and experience first hand. It is still essential to provide them with examples of wind speed and direction in their lives. Examples such as planes flying faster or hand gliders are good examples for this group. Emphasize the direction of the wind and variations in wind speed. Grades 5 and 6 should be able to understand wind speed in miles per hour and can begin to analyze the variations between the speeds and the days you recorded them on. Challenge your students to keep detailed records regarding the temperature, what the wind felt like, and other observations that they made so they can compare the differences with regards to the wind speed they calculated.

Experiment 12 - Model Wind

Time: 10 minutes

Materials:
4-gallon aquarium
small clamp lamp
100-watt light bulb
1 lighter
1 sheet of paper (flints can be used instead of paper)
1 roll plastic wrap
1 small plastic bowl
ice (enough to fill the small bowl)

Vocabulary:
Air
Wind
Convection

Notes: Use diagrams to help explain what is happening in this demonstration especially for students in grades K-2.

Safety Warnings: Beware of fire alarms as you are producing a small amount of smoke for this demo!

Introductory Questions:

? Have you ever been outside on a windy day? What did it feel like? How do we know it is windy if we cannot see it? What happens on a windy day to trees, leaves, your hair, and an umbrella? (Younger children will not be able to answer broad questions so you need to frame them with specifics.)

Procedure:

1. Insert the 100-watt light bulb into the clamp lamp socket. Set the clamp lamp so that it shines down on one end of the aquarium.
2. Place the bowl of ice at the other end of the aquarium and cover the top of the aquarium with plastic wrap.
3. Make a small amount of smoke by lighting a small piece of paper. Let it burn for a few seconds and then blow it out.
4. Puncture a hole in the plastic wrap with the smoldering paper near the bowl of ice. What happens to the smoke?

Wrap-up Questions:

Ask the following types of questions; What did you observe inside the aquarium? Can you think of any ways that you use wind in your everyday lives? What would it be like if there was no wind?

Explanation:

Simple Explanation:

The air we breathe and the atmosphere we live in, is made up of tiny particles of different gases like nitrogen, hydrogen and oxygen. The Sun shines on our atmosphere all of the time. But, it heats the surface of the Earth unevenly, so that in some places it is warm while others are cold. As air gets warmer, its particles spread out. This makes the air lighter, or less dense, so it rises. As air cools, it becomes heavier, or more dense, and sinks. As warm air rises, air from cooler areas flow in to take the place of the heated air. This process is called convection and causes air to move. The differential heating of the Earth's surface and the resulting convection is what causes wind on this planet.

Concept Emphasis by Age:

K-2:
- Wind is moving air.
  Warm air rises and cooler air moves in to take its place. When this happens, air moves and creates wind.

3-6:
- As air is heated, it rises. Cooler air tends to sink.
  When warm air rises, cooler air moves in beneath it and this creates the movement of air. This movement of warm and cool air is called convection.
  Convection is what creates wind.

Lesson Five: Weather Wrap-up

Educational Objective: The experiments in Section 5: "Weather wrap-up" demonstrate what weather data represents and why weather data records are kept. The culmination of the students' knowledge will be brought together as the students utilize the information gathered in previous lessons to predict weather. Through a hands-on approach, the children will learn to observe and read weather maps and track the weather over a period of time. This lesson provides an opportunity to develop scientific skills through inquiry based instructional methods.

