

Weather Unit
Focusing on Building an Understanding of Wild Weather

Description of Resource:

The Planetary Geology Guide contains a range of activities covering Earth sciences including geologic processes, impact craters, planetary atmospheres and surfaces, and geologic mapping. Several activities worked well for my unit on weather but this document focuses on the Coriolis Effect which is exercise seven of the guide. Since this resource does not utilize real data, several additional NASA and NOAA resources were used to gather data on hurricanes (cyclones and typhoons) around the world (see references).

Link:

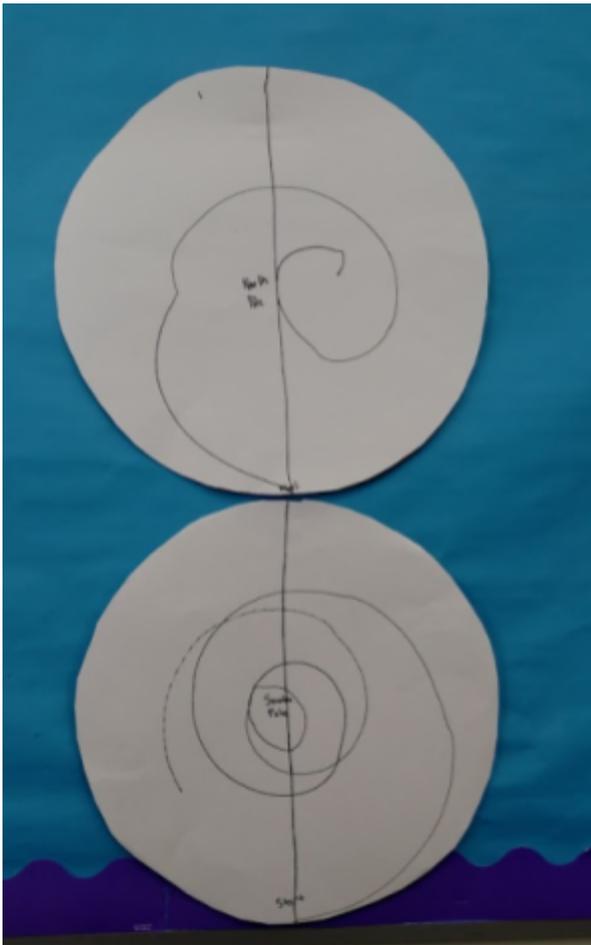
<https://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Planetary.Geology.html>

Student Generated Artifacts:



Students taking turns to rotate the lazy susan (Earth) and draw a straight line from blue tape to blue tape.





Final student samples of winds and currents viewed from the North Pole (top) and South Pole (bottom).



Students grappling with understanding the speeds of objects (index cards) located at the North Pole and the equator.



Students created a word cloud for keywords that encompassed their learning for several PEs (MS-ESS2-4, MS-ESS2-5, and MS-ESS2-6).

Hurricanes

Current Events - New Phenomenon 10/18/18

This past weekend:

- PE&E notified of possible power outages due to high winds (didn't want fires)
- Hurricane Michael in Florida

Find patterns in hurricanes (info on all hurricanes around the room)

hurricane = typhoon = cyclone
name of event depends on where it occurs

type of event	location	when it occurred
hurricane mile	FL	10/15/18
hurricane Sandy	Cuba, New York	10/22/12

Hurricane Patterns 10/17/18

which
called hurricanes in various

patterns we see with hurricanes occur near oceans/coasts they hit the same locations hit US (CA, SA, NC, TX, FL, AL) & Pacific (lands called typhoons in E. Asia (Philippines) called cyclones in W. Asia & central Asia occur in tropical areas & hot regions damages & fatalities don't necessarily match storm size

when
occur in Aug-Oct in N. hemisphere
Dec-Jan in S. hemisphere

last several days → week

where
occur in Atlantic, Indian, Pacific Oceans & Gulf of Mexico
occur mostly in N. hemispheres
hurricanes do NOT occur in a band of the equator, Atlantic Ocean only has hurricanes N of equator
they cover a large distance/area
they occur in warmer waters
they occur closer to equator

Questions We Have About Hurricanes 10/17/18

How do hurricanes form?
Do they move E → W or W → E?
Why do more hurricanes occur N of equator?
Isn't S warmer??
Why do S America & most of Africa not have hurricanes?
Why do hurricanes form in the fall?
Isn't fall cooler than summer?
Why do hurricanes NOT occur at the equator?

In Which Direction Will the Water Swirl?

Three friends were wondering if the direction water swirled down a drain depended on location. Avery lives in the Northern Hemisphere, Tara lives on the Equator, Magdalena lives in the Southern Hemisphere. They predicted what would happen if Avery and Magdalena filled their bathtubs with water at the same time, pulled the plug, and observed the direction of water as it went down the drain. This is what they said:

Avery: I think the water in my bathtub will swirl down the drain in the opposite direction of the water in Magdalena's bathtub.

