Lab Activity #2: The Coriolis Effect on a Flat Spinning Earth

Introduction

In this activity, we begin to study the Coriolis effect, the effect that Earth's rotation has on the motion (from the viewpoint of an observer on Earth) of flying objects, including air molecules.

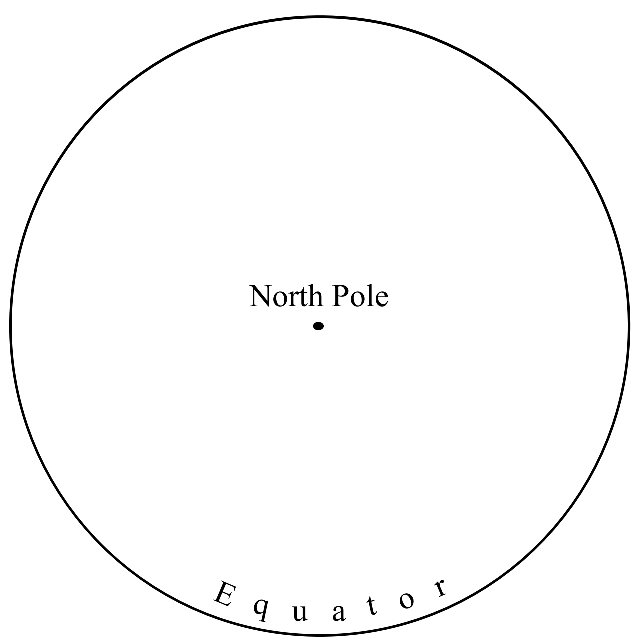
Materials: spinning lab stool
large piece of paper
felt-tip pen
yardstick

Activity

1. Choose a stool that spins easily. Cut out a paper circle that just fits the seat of the stool; tape the paper circle to the stool.
2. Make a mark in the center of the circle to represent the north pole; the edge of the stool represents the equator.
3. Using the yardstick as a guide, draw a path from the north pole to the equator. It should be a straight line. This is the path of an object (such as a missile) that is flying in a straight line from north to south on a NONROTATING Earth.
4. Figure out which way Earth spins, clockwise or counterclockwise, when looking down at the north pole.
5. Repeat step #3, but this time spin the stool (model Earth) in the appropriate direction at a slow constant rate while guiding the pen along the yardstick. This is the path of an object that is flying in a straight line from north to south on a ROTATING Earth.

Questions

1. On the circle below, show the two paths that you drew on the large circle of paper.



2. When you drew the line while rotating the seat of the stool, in which direction (to the right or to the left) was the pen deflected from the intended path (imagine yourself traveling with the pen tip, looking forward)?

3. The experiment you did modeled the situation for the northern hemisphere. Would objects be deflected in the same direction in the southern hemisphere? Explain why or why not.

Lab Activity #3: Coriolis Effect on a Spherical Spinning Earth

Introduction
In this activity, we continue to study the Coriolis effect. This time, we make it a bit more realistic by using a spherical Earth instead of a flat earth.

Materials: "chalk board" globe (we have only two of these, so the groups will have to take turns)
piece of chalk

Activity
1. Without spinning the globe and using the metal arch around the globe as a guide, draw a straight line from the north pole to the equator.
2. Repeat step #1, but this time spin the globe slowly and steadily in the appropriate direction.
3. Repeat steps 1 and 2 but draw your line from the south pole to the equator.