Experiment 13 - Weather Watchers

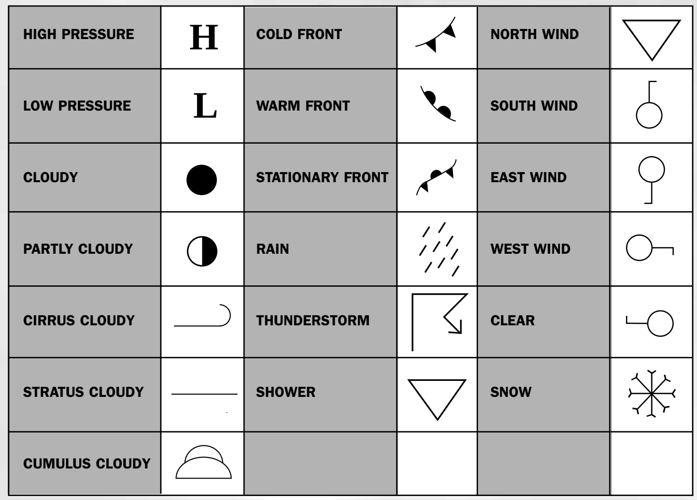
Time: 20 minutes

Materials: weather maps from newspapers
weather symbol chart

Vocabulary: Cirrus cloud
Clear
Cloudy
Cold, warm, stationary front
High, low pressure
North, east, south, west wind
Partly cloudy
Rain
Shower
Snow
Stratus cloud
Thunderstorm

Notes: This activity can be done individually but works best when the students are divided into groups.

Safety Warnings: None



HIGH PRESSURE	H	COLD FRONT		NORTH WIND	
LOW PRESSURE	L	WARM FRONT		SOUTH WIND	
CLOUDY		STATIONARY FRONT		EAST WIND	
PARTLY CLOUDY		RAIN		WEST WIND	
CIRRUS CLOUDY		THUNDERSTORM		CLEAR	
STRATUS CLOUDY		SHOWER		SNOW	
CUMULUS CLOUDY					

Introductory Questions:

Ask your class if anyone has ever watched the weather on television or looked at the weather section of the paper. Have them describe in detail what they learn from these reports. Challenge them to employ the terms used and information provided.

Procedure:

1. Divide your class into groups of 3-4.
2. Create a list of weather vocabulary on one side of the chalkboard and weather symbols on the other side.
3. Have each group try and match the vocabulary to the symbols.
4. Discuss each group's findings and see if everyone is in agreement on the symbols and their meanings.
5. Pass out the newspaper weather maps (make sure that any legends or keys to symbols are removed) to the groups. Ask the students to use their knowledge of weather vocabulary and symbols to see if they can prove their group's matched lists.
6. Distribute copies of the Weather Symbol Chart to allow the students to check their work.

Wrap-up Questions:

Ask your students if they have learned anything new about the weather. What do they think they can learn from listening to or reading about the weather?

Explanation:

Simple Explanation:

Symbols are used on weather maps to simplify a system of international communication. Information about weather patterns and events is communicated by these symbols so that everyone can understand what is happening with the weather regardless of what language they speak. Other forms of international communication use symbols like traffic signals or warning signs on dangerous products. Some of the symbols used in weather maps are designed to look similar to the weather event that they are depicting. For example, rain appears as short lines as if it were rain falling downwards.

Concept Emphasis by Age:

K-2: ■ Symbols are used on weather maps to show different weather patterns or events.

3-6: ■ Symbols are used on weather maps to show different weather patterns or events. They are a form of international communication that does not depend on a specific language. Instead it uses symbols that can be identified by everyone.

BACKGROUND INFORMATION

Here is some additional information on various aspects of weather.

CLOUDS

Clouds and their formations continue to be a source of fascination to scientists and novices alike. You can not touch a cloud way up in the sky, but you have all experienced one up close, it is merely fog - countless tiny droplets of water. In fact, fog is a cloud that forms at ground level. On a cold day, a person's breath makes a miniature cloud exactly like the ones in the sky. The moisture (water vapor) in the warm air from the lungs comes into contact with the outside cooler air and condenses into tiny water droplets. The same thing happens to water vapor escaping from a pot of boiling water: the cooler room air causes condensation, and a tiny cloud develops.

All clouds are water in one form or another, and it does not take much water to make a cloud. A small cloud the size of a school playground contains less water than a full bathtub and would weigh about as much as an adult man. The water that makes up the big, billowing clouds that you often see before storms would probably fill two or three Olympic-sized swimming pools.

