High Touch High Tech®

Science Experiences That Come To You

Tornado Tube©

Supplies:

- 2 x clear plastic 1-liter bottles
- 12 oz. water
- Food color tablet
- Tornado tube connector
- Flying objects (glitter & beads)

Instructions:

1. Fill one bottle with 12 oz. of water.

2. Add food color tablet to the water.

3. Attach the tornado tube connector.

4. Add beads, glitter, and more to have fun objects “flying” in your tornado!

5. Attach the second bottle to the other end of the tornado tube connector. Make sure that the bottles are screwed on securely so that the water does not leak.

6. Place the connected bottles on a flat surface with the empty bottle on the bottom.
    a. What happens?
    b. Why doesn’t the water begin to flow down from the top bottle?
        i. Here’s why: Even though the bottom appears empty, it is really filled with air. Since air occupies the space in the lower bottle, the water cannot flow into the bottom bottle unless the air has somewhere to go.

7. Hold the end of the top bottle and swirl it in a circular motion until a vortex develops.

The intensity of a tornado is measured using the Enhanced Fujita Scale. Adapted from the original Fujita Scale developed in 1971 by Dr. T. Theodore Fujita from the University of Chicago, the scale uses ratings from 0 to 5 to estimate the wind speed and severity of the damage caused by a tornado. Check out the scale below and see what kind of “damage” your tornado tube experiment creates!

The Science Behind It:

A **tornado** is caused by a series of down drafts of cold air, pushing vigorously toward the ground. At the same time warm air rises high in the sky, the cold air forces the warm air down, a swirl may begin to occur, and a funnel cloud may develop. This is the beginning of a tornado.

In our tornado tube experiment, the circular motion of the bottles causes the water to rotate in a circular motion. The force of gravity is acting on the water in the upper bottle and the water is dropping through the hole in the tornado tube connector. Did you notice that the water avoids the center of the vortex and the air from the bottom flows upward through the vortex into the top bottle?

Tornadoes are very cool storms, but they are dangerous. Tornadoes are the same type of storm as a cyclone. **Cyclones** occur in the Southern Hemisphere and the winds rotate clockwise. Tornadoes occur in the Northern Hemisphere and the winds rotate counterclockwise. This is also true with typhoons and hurricanes. **Typhoons** occur in the Southern Hemisphere and the winds rotate clockwise. **Hurricanes** occur in the Northern Hemisphere and the winds rotate counterclockwise.

Hurricanes are exceptionally large, organized storms. Depending on where they originate these storms can be called hurricanes, typhoons, or cyclones. In the northern hemisphere, these storms rotate in a counterclockwise direction due to the **Coriolis effect**. In the southern hemisphere, they rotate in the opposite direction again because of the Coriolis effect. The Coriolis Effect refers to the deflection of air because of the rotation of the earth on its axis.

A hurricane is huge air masses swirling around a calm center (the **eye**), and must have windspeeds of at least 74mph. Hurricanes form when very warm, moist air close to the ground or ocean begins to rise high in the sky. Then really cold air begins to exert pressure or energy upon the warm air. This is now called a **tropical depression**. The tendency at this point, if the storm continues over open water, is to strengthen (through the continued evaporation of warm water) into a **tropical storm** with wind gusts of 45 miles per hour. The air becomes increasingly unstable and begins to swirl in concentric rings around the center.

These rings continue to stack up on one another and continue to add energy and pressure to the system. Soon the wind gusts are at 74 miles per hour and the storm becomes a **hurricane**. Atlantic hurricanes form off the west coast of Africa when warm air from the Sahara Desert blows out to sea, and gains momentum over the warm ocean.

One danger involving hurricanes is that these strong winds can be sustained for a long period of time. Then there is a calm eye where the winds die down to nothing. You could even see the sun shining. However, take cover because the second half of the storm is approaching.

Which do you think is the more dangerous storm, a hurricane, or a tornado? Both are extremely dangerous and both storms create destructive winds. The answer? The tornado is a more dangerous storm than a hurricane. A tornado is not that predictable, and you may only have a few minutes warning to get to a safe place. When a hurricane is coming, we know it is coming for a few days so we can seek shelter and be safe when the storm does come.

You can make your very own “hurricane bottle” by repeating the instructions above using 2-liter bottles! Simply replace the 1-liter bottles with your 2-liter bottles.

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Enhanced Fujita Scale

Scale	Wind (MPH)*	Damage**
EF0	65-85	Minor damage: Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. While permanent buildings generally suffer only minor damage, unprotected mobile homes or trailers may sustain moderate to serious damage.
EF1	86 - 110	Moderate damage: Roofs severely stripped; mobile homes overturned or severely damaged; loss of exterior doors; windows and other glass broken.
EF2	111 - 135	Considerable damage: Roofs torn off from well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136 - 165	Severe damage: Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations are severely damaged.
EF4	166 - 200	Devastating damage: Well-constructed and whole frame houses completely leveled; some frame homes may be swept away; cars and other large objects thrown, and small missiles generated.
EF5	Over 200	Incredible damage: Well-built frame houses destroyed with foundations swept clean of debris; steel-reinforced concrete structures are critically damaged; tall buildings collapse or have severe structural deformations; cars, trucks, and trains can be thrown approximately 1 mile (1.6 km).

*Source: https://www.weather.gov/oun/efscale
**Source: https://en.wikipedia.org/wiki/Enhanced_Fujita_scale