Question: Does the spherical globe display a Coriolis effect similar to the flat lab stool? _________

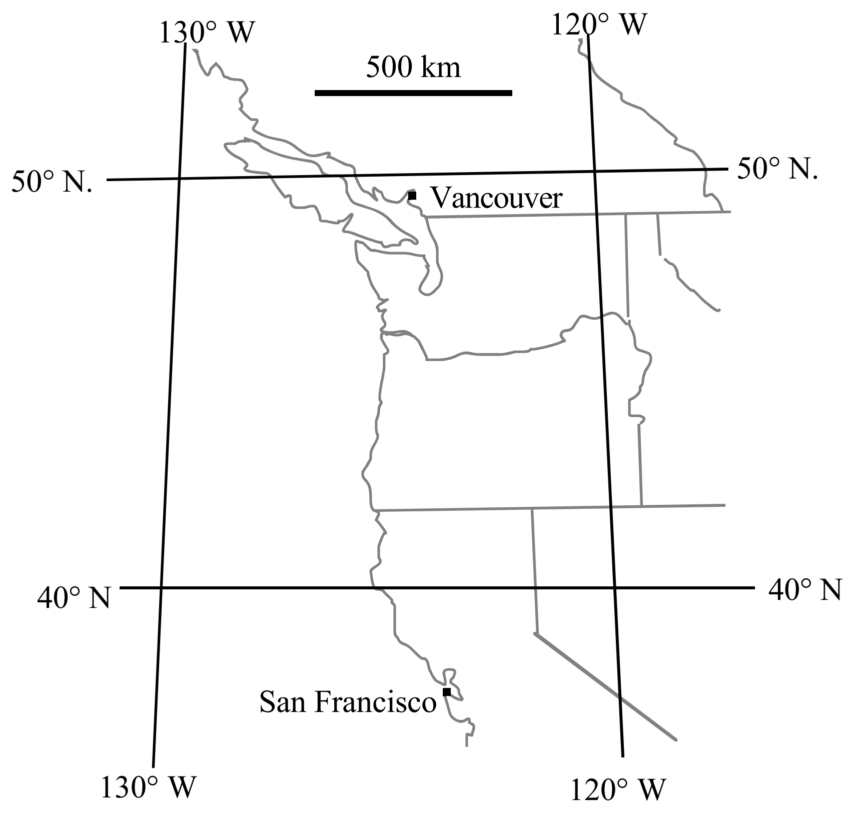
Lab Activity #4: The Coriolis Effect on Objects "Launched" from Somewhere Other than the Poles

Introduction: We will now study how the Coriolis effect works if the object is "launched" from somewhere other than the North or South Pole. This makes things a bit more complicated and almost impossible to model physically. So, we will explore this issue by solving a couple of math "word problems."

1. Imagine a war between Canada and the United States (fortunately, this is a highly unlikely scenario) in which the Canadians shoot a missile from Vancouver, aiming straight south toward San Francisco. Here is some important information:
   - The distance between the two cities is 1300 km.
   - The missile travels toward the south at a speed of 1300 km/hour.
   - Because the missile was launched from Vancouver, it also travels toward the east at the same speed that Vancouver is traveling eastward.
   - As the earth revolves around its axis…
     Vancouver is constantly circling eastward at a speed of 1100 km/hour
     San Francisco is constantly circling eastward at a speed of 1300 km/hour

   a. Why is San Francisco circling eastward faster than Vancouver is?

   b. **Problem to solve:** Where will the missile actually land and why?



2. Even though the missile did not hit San Francisco, the United States is angry about the attempted missile attack and wants to shoot a missile from San Francisco so that it will hit Vancouver. But, like the Canadians, the Americans do not take the Coriolis effect into account. Where will their missile land and why?