Magdalena: I think the location doesn't make a difference to the direction water

Student notebook entries for finding patterns in hurricanes and formative assessment leading to greater understanding of cross cutting concepts related to scale when addressing Coriolis Effect.

Summary:

I have struggled for years trying to confidently provide opportunities for my students to learn about the Coriolis Effect. In meeting the NGSS performance expectation MS-ESS2-6, students need to incorporate the Coriolis Effect into their model describing how the unequal heating and rotation of Earth causes patterns of atmospheric and oceanic circulation. The requirement is to include Earth's rotation as a factor affecting the motion of wind and currents. In past years, I've relied on simply teaching the definition of the Coriolis Effect and had students regurgitate the memorized facts. This year I really wanted to use student inquiry to result in an understanding of how the Coriolis Effect is important in weather and ocean currents. To further student engagement, I plan to have students predict weather patterns on other planets as an extension to their semester-long learnings during the last week of the semester.

To begin the unit, students engaged in finding patterns in hurricane data gathered from NASA and NOAA websites (see references). From there, students generated driving questions about hurricanes which led to several labs on the unequal heating of Earth's surfaces (surface types and latitudes). Once students learned about relationships between temperature, pressure, and density in the movement of air and water, they needed to learn about the Coriolis Effect.

The successes of this lesson implementation on the Coriolis Effect included not only the student-driven exploration of the effect, but also an understanding of frame of reference. Having students manipulate a globe to view it from each pole and then having them determine the direction in which the lazy susan should be turned really added to their understanding. Many students were excited to just figure out the correct directions to spin the device. I did try having students use a marble to roll across the spinning lazy susan instead of using a marker but that change did not work out. Students could not track the ball as easily as having the drawing to look over. Most of the "aha" moments came when students placed index cards on a globe at the poles and equator and had to come up with their own explanation for the speed of objects located on each index card. I think this was the most valuable activity for learning. I have never thought about addressing speed or frame of reference before as those were always part of my old standards 8th grade physical science class. In taking this class and in particular, implementing this lesson, I recognize how important scale, frame of reference, and Newton's laws are in truly gaining an understanding of weather. This is adding to my appreciation of the integration of the sciences under NGSS!

After the lesson, I gave students the Page Keeley probe, "In Which Direction Will the Water Swirl?" This was a fun way to engage students in a final discussion regarding the Coriolis Effect. Using this probe after the lesson was terrific because my students were confident in their incorrect responses that the water will drain out of the sink in opposite directions in the two hemispheres. They had just completed the lazy susan activity and understood how the speed at different locations from the equator will be different and then, according to them, I tricked them with the probe question. Using the probe as a follow up to the activity provided me the opportunity to discuss scale (a cross cutting concept) to further refine student understanding.

As a final piece, students spent time revisiting the data they had originally analyzed on hurricanes and evaluating their new learning to the data and images that introduced them to the unit. They were then tasked with answering the questions that they created in their original engagement lesson on hurricanes. Students enjoyed the lessons and I am more comfortable with meeting the evidence statement requiring that student models show a relationship in the factors that affect motion of wind and currents.

Standards:

MS-ESS2-5 collect data to provide evidence for motions/interactions of air masses and changes in weather

MS-ESS2-6 develop/use a model to describe unequal heating and rotation of Earth causes patterns of atmospheric and oceanic circulation

DCI:

ESS2.C: The Roles of Water in Earth's Surface Processes

- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.

ESS2.D: Weather and Climate

- Because these patterns are so complex, weather can only be predicted probabilistically.
- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns.
- The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents.

Evidence Statement from MS-ESS2-6:

iii. Factors affecting the motion of wind and currents:

1. The Earth's rotation causes oceanic and atmospheric flows to curve when viewed from the rotating surface of Earth (Coriolis force).

References:

Greeley, Ronald, Kelly Bender, Robert Pappalardo. (1998). *Planetary Geology A Teacher's Guide with activities in Physical and Earth Sciences: Exercise Seven Coriolis Effect*. NASA. Pages 87-91.

<https://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Planetary.Geology.html>

Keeley, Page and Laura Tucker. (2016). *Uncovering Student Ideas in Earth and Environmental Science*. NSTA Press. Arlington, Virginia. Pages 61-64.

NASA Hurricanes and Tropical Storms https://www.nasa.gov/mission_pages/hurricanes/main/index.html

NASA Hurricane and Typhoon Updates <https://blogs.nasa.gov/hurricanes/>

NASA Space Place. (2018). *How do hurricanes form? Spaceplace.nasa.gov*. Retrieved 2 October 2018, from <https://spaceplace.nasa.gov/hurricanes/en/>