Why do hurricanes go counterclockwise in the northern hemisphere?

A laboratory experiment from the Little Shop of Physics at Colorado State University

Overview

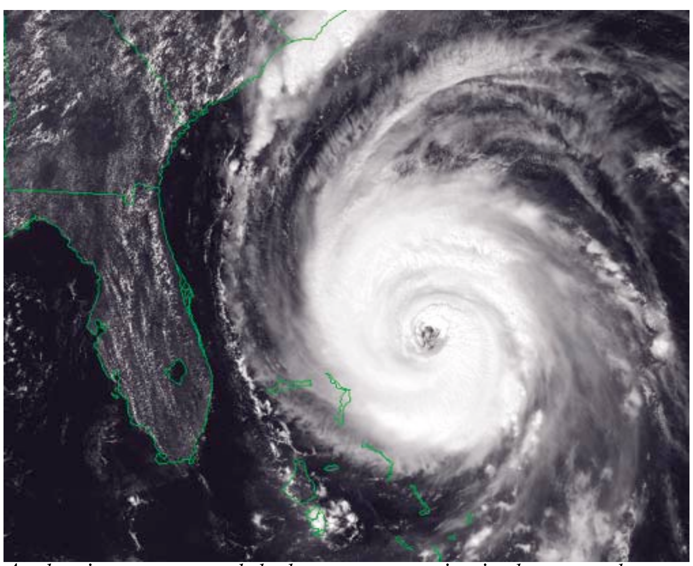
The Coriolis force is part of the reason that hurricanes in the Northern Hemisphere rotate counterclockwise. If the Earth didn't spin, we would have wicked 300 mph winds from the tropics to the poles and back again. The Earth does spin however, and in the mid-latitudes, the Coriolis force causes the wind—and other things—to veer to the right. It is responsible for the rotation of hurricanes.

But the Coriolis force on earth only works on very large scales. It doesn't affect such small things as toilets and sinks. You may have heard of people claiming that toilets and sinks swirl counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere due to this force. As cool as that would be, it's just not true. It turns out that the way the water swirls has to do with a number of conditions such as the shape of the bowl and the way the water enters the bowl. Alistair B. Fraser lists other goofy examples people attribute to the Coriolis force in the different hemispheres, including, the way dogs circle before lying down, and the way women's ringlets curl. The website is called Bad Coriolis and can be found at www.ems.psu.edu.

Necessary materials:

- One foam ball
- A large area to form a circle with your students
- An even number of participants

You may want to demonstrate with just 2 to 6 people in the circle before attempting this with your class. It is also helpful to have a few adults participating in the circle. This activity will be successful if students understand the directions and also are dexterous enough to catch a ball. We know! We tried this with 4th graders and eventually they caught on to how this worked and what was happening.



As the air moves toward the low pressure region in the center, the Coriolis force causes a rightward deflection—leading to the counterclockwise rotation of the hurricane.

Theory

So what is the Coriolis force? Let's look at a scenario before discussing it further.

Imagine two people playing catch. They are running in a straight line, parallel to each other and tossing the ball back and forth. The ball is easy to catch because they are always directly across from each other. Now, let's make this game more complicated. Our two players opt to continue their game of catch, but decide to run in a circle where they are still across from each other. As they circle counterclockwise, the ball is tossed. Rather than go directly to the catcher, the ball appears to veer to the right. They try it again and the same thing happens. They think something mysterious is pushing the ball to the right. When they ask their friends who have been watching the game, the friends say the ball went straight and the two players just missed it. What is going on?

Why did the players think the ball veered to the right, yet their friends watching from the sidelines, clearly saw that the ball traveled a straight path. It all has to do with frame of reference and Newton's 1st Law: All objects in motion stay in motion unless acted upon by an outside force. The ball does travel in a straight line... but the players don't!

The Coriolis force is an example of a ficitious force, and can be compared to another such force, the centrifugal force. You most likely have felt this while riding in a car. You are traveling straight ahead in a car, when suddenly the driver has to make a sharp left turn. Your body continues to travel forward, but it feels as if your body is pushing out on the car door. Actually, the car door is pushing in on you!

Doing the Experiment

- Have your group form a circle. Have each person point to their partner directly across from them, so they know whom they will toss the ball to.
- Have them take turns tossing the ball underhanded to their partners, so they get a feel for how hard they need to toss the ball to get it across the circle.
- Explain to the class that they will now turn their bodies to the right and start circling to the east, just like the Earth in its orbit. They will continue to toss toward their partner, but the ball can only be caught if it comes directly to an individual. The partner is not supposed to reach across and grab it from someone else.
- Students will soon see that the ball starts out aimed at the partner, but by the time it reaches the other side, is caught by the person to the right of the partner.
- It should appear as if the ball is veering to the right, by the participants in the circle.

Summing Up

The Coriolis force is a complicated concept that is difficult for many to grasp. Be patient and give your students as many experiences as you can with this concept. You may want to show them video clips to reinforce this activity. If you can find a merry-go-round in your area, use it with your students to reinforce this concept.

For More Information

CMMAP, the Center for Multi-Scale Modeling of Atmospheric Processes: http://cmmap.colostate.edu

Little Shop of Physics: http://littleshop.physics.colostate.edu