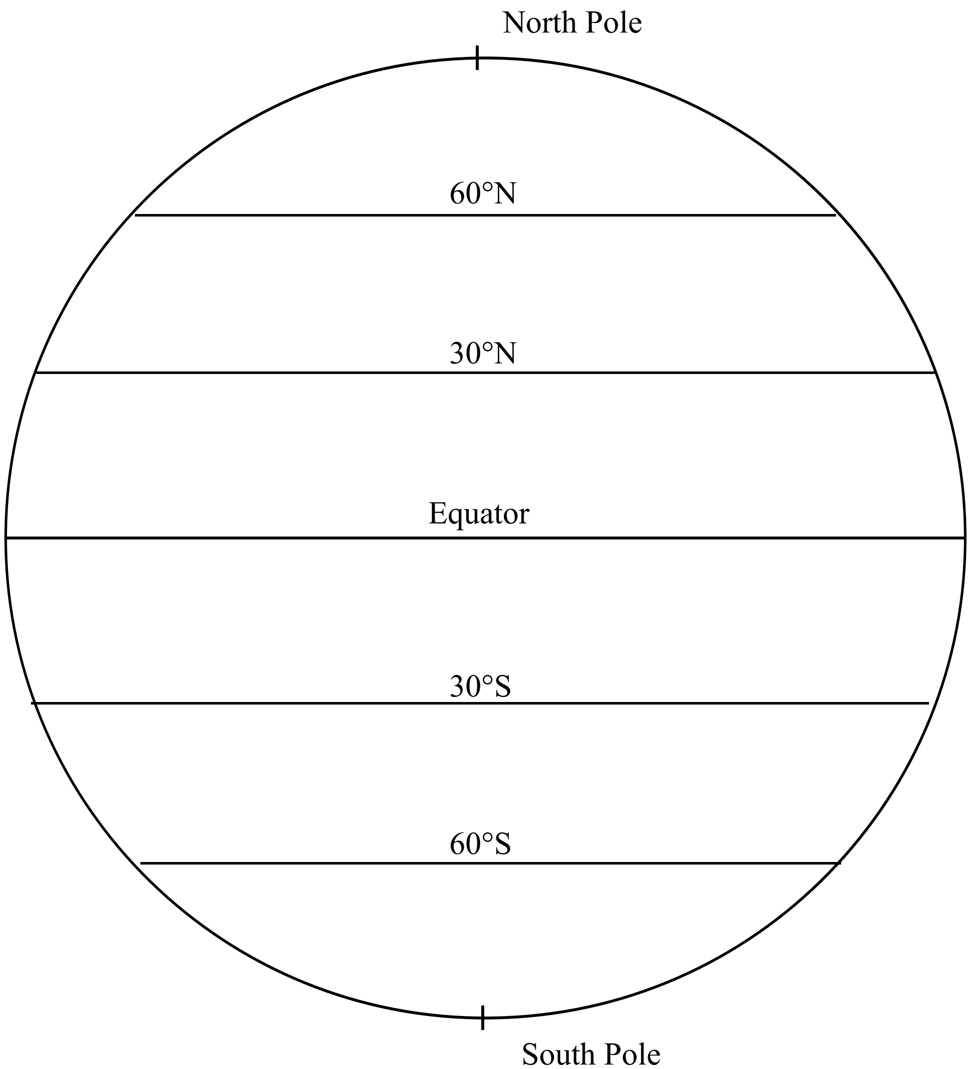
Lab Activity #5: Adding the Coriolis Effect to the Convection Model--Surface Winds

Introduction: It is now time to modify the convection model that you constructed in Activity #1 to take the Coriolis effect into account.

In this model, we will focus on the regions between 30° N and 30° S latitudes--where the trade winds blow. At higher latitudes the wind direction isn't nearly as consistent, partly because the Coriolis effect is so strong (the higher the latitude, the stronger the Coriolis effect).

In this model, we will also focus on the direction of the surface winds, i.e. **the winds near the ground**. We will not worry about the winds aloft yet--we will in the next activity.

Activity: Look at your model from Activity #1 to see which way the surface winds want to blow in each hemisphere. Figure out which way the wind is deflected and show the direction of the wind, using a curved line with an arrow at the end. Draw these lines all across the globe between 0° and 30° N and between 0° and 30°S (the lines should be different in the northern and southern hemispheres).

