Coriolis Effect Lab

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The Coriolis Effect has a major influence on wind direction. In this exercise you will view videos, play a game, read and answer questions to help in visualizing the Coriolis Effect. You will also find the rotational speed of the earth near Indianapolis, Indiana!

Begin by watching these videos:

http://www.youtube.com/watch?v=mcPs_OdQOYU

http://www.classzone.com/books/earth_science/terc/content/visualizations/es1904/es1904page01.cfm?chapter_no=visualization

Now, try this game!:

http://www.montereyinstitute.org/noaa/lesson08/l8ex1.htm

Read the following web pages and watch the video which is linked below, which shows how the Coriolis Effect creates geostrophic wind:

http://ww2010.atmos.uiuc.edu/(Gh)/wwhlpr/coriolis.rxml?hret=/guides/mtr/fw/geos.rxml

http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/fw/geos.rxml

Video to watch: https://www.youtube.com/watch?v=gCfqqwXpbwg

Read the following explanations of the Coriolis Effect:

An intuitive explanation (using Northern hemisphere examples):

Moving from the North Pole toward the equator: This is the easiest direction to visualize and one you have seen in the above videos. Imagine a plane leaving the North Pole and aiming directly for a certain location. The entire time it is flying south toward its destination, the earth's surface is moving out from underneath it, toward the east. The plane will end up west of (or from the plane's point of view, to the right of) its intended destination.

Moving from the equator toward the North Pole:
This requires a little background information. An object at the North Pole would not move, other than turning, as the earth revolves around the pole once in 24 hours. As you go further south, the earth is wider and wider, and the distance to be travelled in 24 hours is literally further, so objects at the surface of the earth are moving faster. Although we do not sense this type of movement, an object at the equator is actually travelling a dizzying 1,018 mph to the east in order to rotate around the earth's axis every day.

To visualize the Coriolis Effect when traveling from south to north in the northern hemisphere, we must consider the fast starting speed of the airplane. Before it even takes off, an airplane leaving the equator and going to a city at 30 degrees north is moving to the east 136 mph faster than is its destination. As the plane flies northward, it also retains this eastward velocity, and continues to move toward the east faster than its destination is moving east. The plane will be east of its intended destination when it arrives at 30 degrees north. This is also a deflection to the right, from the plane's point of view.

A theoretical explanation:

Another way of explaining the Coriolis Effect is by conservation of angular momentum. The following video explains that:

Angular Momentum = Mass x Velocity (i.e., rotational speed) x Radius.

It also indicates that angular momentum must stay the same for a given system, so if one of the values in the equation gets larger, another value must get smaller to keep angular momentum the same.

View the video: http://www.youtube.com/watch?v=aeY9tY9vKgs

The video shows an example of a ball spinning on a string and as the string gets shorter (i.e., the radius gets smaller), the velocity gets larger to compensate. This keeps the value for angular momentum the same. However, on earth, as the radius gets smaller going toward the poles, the rotational speed also gets smaller. The mass can't change, so the only thing that can increase in the equation is rotational speed. The deflection of the Coriolis Effect is a way of increasing rotational speed.

Rotational Velocity at the Surface of the Earth

The Coriolis Effect is greatest near the poles, and least near the equator. Why is this? To find out, you will compute the rotational speed of the earth at various latitudes.

On the next page is a chart showing the circumference of the earth at various latitudes. Fill out the chart by converting kilometers to miles, then finding miles per hour. Then answer the questions.

To convert kilometers to miles, multiply kilometers by 0.62137
To find the miles per hour, divide circumference in miles by 24 hours.

Latitude	**Circumference kilometers**	**Circumference miles**	**Miles/hour**
90	0		
80	6982		
70	13747		
60	20008		
50	25810		
40	30742		
30	34735		
20	37673		
10	39470		
5	39924		
0	40075		

40 degrees north runs along 146th street on the north side of Indianapolis. What is the rotational velocity of the surface of the earth at 40 degrees north? _________________________________

What is the difference in velocity between 0 and 10 degrees north? _________________________

What is the difference in velocity between 80 and 90 degrees north? _________________________

How do these results explain the fact that the Coriolis Effect is stronger near the poles than the equator?

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Hurricanes do not develop within about 5 degrees of the equator because the Coriolis Effect is too weak to cause the rotation. What is the difference in velocity between 0 and 5 degrees north?
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What is NOT caused by the Coriolis Effect?

A popular misconception is that water goes down the drain in different directions in the northern and southern hemispheres and that this is due to the Coriolis Effect. Actually water may circle down the drain in either direction in either hemisphere, and the direction is the result of plumbing differences, not the Coriolis Effect. Although the Coriolis has a major effect over long distances, it is not strong enough to create this kind of rotation over a very small distance.