THUNDER AND LIGHTNING

Most of the time, clouds are pretty peaceful. But every once in a while, the clouds turn dark and KABOOM! - a thunderstorm puts on a show. The clouds turn darker and darker as they accumulate ice crystals and big, heavy raindrops that block out the Sun's rays. Sharp cracks of thunder mean that lightning is nearby. Low, rumbling thunder usually means it is further away. You can tell how far away a lightning bolt is by counting the seconds between the lightning and the thunder and dividing by three. For example, if you see the lightning and count nine seconds before you hear thunder, divide nine by three. The answer (three) is the approximate number of kilometers between you and the lightning. If you see a flash and hear a sharp crack at the same time, the lightning is right above you!

Lightning is a huge electric spark that results when charges jump from one cloud to another or to the ground. Though lightning may discharge an enormous amount of electricity, it lasts for much too brief a time to be trapped into useful energy. On a hot, humid, summer day when hot air climbs quickly, moisture in the air condenses to form billions of water drops and ice crystals. These pick up tiny electrical charges as they move through the air. The violent air currents in thunderclouds move different-sized drops and dust particles at different speeds. Those of the same size and with similar amounts of electricity get concentrated in the same part of the cloud. A very high positive electrical charge is often formed in the cold higher parts, while the part closer to the ground, the thundercloud, usually is negatively charged. The big difference between the charges at the top and the bottom of the cloud creates a powerful voltage or electric pressure. This "push" sends a flash of lightning streaking through the cloud between those parts with opposite electric charges.

TORNADO

What can pluck a chicken, rip the bark off a tree, drive a straw into a piece of wood and send cars flying through the air? A tornado. Over the years tornadoes have done everything from digging up a farmer's potato crop to planting a cow upside down in a field. A funnel-shaped wind cloud whirls at enormous speeds and picks up dust, trees, animals, water, cars, houses (anything in its path) and whirls them upward. The rapidly rising column of air within the funnel lowers the pressure in the funnel's center as the tornado advances.

A house can be crushed in the midst of a tornado because the air pressure in the center of the tornado is lower than the normal pressure inside the house. The tornado spins, smashing and destroying, until all the heated air that was near land has been squeezed up by the cooler, inflowing air. Then the air stops flowing and the tornado dies.

HURRICANE

A hurricane starts out as an ordinary storm over a warm tropical ocean. It grows bigger and bigger as it absorbs heat and moisture from the warm ocean water. Differences in air pressure start winds spiraling, creating a doughnut-shaped storm system that can be as wide as 600 km (375 miles). Scientists monitor hurricanes and tropical storms carefully. If a hurricane starts heading towards land, they want to warn people in its path. They know that hurricanes travel an average of 20 km/h (12 mph), so they can tell people approximately how much time they have to evacuate their homes before a hurricane hits. If a hurricane hits land, the first thing you experience are the weak edges of the storm. But as the doughnut-shaped storm moves overhead, the winds travel so fast they often break highway speed limits. They uproot trees, rip off roofs, and whip up giant waves that cause flooding. As much as 25 cm (10 inches) of rain can pour down in just one day, enough to fill a pail!

Strangely, in the middle of the chaos, there is a calm. Like a doughnut, a hurricane has nothing in its center (no wind, no rain, just calm air). In this, "eye" of the hurricane the winds may be calm and the sky blue. The "eye" sometimes serves as a huge bird cage, trapping birds who travel with it to keep from being sucked into the storm. The calm of the "eye" has been known to lure people out of their homes. They think the storm is over, and then POW! They are hit by the other half of the doughnut's ring.

The idea of naming hurricanes started in the United States in 1953. At first, all hurricanes were named after girls, but in 1979 boys' names were added. Now, if the first hurricane of the year is a female name, the next would be male and so on starting at the beginning of the alphabet each year. The following year a male name is chosen. Hurricanes are the same thing as cyclones and typhoons, except that cyclones occur in the Indian Ocean and typhoons in the China Sea. The word hurricane comes from Hunraken, the storm god of the Mayas of Central America. Typhoon comes from ty fung, meaning "great wind."