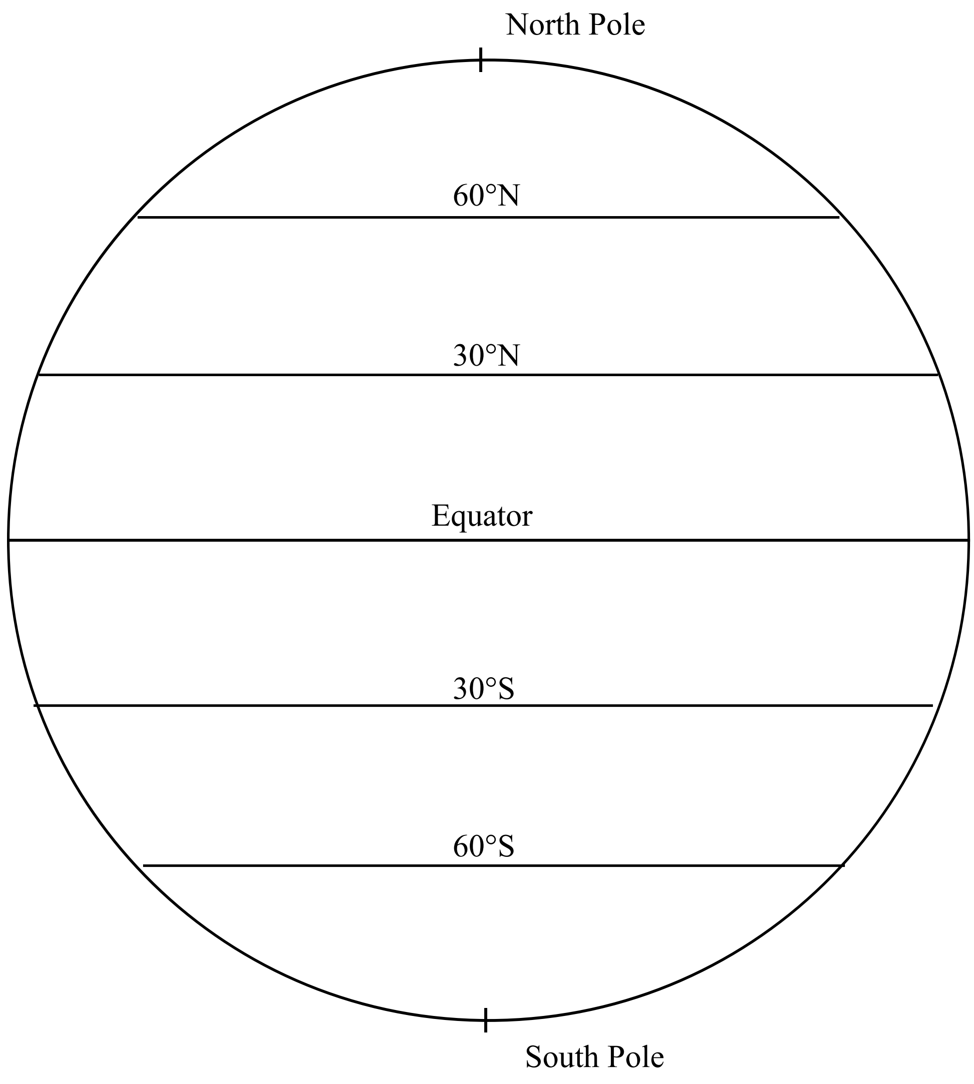


1. Are the trade winds in the northern hemisphere easterly (out of the east) or westerly (out of the west)? Why?

2. Are the trade winds in the southern hemisphere easterly (out of the east) or westerly (out of the west)? Why?

Lab Activity #6: Adding the Coriolis Effect to the Convection Model--Winds Aloft

Activity: Look at your model from Activity #1 to see which way the winds aloft want to blow in each hemisphere. Figure out which way the wind is deflected and show the direction of the wind, using a curved line with an arrow at the end. Draw these lines all across the globe



Questions

1. Which way do the winds aloft tend to blow? ____

   Why?

2. The jet stream is a narrow band of extra-fast wind aloft. Which way do the jet-stream winds blow? Why?

3. Mid-latitude storms (the kind we get during the winter rainy season) are often caused by diverging winds of the jet stream. These storms are always pushed along by the jet stream. Which direction do these storms tend to migrate? Why?