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| Topic: | Pre Visit Lesson Plan for the Hurricane Prediction Lab |
| Lesson Title: | Recipe for Disaster.... How to Create a Hurricane |
| Grade Level: | 4th – 5th Grades |
| Science Domain: | Earth's Systems |
| Purpose: | Students will learn how the spheres of the Earth interact in order for a hurricane to form. |

Connecting to the Next Generation Science Standards:

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| <p>Students who demonstrate understanding can:</p> <p>Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. 5-ESS2-1: Earth's Systems</p> <p>The materials/lessons/activities outlined below are intended to help students reach the Performance Expectations listed below.</p> | |
| Performance Expectations: | Connections to Classroom Activity Students: |
| <i>Science and Engineering Practices</i> | |
| <p>Developing and Using Models</p> <p>Modeling in 3-5 builds on K-2 experiences and progresses in building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> Develop a model using an example to describe a scientific principle. | <p>I can create a model hurricane to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. I can identify the necessary components of a model hurricane and include features of two systems as an example.</p> |
| <i>Disciplinary Core Idea</i> | |
| <p>ESS2.A: Earth Materials and Systems</p> <ul style="list-style-type: none"> Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, | <p>I can describe the conditions in which hurricanes form when more than one Earth system interacts and how that affects the Earth's surface materials.</p> |

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| and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. | |
| <i>Crosscutting Concept</i> | |
| Systems and System Models <ul style="list-style-type: none"> • A system can be described in terms of its components and their interactions. | I can describe the parts of a hurricane system. |

Teacher Background Information:

The Hurricane Prediction Lab at the INFINITY Science Center in Pearlinton, Mississippi, is designed as a team activity, in which visitors learn the importance of different variables for accurately predicting a storm's path and its risk. Within the exhibit, there are four touch-screen stations. Students will learn about four different variables of hurricane prediction:

1. Wind speed and direction
2. Barometric pressure
3. Air temperature, and
4. Water temperature

Visitors will see a 2D map of the Gulf and Caribbean region extending into the mid-Atlantic Ocean. A typical storm path is shown, along with current readings for the four variables. Narration by an actual NOAA or National Weather Service scientist introduces the students to the activity and invites them to learn about the influence of these variables on the storm's path. For example, students will see how changing barometric pressure, can change a storm's landfall from eastern Florida to southern Louisiana. Working in teams of four, students will work together to predict the path of a storm that is forming out in the Atlantic. Data from Hurricane Katrina is used to predict this storm. While at the exhibit, students will learn that scientists use similar training to predict an actual storm's path and the important role of data collection for accurate weather predictions. Artifacts from Hurricane Katrina will also be incorporated into the exhibit.

Additional teacher background about hurricanes from NOAA:

<http://www.nws.noaa.gov/os/hurricane/resources/TropicalCyclones11.pdf>

Teacher Background Facts for the Spheres of the Earth:

- Geosphere – The geosphere consists of the core, mantle, and crust of the Earth
- Atmosphere – The atmosphere contains all of the Earth's air and is divided into troposphere, stratosphere, mesosphere, thermosphere, and ionosphere.
- Hydrosphere – The hydrosphere contains all of the solid, liquid and gaseous water on Earth, extending from the depths of the sea to the upper reaches of the troposphere where water is found. Ninety-seven percent of the hydrosphere is found in salty oceans, and the remainder is found as vapor or droplets in the atmosphere and as liquid in ground water, lakes, rivers, glaciers, and snowfields.
- Biosphere – The biosphere is the collection of all Earth's life forms, distributed in major life zones known as biomes: tundra, boreal forest, temperate deciduous forest, temperate grassland, desert, savannah, tropical rainforest, chaparral, freshwater, and marine."

Information retrieved: <https://www.csun.edu/science/books/sourcebook/chapters/8-organizing/files/earth-systems-interactions.html>

For additional background information about **Disciplinary Core Ideas** you may visit <http://www.bozemanscience.com/next-generation-science-standards/> and click on the following links: [ESS2D – Weather & Climate](#) (0:00-5:50)

Statement of Learning Objective:

Students will learn how to create a model of a hurricane by inputting the ingredients and conditions needed when at least two of the Earth's spheres interact.

Common Learner Misconceptions:

Students may not fully understand that the Earth is never fully at rest. It is important to note that students understand that wind speed and direction, barometric pressure, air temperature, and water temperature are all phenomena that influence the formation, motion, and direction of hurricanes.

Additional information about student misconceptions can be found @ <http://sciencenetlinks.com/lessons/hurricanes-1-the-science-of-hurricanes/>

Materials:

- Computer and Internet access
- Science notebook
- Pencils, crayons, and colored pencils
- Digital camera or phone camera to take pictures at the Hurricane Prediction Lab at the INFINITY Science Center

Vocabulary:

- Hurricane
- Barometric pressure
- Wind speed
- Latitude and longitude
- Hydrosphere
- Atmosphere
- Biosphere
- Geosphere

Safety:

Before using any Internet links described in the lesson plan, check first to be sure they are appropriate and have not been compromised. Your school's Technology Plan may prohibit your students from accessing some links so always check prior to using with students.