WIND

Wind is air in motion. Sometimes air moves slowly, creating a gentle breeze. At other times it moves rapidly, creating gales and hurricanes. Gentle or fierce, wind always starts the same way. As the sun moves through the sky, it heats up some parts of the sea and land more than others. The air above these spots is heated, becoming lighter than the surrounding air, and will begin to rise. Elsewhere, cool air sinks because it is heavier. Winds will blow wherever there is a difference in air temperature and pressure, always flowing from high to low pressure. Some winds blow in one place and have a local name. In North America, there is a warm wind that blows in the west called a Chinook, bringing summer-like temperatures to a January day. France has a famous wind called a Mistral. Other winds like these are part of a huge circulation pattern that sends winds over the entire span of the globe.

The world's winds are part of a global system of air circulation that moves warm air from the equator to the poles and cold air the opposite way, keeping temperatures around the world in balance. At the poles, cold air sinks and moves toward the equator. Conversely, at the equator, warm air rises and moves towards the poles high in the atmosphere. As this air moves away from the equator, it cools and sinks toward the surface over subtropical areas. In these areas, some air continues to flow towards the poles and some flows back to the equator. Due to the fact that the Earth is spinning, winds bend to the right, north of the equator and to the left in the south. This phenomenon is known as the Coriolis Effect and causes the bending of the Earth's winds. So the winds blowing toward the equator from the subtropics (known as Trade Winds) become "northeasterlies" north of the equator and, "southeasterlies" to the south. Winds that blow towards the poles from these subtropical areas are called, "westerlies."

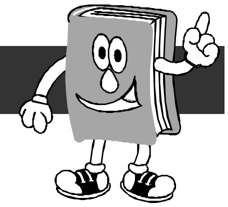
In 1805, a British Admiral named Sir Frances Beaufort created a scale for measuring the speed of winds at sea. He devised this scale (now known as the Beaufort Scale) by observing winds' effects on sailing ships and waves. His scale was later adapted for use on land and is still in use today by many weather stations. According to this scale, wind strengths are divided into 12 forces:

Force 1	Light air
Force 2	Light breeze
Force 3	Gentle breeze
Force 4	Moderate breeze
Force 5	Fresh breeze
Force 6	Strong breeze
Force 7	Near gale
Force 8	Gale
Force 9	Strong Gale
Force 10	Storm
Force 11	Violent Storm
Force 12	Hurricane

Force 0 on the Beaufort Scale is complete calm.

All of these aforementioned weather occurrences and many more that have not been listed, demonstrate the sky is alive and changing constantly (often before our eyes). All we need to do is look up to enjoy the glory of one of nature's most fascinating and accessible phenomena.

Extension Ideas



Math

- ✓ Place a measuring cup or beaker outside and leave it there for a month or two. Have the students record the amount of water collected each day or week. Compile the results in a graph or chart.
- ✓ Integrate weather vocabulary into word problems. For example, a tornado passed through a small town and picked up a car that was thankfully empty. It moved the car two black from its owner's house. Then a snowstorm blew through the town and a snow removal truck moved the car another two blocks from the owner's home. How many blocks away from the owner's home was the car?
- ✓ Make a sundial and challenge the students to use the dial to determine the time of day.

Language Arts

- ✓ Have your students imagine that someone from another country was moving to your city. Challenge the students to write a guidebook to help the visitors learn about the weather at different times of the year. They can even include details about the different clothes to wear and activities to try.
- ✓ Challenge your students to write poems about their most favorite and least favorite types of weather. They can even print the poems in the shape of the weather they are writing about.
- ✓ Ask the class to write newspaper articles or reports about some strange changes in the weather, for example, snow in July (if you live in a colder climate) or huge rainstorms in February.
- ✓ Have the children write a short story about the weather as if the different types of weather were people. For example, the sun is always happy, the rain is grumpy, lightning always has energy. They could publish their books and add them to the classroom library.

