National Weather Service
Huntsville

Weather Activities Pack

Bring the weather home!

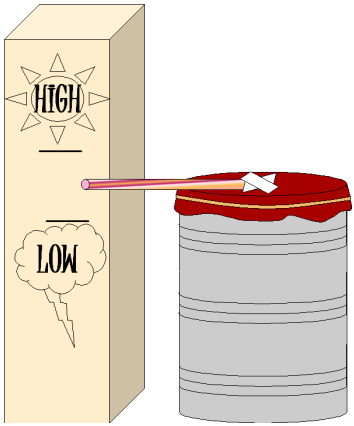
What you'll find inside:

- Make your own weather instruments
- Simulate a weather front
- Create lightning
- Capture a cloud in a bottle

Visit us on the web: weather.gov/huntsville

Make a Barometer*

Air pressure, which is measured with a barometer, changes from day to day when weather systems move nearby. When air warms up it rises and can create clouds...so low pressure is associated with stormy weather. When air cools, it sinks so fewer clouds can form...so high pressure is associated with clear skies!



Materials

» Petroleum jelly
» Empty can without top
» Tape
» Light colored poster board
» Balloon
» Rubber band
» Drinking straw

Instructions

1. Spread a thin layer of petroleum jelly around the edge of the can (be careful not to cut yourself). Stretch the uninflated balloon over the can and seal it with a rubber band.
2. Tape a straw onto the middle of the balloon.
3. Place a piece of folded poster board next to the can where it won't be disturbed. Mark the end of the straw on the poster board.
4. Check your barometer once or twice a day for a week and mark any changes in position. Label your highest mark 'HIGH' and your lowest mark 'LOW'.

Results

When there is high air pressure, the air outside the can pushes down on the balloon harder, tipping the straw up. When the outside air pressure is lower, the balloon top of the can expands which tips the straw downward.

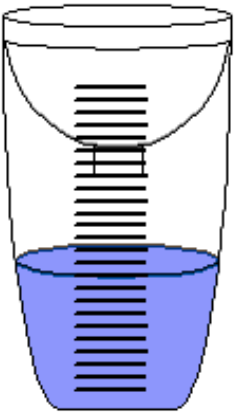
Make a Rain Gauge^

A good rain gauge gives you an accurate measurement of how much liquid has fallen during a storm.

Materials

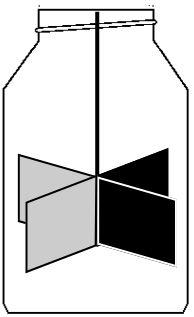
» Plastic bottle
» Scissors
» Pencil
» Colored tape
» Ruler

Instructions



1. Cut the top off the bottle where the curved top meets the straight sides.
2. Turn the top upside down and fit it into the base. This will stop the water inside the bottle from evaporating.
3. Cut thin strips of tape and use them to make $\frac{1}{4}$ inch divisions along the straight part of the base. Pour water up to the lowest division.
4. Place your rain gauge outside, away from any buildings and trees. Record the amount of rain each day for a week, and remember to pour out the water to the lowest division each morning.

Make a Radiometer^



While the sun does heat the Earth, it does not do so directly. The sun heats the ground or the ocean, and the warmed surfaces then heat the atmosphere. A radiometer measures the amount of energy given off by the warmed air.

Materials

» A glass jar with lid
» Aluminum foil
» Black paper
» Glue
» Cardboard
» A matchstick
» Thread
» Tape

Instructions

1. Cut four 1-inch squares of cardboard. Cover both sides of two squares with black paper and two with foil.
2. Glue the squares to the matchstick—alternating black and foil-covered, so they resemble a pinwheel, with right angles between each piece of covered cardboard.
3. Tape one end of the thread to the end of the matchstick. Tape the other end of the thread to the middle of the inside of the lid. Put the lid on the jar and make sure that the cardboard cross can spin inside the jar.
4. On different days, place your radiometer outside in the sunshine and note how often the cross spins in one minute.

Results

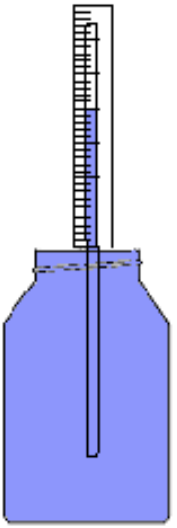
When the jar is placed in the sunshine, the black paddles absorb the suns heat, while the foil reflects it. This differential heating causes the paddle to spin more quickly in full sunlight, and will stop spinning in a dark room.

