Little Globes and the Earth
4th Grade

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Benchmarks:

ES-1: Explain that air surrounds us, takes up space, moves around us as wind, and may be measured using barometric pressure.

ES-2: Identify how water exists in the air in different forms (e.g., in clouds, fog, rain, snow and hail).

ES-3: Investigate how water changes from one state to another (e.g., freezing, melting, condensation and evaporation).

ES-4: Describe weather by measurable quantities such as temperature, wind direction, wind speed, precipitation and barometric pressure.

ES-6: Trace how weather patterns generally move from west to east in the United States.

Objective:

The goal is to teach the students about how the sun and the tilt of the earth not only causes seasons but causes weather patterns around the globe. This is an introduction to Hadley, Ferrell, and polar cells (and, of course, the Coriolis Effect). Students should see that air of different temperatures and pressures are constantly circling the earth in chaotic motions following some general trends (e.g., west to east across the U.S.). This helps explain what's behind the weather.

Materials:

- Each student should have a small globe to use during discussion.

Target Concept:

- The weather is driven by the sun. If the sun turned off, so would the weather.
- The seasons are caused by the tilt of the earth.
- Water vapor gets into the air when warm sun causes it to evaporate, especially near the equator/tropics.

Initial Introduction:

What causes the seasons? What causes the weather? Why is the weather so different during different seasons? Why does weather west of us soon end up on top of us?

Procedure:

Draw a large sun on the board. Alternatively, you can use a large object in the center of the room to serve as everyone's sun. Place your earth out in space somewhere away from the sun. The goal is to come up with the right way to draw the earth around the sun in the journals. Use the 3D globes to test ideas. You may need to take certain things as givens, like the rotation of the earth on its axis and possibly the rotation of the earth around the sun. However, the

students should have the ability to figure out that regions that get more sun get warmer, and that a tilt of the earth will cause certain regions to get more sun during certain parts of the year. The students may not know how long it takes the earth to go around the sun. The students may also think the sun has a dark side.

Once earth's tilt is established, bring the discussion back to the planet. The water cycle has already been discussed, so talk about what happens to the water in the areas that receive the most sun. That water evaporates and gets put into the atmosphere. Discuss what the students have observed about hot air balloons. Have them admit that hot air balloons seem to fly because the air inside the balloon is hotter than the other air. Get them to admit that that maybe what happens with air around the equator, warm moist air. On the picture of the globe that you've drawn on the board (after you figured out with them how to draw it), draw a line showing the movement of air away from the equator upward toward the sky and have it start to curve and travel parallel to the earth. It may be difficult to deliver this particular explanation with inquiry, but you should be able to keep the kids engaged at each transition point in the flow of this air. About at the point of lowest latitude in the United States, convince the kids that the air is far enough away from where it was warmed that it cooled off. Ask them what happens to cool air. This should motivate you drawing that air coming back down toward the earth, but still maintaining pole-ward pressure traveling across the surface of the earth. Just north of the United States, get the kids to tell you that the poles are very cold, and have the air rise again. Then have the air turn around at the poles and come back, but this time convince them that the air that's being pushed up the earth (pole-ward) is forcing the air coming away from the poles to do the opposite thing. This should form a sort of double-figure-8. This is a gross oversimplification of the processes that form Hadley, Ferrell, and polar cells. Additionally, you may be able to convince them that the pressure near the equator is low because lots of air is spreading out there and that the pressure near the U.S. is high because it's coming together again at the surface and then low again at the poles.

Now talk about merry-go-rounds. Draw a merry-go-round and/or have the students form a circle and try to do this themselves. Lead a discussion about how to toss a ball from one person on one side of the merry-go-round to another person on the other side. The kids should see (and may know this already) that it's very difficult to toss a ball to the person if the merry-go-round is spinning. The ball APPEARS to curve to the left. Draw what is actually happening (the ball is traveling in a straight line but you and the target are moving in a curved trajectory) on a piece of paper.

Now go back to the earth. Look at the earth (and perhaps the little globes) from the top. Draw people standing on the earth far way from each other trying to throw a ball to each other, and set the earth in motion. The kids should see that the same curving occurs. In the northern hemisphere, everything curves to the right. In the southern, everything curves to the left. Now have them predict which way the SURFACE WINDS in the three different cells will curve. This will show them why winds typically move from west to east across the U.S.

By now the students should have a picture of the winds on the earth shuttling around water from the southern latitudes to the northern latitudes. You'll talk about weather fronts later

which will help explain what happens to that weather. You also talk about how the winds shuttle around high and low pressure air.

BONUS: If the kids are really engaged, have them predict what happens when you get zones over the Atlantic (between the equatorial cell and the cell over the U.S.) have low pressure moving one direction and high pressure moving the other direction right next to each other. You may be able to get them to picture large storms developing around those regions. Of course, again, this is a gross oversimplification. However, it models the behavior of weather pretty well and isn't too difficult to wrap a head around.

Target Observations:

- The earth's tilt gives it seasons.
- The reason we have changing weather is because of the sun's heat.
- Water and different pressure air is constantly be shuttled around the planet.

Final Target Concept:

- Weather isn't completely random. The sun is a major part of it, just as it is a major part of the water cycle.
- Keep in mind that this lesson is primarily meant to give the students some idea that it's not too strange that high and low pressure zones keep moving around the earth.