The usual safety conditions apply in this lesson plan. Prior to the field trip, review the Conduct and Behavior Code of Conduct with your students for the INFINITY Science Center @ <http://www.visitinfinity.com/am-site/media/conducts-standards.pdf>

Safety Rules available for download from NSTA (National Science Teachers Association): <https://www.nsta.org/docs/SafetyInTheScienceClassroomLabAndField.pdf>

NSTA: Field Trip Safety
<http://www.nsta.org/docs/FieldTripSafety.pdf>

Adaptations/Accommodations for Exceptional Students:

ELL students may need help with understanding the vocabulary. Pair students with a partner to help with directions and label the materials with the English word and also the student's native language when learning new material. Considering pairing students who may need additional help while researching the information in the computer lab or in the classroom.

Literacy/Media Connections:

Animated video of how a hurricane forms

www.cbsnews.com/htdocs/natural_disasters/hurricanes/framesource_flash.html

Create-a-Cane Game

<http://www.nhc.noaa.gov/outreach/games/canelab.htm>

NOAA Education Resources for teachers

http://www.education.noaa.gov/Weather_and_Atmosphere/Hurricanes.html

NOAA video: Dr. Gerry Bell, lead seasonal hurricane forecaster with NOAA's Climate Prediction Center, discusses the 2016 Hurricane Season (Time: 2 minutes 44 seconds)

<http://www.noaa.gov/near-normal-atlantic-hurricane-season-most-likely-year>

National Hurricane Center – Blank Tracking Charts

www.nhc.noaa.gov/tracking_charts.shtml

5E Instructional Process: This lesson plan could take several days to complete.

Engage:

Activity

1. Gather your students in a central location in your classroom and ask them, "What do you know about hurricanes? What is a hurricane?" Listen as students share what they think they know about hurricanes and write their ideas on a class chart.
2. Tell the students you are planning a field trip to the INFINITY Science Center and one of the exhibits they will view will be the Hurricane Prediction Lab. Before the students visit the exhibit, they will learn about hurricanes and how they form.

Guiding Questions

1. What do you know about hurricanes?
2. What is a hurricane?

Explore:

Activity:

1. Teacher Note: In order for students to know exactly how a hurricane is created it will be helpful for them to know how the different Earth Systems interact in order for a hurricane to form. Scientists collect data from satellites, buoys, ships, aircrafts with vertical data, and surface observing stations on land to learn about hurricanes so they can predict the path of a hurricane.
2. Ask your students, "Have you ever helped your parents or someone bake cookies or a cake? What ingredients do you need in order to bake chocolate chip cookies?" Listen as students share

what they know about making cookies, and record their list on chart paper. If no one has baked homemade cookies, then share your experience with baking your favorite item. For example, when you bake chocolate chip cookies there are several ingredients needed as well as tools. Ingredients: flour, salt, baking soda, sugar, brown sugar, butter, eggs, vanilla and chocolate chips. The following tools are also needed: an oven set at just the right temperature, usually 350 degrees, a mixer and bowl, measuring cup, measuring spoon, a cookie sheet, a spatula, spoon to scoop out the dough.

3. "What would happen if you leave out a key ingredient, such as baking soda or eggs? Would the cookies taste or look the same?" Just like in baking, certain types of weather need just the right ingredients and conditions in order to form. Ask, "Do hurricanes form over land or water? What kind of 'ingredients' do you think are necessary in order for a hurricane to form?" Ask students to write their "recipe" for a hurricane in their science notebook. Create an ingredients list first and then write down how they think the ingredients must be interact in order for a hurricane to form. Students should work individually first, then share with a partner and then share with the class as time allows. After everyone has had time to share their list with at least two classmates, then create a "Recipe for a Hurricane" on chart paper. After listening and creating the class recipe, help students make important content connections with the spheres of the Earth. If students shared that an ocean or the Gulf of Mexico is needed for a hurricane, then point out that oceans are part of the hydrosphere. If they just say "water is needed", then make sure they understand that hurricanes do not form over rivers, but warm tropical oceans. This explore time of the lesson is to find out what your students think they know about hurricanes and is designed as a formative assessment tool so you can clear up student misconceptions as you guide their understanding of hurricanes, spheres of the Earth, and how scientists use data to predict the path of a hurricane.
4. Next, watch the animation model of how a hurricane forms. Then watch the animation a second time, and ask students to take notes in their science notebook of how a hurricane forms. Click on the following link:
www.cbsnews.com/hdocs/natural_disasters/hurricanes/framesource_flash.html
5. Next, revisit the class Recipe for Hurricane and ask groups of 3 to 4 students to create a revised recipe based on the information they learned from the animation. Give each group chart paper if it is available, otherwise notebook paper will work. Allow time for students to share their recipe with the class. This activity will take longer than one class period.
6. After students have had ample time to interact with the animation, and create their recipe for a hurricane, share the following "Create a Hurricane" link on your classroom computer or in a computer lab. <http://www.nhc.noaa.gov/outreach/games/canelab.htm>
7. Students will use their knowledge about winds, moisture, sea temperature, and latitude to "Create-a-Cane". Using this technology allows students the opportunity to use their knowledge of the key ingredients and conditions needed to create a hurricane model.
8. Teacher Note: You may find the following link from the National Hurricane Center in Miami, Florida helpful as well. Introduce as needed for additional background knowledge. This link displays real time data of the Atlantic Tropical Cyclones and Disturbances page. If a tropical cyclone is expected during the next five days, it will be written on the screen.
<http://www.nhc.noaa.gov/>