Make a Water Thermometer^

A thermometer is used to measure temperature. Traditionally, they were made with a narrow glass tube filled with mercury or alcohol. These liquids expand when they warm up, and contract when they cool down.

Materials

» A glass bottle
» Jug
» Rubber bands
» Stick
» Cardboard
» Clear plastic tube
» Ice bucket with ice
» Colored water
» Rubber stopper with hole
» Modeling clay
» Scissors
» Tape
» Pens
» Glue



Instructions

1. Push the tube into the stopper and seal any gaps with modeling clay.
2. Mark $\frac{1}{2}$ inch divisions on a strip of cardboard and glue onto a stick. Fix the stick to the bottle using the rubber bands.
3. Using the jug, fill the bottle with water up to the brim. Plug in the stopper so that the water rises about halfway up the tube. Tape the tube in place to complete your thermometer.
4. Place the thermometer in an ice bucket. Fill the bucket with ice.
5. Water expands when it gets warmer and contracts when it gets colder. So the water level falls as it gets colder. Cut a small triangle out of the cardboard. After about 10 minutes, mark the water level with the triangle. This is zero on your scale.
6. Take the thermometer out of the bucket and leave it outside in the shade. Wait for the water level to rise and count the divisions from zero. Make a note of this temperature.
7. Let the thermometer sit a day and take the temperature once again. Has it gotten warmer or cooler?

Break it Down Now

The Composition of the Air^

The atmosphere is made up of many gases, including oxygen, nitrogen, water vapor, carbon dioxide, and argon. While oxygen is so important to life on the surface of the earth, it does not make up the majority of the air.

Materials

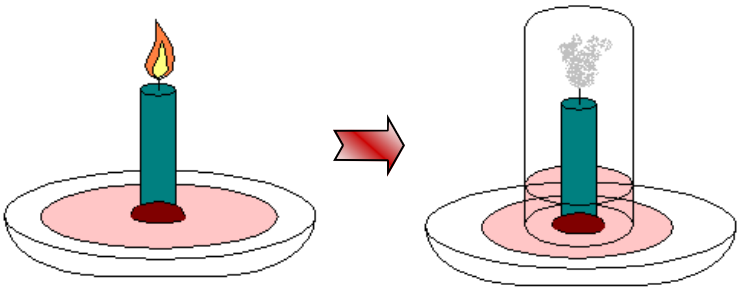
» A candle
» Modeling clay
» A tall glass
» Matches
» Shallow bowl
» Colored water

Instructions

1. Use the modeling clay to attach the candle to the center of the bowl. Pour the colored water into the bowl and then light the candle.
2. Set the glass carefully over the candle so that no air can enter it.
3. Observe how much water rises into the glass.

Results

Fire needs oxygen to burn, so the candle goes out when all the oxygen is used. The water rises about one-fifth of the way up the glass. This shows that our atmosphere is made up of about one-fifth oxygen. The other main parts of the air include nitrogen (about 78%), argon (~0.9%), carbon dioxide (0.03%), and water vapor (1-4% at the surface).



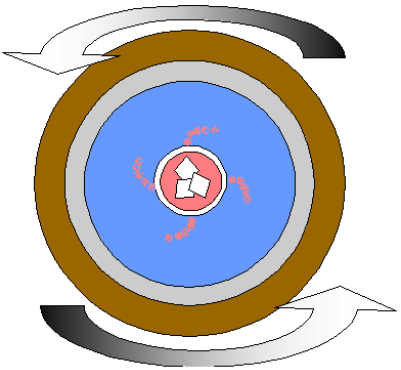
Round and Round We Go

Coriolis Force ~

Winds on the Earth don't simply blow from north to south. Does the rotation of the Earth have something to do with that?