Social Studies

- ✓ Challenge your students to conduct research projects about meteorology and the history behind studying the weather.
- ✓ Ask your students to study ways that weather can be used to create energy.
- ✓ Have the class conduct research projects on scientists that have studied the weather.
- ✓ Ask the students to use the newspaper to record the temperature of different countries or cities on a map.

Art

- ✓ Provide your students with an assortment of materials (like sand, glitter, cotton balls, felt, paint) and ask them to create textured pictures about the weather.
- ✓ Have the class draw pictures with markers or watercolors and then let the pictures sit out in the rain.

Field Trip Suggestions

✓ Visit a weather station.
✓ Invite a meteorologist to visit the class.
✓ Visit a solar energy station or wind energy plant.
✓ Invite Mad Science into the classroom to present a workshop all about the weather. All workshops are age-appropriate and curriculum relevant. Visit our website at www.madscience.org or call toll free 1-877-900-7300

Books

Reference Books

Title: Eyewitness Explorers: Weather
Author: John Farndon and John Bendall-Brunello
Publisher: DK Publishing
ISBN#: 0789429853

Description: *This book describes elements of weather such as clouds, humidity, frost, ice, wind, and air pressure. It includes projects and activities appropriate for children in Grades 3 to 6.*

Title: It's Raining Cats and Dogs: All Kinds of Weather and Why We Have It
Author: Franklyn Mansfield Branley
Publisher: Houghton Mifflin Company
ISBN#: 039533070X

Description: *This book discusses various weather phenomena including rain, hail, smog, snow, lightning, hurricanes and tornadoes. It is appropriate for students in Grades 3 to 6.*

Experiments and Activities

Title: Can It Really Rain Frogs: The World's Strangest Weather Events
Author: Spencer Christian and Antonia Felix
Publisher: John Wiley and Sons
ISBN#: 0471152900

Description: *This entertaining and illustrated activity book explains how weather works and reveals secrets about remarkable meteorological oddities. It is appropriate for students in Grades 3 to 6.*

Title: Experiment with Weather
Author: Miranda Bower
Publisher: Learner Publications
ISBN#: 0822524589

Description: *This book provides an introduction to meteorological phenomena and includes experiments to illustrate various aspects of our weather, such as clouds, wind, fog and rainbows. It is appropriate for students in Grades 1 to 3.*

Title: The Science Book of Weather
Author: Neil Ardley
Publisher: Harcourt Brace
ISBN#: 0152006249

Description: *This book provides simple experiments that demonstrate the different forces that produce different types of weather. It is intended for students in Grades 1 to 3.*

Storybooks

Title: The Dark Secret of Weatherend
Author: John Bellairs
Publisher: Puffin
ISBN#: 014038116X

Description: *When Anthony Monday stumbles upon a book that reveals a frightening plan to turn the world into an icy wasteland, he knows he must find the person responsible before it is too late. This book is intended for students in Grades 3 to 6.*

Title: The Dust Under Mrs. Merriweather's Bed
Author: Susan Grohmann
Publisher: Whispering Coyote Press
ISBN#: 1879085658

Description: *Mrs. Merriweather, who lives in the sky, is extremely tidy, and as she cleans her house and waters her garden, interesting things happen with the weather. This book is appropriate for students in Kindergarten to Grade 3.*

National Science Education Standards Correlated to the Teacher Resource Manual for "Taking the World by Storm"

Mad Science Productions	Don't Try This At Home	Taking the World By Storm	
Science As Inquiry			
Abilities necessary to do scientific inquiry	●	●	
Understanding about scientific inquiry	●	●	
Physical Science			
Properties of objects & materials			
Position & motion of objects	●		
Life Science			
Characteristics of organisms			
Life cycles of organisms			
Organisms & environments			
Earth and Space Science			
Properties of earth materials			
Objects in the sky		●	
Changes in earth and sky		●	
Science and Technology			
Ability to distinguish between natural objects and objects made by humans			
Ability of technological design	●	●	
Understanding about science and technology	●		
Science in Personal & Social Perspectives			
Personal health			
Characteristics & changes in populations			
Types of resources			
Changes in environments		●	
Science and technology in local challenges			
History and Nature of Science			
Science as a human endeavour	●	●	

✓SCIENCE: KINDERGARTEN TO GRADE 6

Mad Science Productions Correlations to the Common Framework of Science Learning Outcomes by the Council of Ministers of Education, Canada

Mad Science Productions shows and educational packages meet the following requirements outlined in the Common Framework of Science Learning Outcomes by the Council of Ministers of Education, Canada.

