National Oceanic and Atmospheric Administration
U.S. Department of Commerce

Learning Lesson: Updrafts in Action

Overview

Rain and hail will be suspended by the updraft inside a thunderstorm until the weight of the hail and water can no longer be supported. Usually, the stronger the updraft in a thunderstorm, the more intense the storm and the larger the size of hail that can be produced. Suspending a ping pong ball in the stream of air supplied by a hair dryer will demonstrates how hail is supported in thunderstorms.

TOTAL TIME	10 minutes
SUPPLIES	Hand held hair dryer; at least two ping pong balls
PRINTED/AV MATERIAL	None
TEACHER PREPARATION	It is better to have several ping pong balls on hand as occasionally they will fall out of the air stream.
SAFETY FOCUS	Thunderstorm safety

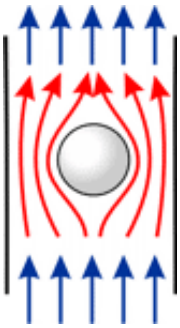
Procedure

1. Point the nozzle of the hair drier up and turn the power on HIGH. Place the ping pong ball in the stream of air. The ping pong ball will be suspended by the air flow. Slowly tilt the hair dryer to the left or right until the ball falls.
2. Repeat the demonstration, but add a second ping pong ball. Depending upon the power of the hair dryer, both ping pong balls will be suspended. Occasionally, the balls will swap their order as they bounce around in the air stream.

Discussion

The ping pong ball remains in the stream of air due to lower pressure created around the surface of the ball. The effect is called the Bernoulli Principle, named after Daniel Bernoulli, an eighteenth-century Swiss scientist who discovered that as the velocity of a fluid increases, its pressure decreases.

Bernoulli's principle can be seen most easily through the use of a venturi tube (see figure left). A venturi tube is simply a tube which is narrower in the middle than it is at the ends. When the fluid passing through the tube reaches the narrow part, it speeds up. According to Bernoulli's principle, it then should exert less pressure.



This low-pressure effect also can be seen around the ping pong ball, albeit in a slightly different way. Instead of narrowing in the center of the venturi tube from the outside, the narrowing takes place around the perimeter of the ping pong ball inside the air stream (see figure right). In effect, there is an area of low pressure immediately adjacent to the ball.

The pressure is higher in the air outside of the stream created by the hair drier. As the ping pong ball reaches the edge of the flowing air, it is pushed back into the region of low pressure. The result is the ping pong ball bouncing from side-to-side inside the stream of air.

Repeat the experiment, and this time have the students notice the back-and-forth oscillation of the ball as it tries to fall out of the stream but is pushed inward. Here is another way of seeing this inward push.

Updrafts are the engine for the thunderstorms we experience, pulling in moisture (the fuel) from the surrounding area. As the storm grows, warm and moist air is pulled rapidly upward, causing water drops and ice to be pulled upwards due to the rapid wind speeds and lower pressure. Generally, the stronger the updraft, the stronger the thunderstorm and the larger the hail it can produce.

While we cannot predict if you will definitely experience a thunderstorm on any particular day, we can know the areas where thunderstorms are possible. If atmospheric conditions are such that thunderstorms may become severe, the National Weather Service will issue a **SEVERE THUNDERSTORM** or **TORNADO WATCH**.

A **WATCH**, issued by the Storm Prediction Center in Norman, Oklahoma, is used when the risk of severe thunderstorms and/or tornadoes has increased significantly, but their exact occurrence, location, and/or timing is still uncertain.

It is intended to provide enough lead time so that those who need to take action on emergency plans can do so. These watches are issued by county.

The National Weather Service defines a severe thunderstorm as one having **wind speed of 58 mph (93 km/h) or greate**r and/or **hail size of 1" (2.5 cm) or larger**.

Each watch is numbered sequentially, beginning with number 1 for the first issuance of each calendar year and contains:

- hail size (in inches),
- turbulence (for aviation community),
- surface wind speed (in knots),
- maximum height of thunderstorm tops (in hundreds of feet),
- estimated direction and speed of thunderstorm movement, and

- a discussion of the meteorological reasoning that supports the watch issuance and forecast for severe weather.

Building a Weather-Ready Nation

The most important weather safety rule is to know what is happening so that you will not be caught unaware in a hazardous situation. At the beginning of each day:

1. Learn of any hazardous weather that might impact you. You can do this by listening to the NOAA Weather Radio or checking out the day's forecast at www.weather.gov.
2. Check the Convective Outlooks to discover where thunderstorms are most likely to occur.
3. Stay aware throughout the day by periodically rechecking the forecast to learn of any updates.

If a **WATCH** is issued for your area, listen carefully to the message; it will tell you the type of threat you can expect from severe thunderstorms or other hazardous weather. If hazardous weather approaches your location, seek sturdy shelter. For more information on what to do during severe weather, check out the NWS Seasonal Safety Campaign website.

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