Materials

» Rotating platform (Lazy Susan)
» Aluminum pie pan
» Paper cup
» Food coloring
» Water
» Pushpin
» Crushed ice



Instructions

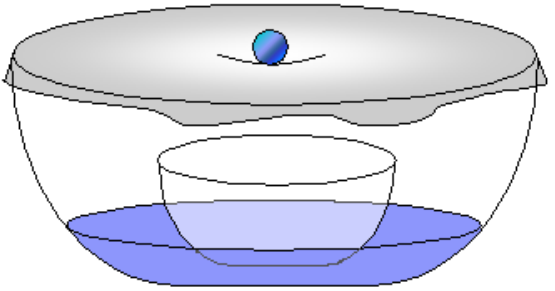
1. Put the pie pan on the Lazy Susan and fill it with water to about 1-2cm from the top.
2. Use the pushpin to poke 4 holes in the side of the cup about 1 cm from the base of the cup. Space the holes evenly.
3. Fill the cup about half way with crushed ice then place it in the middle of the pie pan.
4. Slowly turn the Lazy Susan counterclockwise (this simulates the rotation of the Earth). Keep the rotation smooth and slow.
5. While the pie pan is spinning, add several drops of food coloring to the cup. Then add a enough water to come above the holes poked in the side.
6. Observe what happens to the colored water coming out of the holes in the cup. What happens if you stop spinning the Lazy Susan?

Results

The curving of the food colored water is similar to the reaction of large air masses in the Earth's atmosphere. As the Earth rotates, the spinning air deflects counterclockwise in the Northern Hemisphere. This deflection is called the Coriolis effect.

It's a Vicious Cycle

The Earth's Water Cycle ~



The water on the Earth goes through a great cycle - from the oceans and lakes it evaporates and becomes part of clouds in the sky. It will eventually change to rain, which gets absorbed into the ground...and finds its way back to the rivers, lakes and ocean. You can create a smaller version here!

Materials

- » Large clear glass bowl
- » Pitcher of clean water
- » Spoon
- » Ruler
- » Small glass bowl
- » Salt
- » Plastic wrap
- » Small marble

Instructions

1. Fill the large bowl with water so it is about 1 cm deep.
2. Add several dashes of salt and stir to dissolve. You can taste the water to see how salty it is.
3. Place the small bowl in the center of the large bowl then cover the large bowl with plastic wrap.
4. Set the marble in the center of the plastic wrap (over the small bowl) so that the plastic wrap sags a bit.
5. Place the bowls in a sunny spot for a few hours.
6. After a few hours you should now have some water in the small bowl. Taste that water, too. Does it taste salty or not?

Results

The big bowl acts like the ocean, the plastic wrap is like a cloud. The marble helps collect water to form 'rain' which falls into the smaller bowl.

National Weather Service - Huntsville

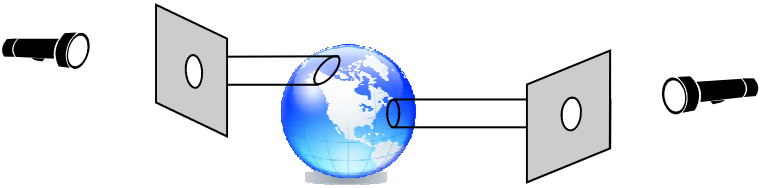
Is it Hot in Here or is it Just Me?

Differences in Heating the Earth ^

The Earth is at an angle, which allows the Equatorial regions to receive more direct sunlight than the poles.

Materials

» Flashlight
» Cardboard
» A large coin
» Globe
» Scissors

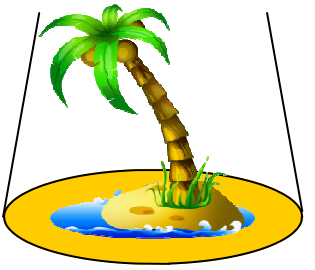


Instructions

1. Place a coin on a piece of cardboard. Draw a circle around it and cut out the circle.
2. Shine a flashlight toward the globe through the hole in the cardboard.
3. Move the cardboard to direct a circle of light at the Equator.
4. Keep the flashlight still and move the cardboard up to shine light at the North Pole.

Results

The light makes a small, bright dot at the equator, but is more pale and spread out at the poles. The sun acts in much the same way—providing more direct sunlight at the equator than at the poles. That is why it is generally hotter nearer the equator (think of the tropical islands) and colder near the North and South Poles (think of penguins and polar bears).



Under Pressure

Atmospheric Pressure and Elevation *

Meteorologists talk a lot about pressure (high pressure and low pressure systems)...but what *is* air pressure?