Kindergarten

Exploring the World with Our Senses
✓Don't Try This at Home
✓Taking the World by Storm

Grade 1

Life Science
Needs and Characteristics of Living Things – Students can observe similarities and differences and develop an understanding of the general characteristics of living things.

Materials and Our Senses – Our awareness of our environment – and the many materials found within it – are based on our sensory experiences. Through guided experiences that require careful and critical use of the senses, students can be encouraged to refine and become aware of their skills of observation.
✓Don't Try This at Home
✓Taking the World by Storm

Earth and Space Science
Daily and Seasonal Changes – In observing their environment, students become aware of things that change, including changes in physical factors, such as temperature, wind, or light, and changes in plants and animals found near their home.
✓Taking the World by Storm

Air and Water in the Environment – Air and water are all around us. Through investigations, students learn about changes and interactions of air and water when they are heated or cooled, and about their movement through the environment.
✓Don't Try This at Home
✓Taking the World by Storm

Grade 2

Life Science
Animal Growth and Changes – Students can observe that all animals grow and change from their earliest beginnings until they reach their full adult condition. The form and pattern of this growth distinguish one kind of animal from another and are sources of interest for children.

Physical Science
Liquids and Solids – Students examine materials in their environment and they become aware of a wide array of similarities and differences in their properties: the way they look, the way they feel, and the way they respond to environmental change. The categories of liquid and solid provide one way for students to organize their understanding of materials.
✓Don't Try This at Home
✓Taking the World by Storm

Relative Position and Motion – Through observation and the use of specific language, students develop the ability to describe where things are and how they are moving, and share their experience with others.
✓Don't Try This at Home

Earth and Space Science
Air and Water in the Environment – Through investigations, students learn about changes and interactions of air and water when they are heated or cooled, and about their movement through the environment. In the process, students will discover that water is important to us in many ways.
✓Taking the World by Storm

Grade 3

Physical Science
Materials and Structures – Students learn about the nature of materials, not just by observing them but, more importantly, by using them – sometimes in their original form and sometimes as things the students themselves construct. The focus for students is on building things, and on selecting and using materials to fit the task at hand.
✓Taking the World by Storm

Invisible Forces – Students learn that magnetic forces and electric forces both involve attraction and repulsion, but have different origins and involve different kinds of materials. Students discover a variety of ways these forces can be applied or can affect their daily life,

Grade 4

Physical Science
Light – Students become familiar with the properties of light by observing how light interacts with various objects in the environment.
✓Taking the World by Storm

Sound – Sound is a phenomenon that can be observed, measured, and controlled in various ways. Learning how sound is caused by vibrations is important as students explore both how sound travels and factors that affect the sounds that are produced.

They should be provided with opportunities to learn that rocks are used for many things within a community and that rock characteristics help determine their use.

Earth and Space Science
Rocks, Minerals, and Erosion – In addition to exploring the living things around them, students should also become familiar with the earth materials that make up their world.

Grade 5

Physical Science
Properties and Changes in Materials – Students learn that the form a material takes, including its shape and structure, can be modified as required. They also learn that material substances themselves can be changed, and that some changes involve the production of new materials through reactions that are not reversible.

Forces and Simple Machines – The study of motion and the forces causing motion help students begin to build a more sophisticated understanding of forces. Students are able to move from qualitative to simple quantitative descriptions of forces acting on objects as they manipulate simple machines.

