Meteorologist demo: Vortex

Time: 45 Minutes **Skill Level:** Elementary (age 6-11), Middle School (age 12-14)

Background

What is Science Inquiry?

Children are natural scientists. From a very early age they explore the world, ask questions and seek answers. This journey of exploration and discovery is Science Inquiry. Science Inquiry helps young people understand their environment, solve problems and gain knowledge about scientific ideas and processes.

Next Generation Science Standards (NGSS)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions	**PS1:** Matter and its interactions	**1.** Patterns
3. Planning and carrying out investigations	**PS2:** Motion and stability: Forces and interactions	**2.** Cause and effect: Mechanism and explanation
6. Constructing explanations	**ESS2:** Earth's systems	**4.** Systems and system models
7. Engaging in argument from evidence	**ESS3:** Earth and human activity	**5.** Energy and matter: Flows, cycles, and conservation
		7. Stability and change

Objective

In this demonstration, students will learn about vortices and observe a tornado in a bottle.

About the Scientist

Meteorologists are scientists that study weather and the atmosphere. The word meteorologist comes from the ancient Greek word, metéōros, meaning *high in the sky*. Meteorologists predict weather and climate patterns, and identify how other environmental processes may be affected. This is important both locally and globally, since weather impacts our daily lives, as well as the economy.

The Science of Vortices

One type of phenomena that meteorologists study is a *vortex*. A vortex is a mass of whirling liquid or gas. Some common examples are tornadoes, dirt devils, and whirlpools. In liquids, a whirlpool forms when the downward flow of the water into a drain (or small opening) begins to rotate. As the rotation speeds up, a vortex forms. Similarly, a tornado can form from the pressure and temperature imbalance present during thunderstorms, in combination with wind.

Materials List:

2 two-liter plastic bottles (empty)
Tornado Tube®
Water

Prep …Partially fill one bottle with water. Screw the bottles into opposite ends of the Tornado Tube. Ensure the Tornado Tube is tightened sufficiently and the bottles are secure. Optionally, you can add food coloring, glitter, or a small object such as a toy diver.

Discuss …What do students know about meteorologists? Have they seen one on TV? Has anyone heard the word *vortex* before? Has anyone seen a whirlpool from a tub draining? Or experienced a dirt devil? A tornado? Show the students the bottle assembly. What's going to happen if we flip the bottles over and put the full bottle on top?

Predict …Generate Ideas. Select a Solution

Experience "What to Do"- What is the plan for the investigation?

Part 1: Invert the bottle assembly and set it on the table with the full bottle on top. Allow water to drop through the Tornado Tube into the empty bottle.
Part 2: Demonstrate a "tornado in a bottle" by inverting the assembly again (so that the full bottle is on top) and swirling the bottle to create a spiral motion in the water until a vortex forms.

Share …Encourage students to observe and discuss Part 1 before proceeding to Part 2. What's happening to the water? Why does it move? Is there anything in the empty bottle?

Reflect …**Analyze and interpret the data and results. Discuss among the group.** In both examples, water in the top bottle is falling due to gravity and exchanging locations with air in the bottom bottle. What is the interaction between the air and water in Part 1? How does that interaction differ for Part 2? In which example does water move the quickest? Why?

Generalize …**to real world examples. Construct explanations.**
Where else do students see vortices? Outside? In your home?

Apply …**outside the classroom or club meeting.**
Based on your observations, how does an actual tornado form?

Additional resources:

- This experiment is based on an activity designed by Steven Spangler, available on his website, **http://www.stevespanglerscience.com/lab/experiments/tornado-in-a-bottle1**
- For more information on meteorologists, see the American Meteorological Society website, **http://www.ametsoc.org/careercenter/careers.html**

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