Materials

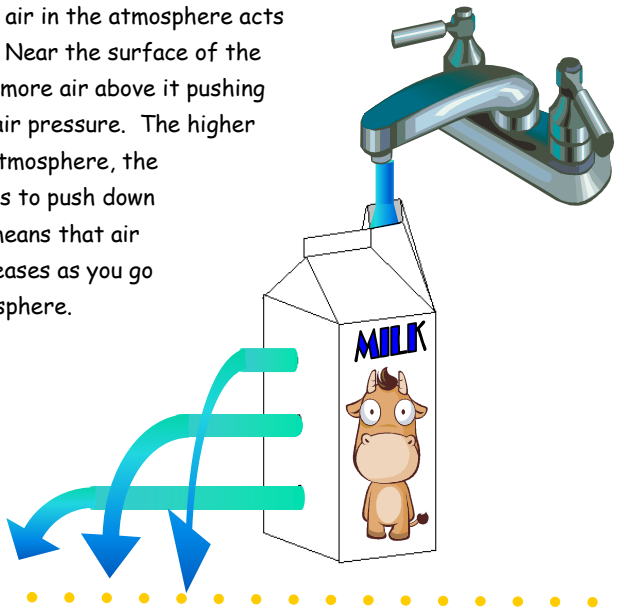
» Half-gallon cardboard milk carton
» A sharp pencil or nail
» Sink
» Water faucet

Instructions

1. With the help of an adult, poke three holes at different heights in the side of the milk carton.
2. Fill the carton with water - keep it in the sink!
3. Watch how the water streams out of the holes as different heights.

Results

More water and more weight is pressing on the bottom hole so more force pushes water out of that hole. Less water and force pushes water out of the top hole, so that water stream doesn't go as far. The air in the atmosphere acts the same way. Near the surface of the earth there is more air above it pushing down - this is air pressure. The higher you go in the atmosphere, the less air there is to push down on you. That means that air pressure decreases as you go up in the atmosphere.



Time to Weigh In

The Weight of Air~

In the previous experiment it was said that at the surface of the earth there is more air pushing down and therefore more air pressure. But does the air really weigh anything? Let's test to see.

Materials

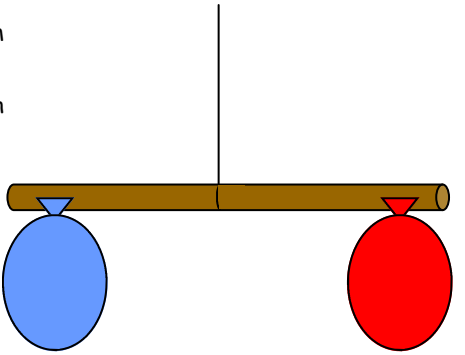
» Thin dowel (~50 cm long)
» Scissors
» Straight pin
» A piece of string (25 cm long)
» Two balloons of equal size
» Tape
» Pencil

Instructions

1. Find the center of the dowel and tie the string at the center point.
2. Hold the dowel by the string and adjust the position of the string until the dowel is balanced on it.
3. Blow up the balloons to about the same size and tie off the ends.
4. Tape the tied-off end of each balloon to each end of the dowel.
5. Adjust the string as needed to maintain balance.
6. Place a piece of tape approximately 2-3 cm long on one balloon.
7. Have your partner or an adult use the pin to carefully prick a hole through the tape and into the balloon. The tape will stop the balloon from popping.

Results

As the air slowly escapes from one balloon, you'll notice the dowel move. The empty balloon will rise higher than the full balloon, indicating the weight of the air inside the full balloon.



The Eggceptional Power of Pressure

The Strength of Air Pressure

Materials

» Hard-boiled, shelled egg
» Matches
» Glass bottle (opening slightly smaller than the diameter of the egg)
» Several strips of paper

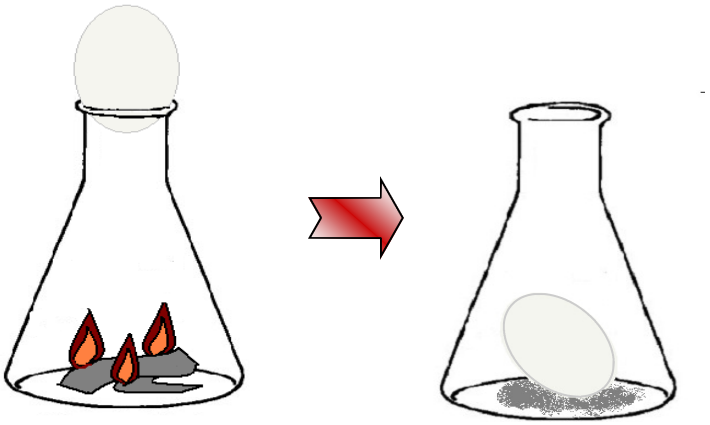
Instructions

1. Rinse the jar and dry thoroughly.
2. Have an adult light a match and set the paper on fire. Quickly drop the burning strips of paper into the bottle.
3. Immediately cover the opening of the bottle with the egg.