Earth and Space Science
Weather – Students should be provided with opportunities to realize that daily weather conditions are not the result of random occurrences, but rather are part of larger systems and patterns that can be predicted on both a short-term and seasonal basis.
✓Taking the World by Storm

Grade 6

Electricity – Students encounter electricity every day of their lives. A basic understanding of how electricity works can help students recognize the need for safe practices when around electricity, begin to realize that they have control over how much electricity they use in the home and at school, and begin to understand the impact energy consumption has on electricity as a resource.

Flight – Students learn to appreciate the science and technology involved as they investigate how things fly and develop and test a variety of prototype devices.
✓Don't Try This at Home

Earth and Space Science
Space – Space science involves learning about objects in the sky to discover their form, their movements, and their interactions. Students learn that manned and unmanned probes and earth-based devices are contributing to our knowledge of space, and that new capabilities are being developed for monitoring the Earth, for communications, and for the further exploration of space.

Welcome to the World of Mad Science

In March 1985 brothers Ariel and Ron Shlien, teenagers at the time, began launching rockets at birthday parties in their neighborhood. They quickly realized that their means of extra income was very appealing to educators, parents, after school programs and community centers. Fun, cool, hands-on science experiments were in demand. As a result, the first franchise was opened in 1994 and has grown to include over 120 franchises all over the world.

The franchise system, which continues to expand, is comprised of a network of thousands of Mad Scientists who work with schools, camps, community centers, and scout groups to spark imaginative learning in millions of elementary school children. All of the programs are inquiry based, age appropriate and are tested by both children and scientists prior to their integration into programs.

Mad Science sparks the imagination and curiosity of children everywhere. Our array of programming fosters confidence in children as potential scientists and engineers.

Workshops
This is a hassle-free and convenient way to bring hands-on science programs directly into your class. All workshops meet state and provincial curriculum requirements and offer teachers the flexibility to continue enriching their class with pre and post science activities. Children from kindergarten to grade 6 can learn about the intriguing world of light, sound, electricity, physical science, chemistry and so much more.

After School Programs
Mad Science sparks imaginative learning when school is out! We offer fun, hands-on science classes that will keep your students entertained and engaged. After-school programs are held during the lunch hour or after classes, and typically last from four to eight weeks. Parents pay a low, all-inclusive fee, with no cost to the school. Your students will create and take home their own model rockets, Mad Science Putty, periscopes and lots more!

Birthday Parties
Mad Science Birthday parties are exciting, high energy and interactive shows that make all children feel extra special on their birthday. Our edu-taining Mad Scientists come to your house or party room to animate the children with bubbling potions, laser lights, spectacular chemical magic, slippery slime and much more!

Special Events
Thrill and captivate your school assemblies with an extraordinary Mad Science Special Event. In large groups, children will participate in conjuring up foggy dry ice storms, taking a float on a Mad Science hovercraft, making magic mud and altering voice waves. Mad Science Events can be customized to suit any group size, any theme and any budget.

Pre-School
Mad Science pre-school workshops are developmentally appropriate and cover science that is relevant to preschoolers. Science is made fun with hands-on and minds-on programming such as colour, sound, sight, dinosaurs and much, much more! Children are further enthralled with imaginative projects they make and take home, and teachers can continue the learning process using the Mad Science Teacher’s Resource Package.

Camps
Our summer camp programming relates science to life for children. With interactive and unique activities, children learn to discover the world around them with fascinating experiments such as testing the soil for "Martian" life, discovering pollution solutions by baking nachos with solar power and by teaming up with camper engineers to build bridges, domes and pyramids.

For more information about Mad Science in your area, please call 1-877-900-7300 or visit our website at www.madscience.org.

Acknowledgments

This manual is the product of a collaborative effort on the part of many talented individuals.

First and foremost we thank our sponsor, The Weather Network, for the key information they provided during the development of our manual.

A special thank-you to Karen Trexler, Sharon King and Monica Lynch (Mad Science R&D department) for all of their help in producing the manual.

Many thanks to Alain Gagnon for creating such a spectacular color cover for our manual and to Ayako Kiyokawa and Nicholas Robinson for their wonderful work on the layout.