Results

The burning strips of paper create hot air inside the bottle. When the egg is placed over the opening of the bottle, the fire loses its oxygen source and extinguishes itself. As the air inside the bottle cools, it contracts, causing the pressure outside the bottle to be higher than the pressure inside the bottle. As a result, the egg is 'sucked' into the bottle.

**HINT* To get the egg back out of the bottle, add baking soda and vinegar to the bottle and turn the jar upside down over a sink.*



Windy City

Pressure Systems and the Wind ~

The wind affects us every day (by providing energy for kites to fly and giving us bad hair days) but what creates the wind?

Materials

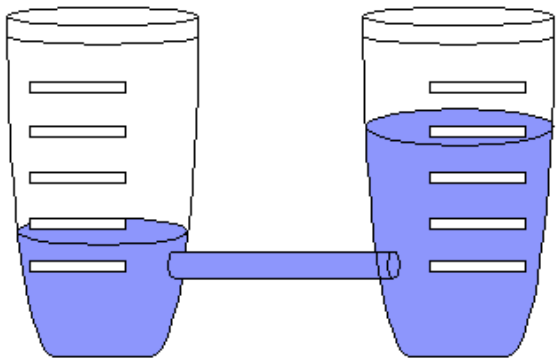
» 2 Two-liter bottles
» 30 cm of plastic tubing
» Tape
» Ruler
» Water
» Scissors
» Food coloring
» Clay
» Marker
» A pitcher

Instructions

1. Have an adult help you cut the tops of each bottle and drill a hole in each about 10 cm from the bottom. Seal the cut edges with tape.
2. Mark each bottle at 10, 15, 20 and 25 cm from the bottom.
3. Place the plastic tube in the hole of each bottle to connect them. Use clay to seal the connection between the tube and bottles.
4. Fill a pitcher with water and food coloring and stir.
5. Fill one bottle up to the level of the tube. Then fill the other bottle all the way to the top.
6. Watch how long it takes for the water to level off—what happens if you try starting with different levels of water in each bottle?

Results

There is less pressure in the bottle with less water. The water continues to flow until the pressure difference between the bottles evens out. Air flows from high to low pressure (the wind!) just like water flows from a higher level to lower ones. The greater the difference between the pressure areas, the greater the wind speed.



Full of Hot Air

Hot Air Currents ~

Clouds and thunderstorms are created by rising air, but what makes the air rise in the first place?

Materials

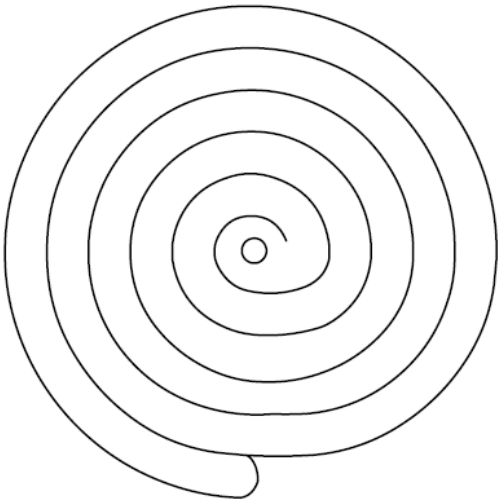
» Spiral on white paper
» Scissors
» Sewing thread / string
» Pencil
» Large sewing needle
» Light bulb / lamp

Instructions

1. Trace and cut out a copy of the spiral pattern below (leave the center circle).
2. Thread a needle with the string. Bring the ends of the string together and make a knot.
3. Poke the needle through the circle in the center and pull the string through so the spiral hangs from the string.
4. Hold the spiral above the light (but DON'T place it on the bulb) and turn on the lamp.

Results

The air around the light bulb is heated, which causes molecules to expand and move about. Air that is heated is less dense and rises while cooler air sinks in its place. This rising air (or hot-air currents) causes the spiral to spin. This process is an example of convection which can lead to strong thunderstorms on a larger scale!



Look for the Silver Lining

Creating a Cloud in a Bottle+

For clouds to form, three key ingredients are needed—1) water, 2) dust particles, and 3) temperature or pressure changes.

Materials

» Two-liter soda bottle
» Matches
» Water
» Bicycle pump

Instructions

1. Add a small amount of warm water to the bottle. Replace the cap and shake up the bottle so the water drops stick to the inside of the bottle. Pour out the rest of the water so there is none sitting in the bottom. This provides the first ingredient of water.
2. Light a match and let it burn for a few seconds. Blow it out, immediately drop it in the bottle and replace the cap. The smoke from the match provides the key ingredient of dust!
3. Squeeze the bottle as hard as you can then release both hands evenly and quickly six or seven times (or more). This provides the last key ingredient of temperature and pressure changes.
4. After several squeezes, squeeze and hold for a few seconds. You should see a cloud appear when you release your hands. (Try placing in front of a dark background for easier viewing.)
5. For a more advanced version, you can use the bicycle pump to greatly increase the pressure inside the bottle and then quickly release it to create a cloud.

Results

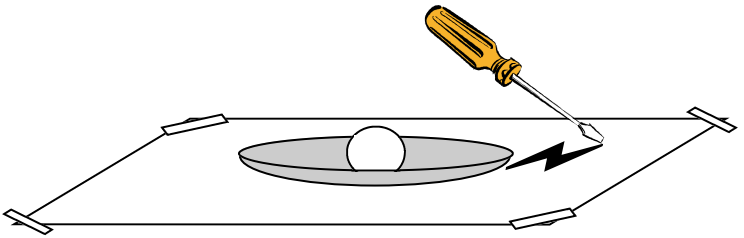
Dust particles are necessary for the formation of clouds. Water vapor in the air collects on these particles and make the clouds we see in the sky and in our bottle. Also, when air pressure or temperature decreases it cannot hold as much water...so by increasing the pressure inside the bottle (by squeezing or pumping in air with the bike pump) and then letting the pressure drop, we can see a cloud.

See a video of this experiment at:
http://www.stevespanglerscience.com/experiment/00000030

It's Electric!

Making Lightning^

As many as 50,000 storms happen every day throughout the world. Inside a storm cloud, water droplets and ice crystals rub against each other, giving them an electrical charge. Eventually, built up energy within the storm is released as flashes of lightning.



Materials

» Metal tray
» Modeling clay
» Rubber glove
» Plastic sheet or cotton cloth
» Screwdriver
» Tape

Instructions

1. Tape the sheet or cloth to the surface.
2. Adhere a ball of clay to the tray. Put on the glove and use the clay as a handle to rub the tray against the sheet or cloth for about two minutes.
3. Make sure the room is dark. With an adult's help, hold the screwdriver in your gloved hand and bring it close to the edge of the tray. Do not touch the tray with your hands.

Results

The tray builds up a charge similar to that in a storm cloud. As the energy is released to the screwdriver, you should hear a crackle and see a spark of lightning.

Living On the Edge

Simulate a Weather Front+

A weather front is a region where two air masses are interacting. Using cold blue water and warm red water, you will see how frontal boundaries are formed between two air masses.

NOTE - Do this experiment over a sink!

Materials

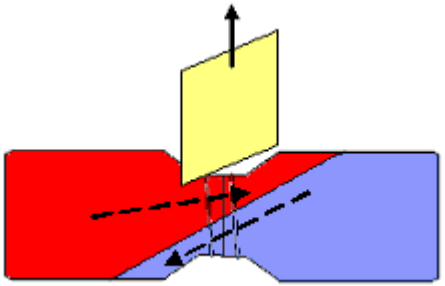
» Red and blue food coloring
» Warm water
» Index card / plastic coated paper
» Two glass jars of equal size
» Cold water
» Spoon

Instructions

1. Fill one of the jars full to the brim with warm water. Add a few drops of red food coloring and stir with a spoon to disperse the color.
2. Fill the other jar full to the brim with cold water. Add a few drops of blue food coloring and stir with a spoon to disperse the color.
3. Place index card on top of the warm jar and press down around the edges of the jar to make a seal. Keeping your hand flat on the paper, slowly turn over the jar until it is upside down. Do not remove your hand. Some spilling of the water is normal.
4. Move the warm water jar over top the cold water jar so the edges meet up. The paper will act as the boundary between the layers.
5. Slowly remove the paper once the jars are stacked.
6. Keeping one hand on each jar, slowly turn the jars to one side, making the jars parallel with the ground.

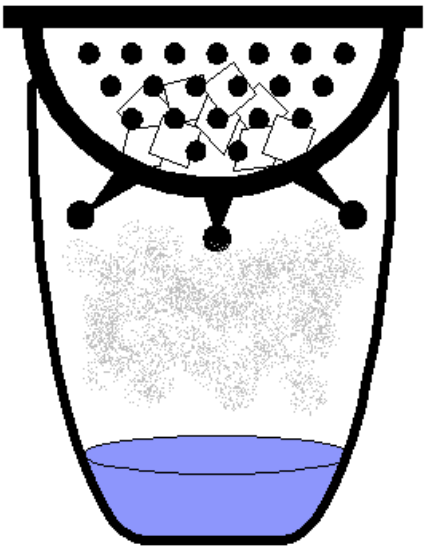
Results

The cold water is more dense than the warm water, and so the blue water slides underneath the red water. This experiment simulates what happens when a cold front approaches a warm airmass.



Haven't the Foggiest Idea

Creating Fog



There are many types of fog but all types are simply clouds that occur very close to the surface. The main problem with fog is that it can quickly reduce visibility for drivers on roadways. Some examples include fog that can be created when cold air flows over a warm water surface (steam fog), some that is created on windless, cloudless, cool nights (radiation fog), and some that occurs when warm air flows over a cool surface (advection fog). Here is a simple way to make steam fog.

Materials

- » Glass jar
- » Water
- » Strainer
- » Ice cubes

Instructions

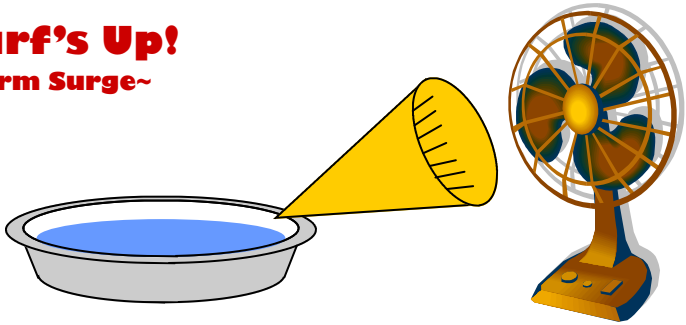
1. Fill up the jar almost completely with hot water and let it sit for about one minute.
2. Pour out almost all the water, leaving about one inch in the jar.
3. Put the strainer over the top of the jar.
4. Place a few ice cubes in the strainer.

Results

The cold air from the ice cubes collides with the warm, moist air in the bottle. This causes the water vapor in the bottle to condense and form the eerie fog.

Surf's Up!

Storm Surge~



Hurricanes are dangerous because they produce damaging winds, heavy rainfall, inland flooding, and even tornadoes. But along the coast, a major cause of damage is storm surge.

Materials

» Small electric fan
» Construction paper
» Tape
» Grease pencil
» Scissors
» Dish pan
» Water

Instructions

1. Make a funnel out of the construction paper so it fits over the fan.
2. Tape it to the wide end of the fan to concentrate the wind.
3. Fill the dishpan with water to within 5 cm of the top.
4. Mark the water level at one end of the pan with the grease pencil.
5. Position the fan so it will blow toward the marked end and turn it on.
6. Mark the new water level with the grease pencil.
7. Turn off the fan and measure the difference between your marks.
8. Repeat the experiment but tilt the pan to raise the water level at your first mark. Now you can simulate storm surge at high tide.

Results

Winds in a hurricane create storm surge in two ways - you have simulated one of them. Storm surge increases with stronger winds but it also increases when hurricanes have lower pressure at their center. Can you think of a way to simulate that?

National Weather Service
Huntsville, Alabama

Looking to learn more about the weather or the NWS?
Check out some of these websites for more activities and other information.

The National Weather Service Homepage:
www.weather.gov

The National Weather Service in Huntsville:
www.weather.gov/huntsville

JetStream Online School for Weather:
www.srh.weather.gov/jetstream

National Severe Storms Laboratory Education:
www.nssl.noaa.gov/edu

SOURCES FOR PROJECTS

* - Kids' Book of Weather Forecasting (By Mark Breen, Kathleen Friestad)
\# - Weather Forecaster (By Barbara Taylor-Cork)
^ - Make it Work! Geography: Weather (By Andrew Haslam, Barbara Taylor)
+ - About.com
~ - Nasa Sci-Files

National Weather Service - Huntsville

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www.weather.gov/huntsville