Guiding Questions:

1. Have you ever helped your parents or someone bake cookies or a cake? What ingredients do you need in order to bake chocolate chip cookies?
2. What would happen if you leave out a key ingredient, such as butter or eggs? Would the cookies taste the same?
3. Do hurricanes form over land or water? What kind of 'ingredients' do you think are necessary in order for a hurricane to form?

Explain:

Activity

1. It is important to note, that this lesson is designed to give the students background knowledge

about hurricanes so that when they visit the Hurricane Prediction Lab at the INFINITY Science Center, they will have the opportunity to work as student scientists and create a hurricane. They will also learn how scientists collect data to predict hurricanes and how the different variables can determine the various “risk factors” for the general public.

2. Revisit the first class chart and question, “What is a hurricane? What do you know about hurricanes? Are there any statements that we should mark through or modify?”
3. Also, revisit the class “Recipe for a Hurricane.” After students have had ample time to interact with the Create-a-Cane as well as the animation of how a hurricane forms, ask student groups to lead and explain the conditions needed in order for a hurricane to form. Students should be able to share how with the right conditions a hurricane can form. Scientists use four different variables to predict a hurricane:
 - Wind speed and direction
 - Barometric pressure
 - Air temperature and
 - Water temperature
4. Ask students to create a graphic organizer and label each of the four variables. Allow time for students to research the conditions needed in order for a hurricane to form and add notes to the graphic organizer such as a shutter fold foldable or they could divide their paper into four different sections to record facts about the four variables.
5. Allow time for students to share and explain their work with other classmates groups and/or communicate their information to others. Listen carefully as students explain, take notes and then address any misconceptions.

Guiding Questions

1. What is a hurricane?
2. What do you know about hurricanes?
3. Are there any statements that we should mark through or modify?

Elaborate:

Activity

1. Ask your students if they have ever heard of a Hurricane Hunter. What do you think they do? Of course the name gives it away! The Hurricane Hunters are a part of the Air Force Reserve and their headquarters are located in Biloxi, Mississippi. If students are interested in finding out more about the Hurricane Hunters Association, then direct them to the following link:
<http://www.hurricanehunters.com/>
2. Download the Hurricane brochure from NOAA to use as a follow up teaching tool and/or duplicate for each student.
<http://www.nws.noaa.gov/om/brochures/owlie/Owlie-Hurricanes.pdf>
3. Research to find out the list of hurricane names for the upcoming season. Write a brief summary about how hurricane names are chosen and when or if the names are retired.

Guiding Questions

1. Have any of you heard of a group called the Hurricane Hunters?
2. What do you think they do?

Evaluate:

Activity

1. Evaluate students as they work in small groups and listen as they discuss their “Recipe for Hurricane.” Do students understand that the different spheres of the Earth interact in various ways and that under the right conditions a hurricane can form?
2. Can you draw and describe a model hurricane? Can you describe the ways in which the geospheres interact as a result of a hurricane forming? What is the risk factor for the biosphere and geosphere?

3. Give each student one of the downloaded Hurricane Tracking maps from the National Hurricane Center: www.nhc.noaa.gov/tracking_charts.shtml
4. Each student will create a model hurricane on the map and then on a separate piece of paper describe ways that the geosphere, biosphere, hydrosphere, and/or atmosphere interact. They should also identify the necessary components of the model hurricane and include features of two systems as an example.
5. At The INFINITY Science Center students will also have the opportunity to learn more about how scientists use data to predict storms as well as the effects of a hurricane. Take pictures of students as they interact with the exhibit and use the pictures as a review when you return to school.

Guiding Questions

1. Can you draw and describe a model hurricane?
2. Can you describe the ways in which the geospheres interact as a result of a hurricane forming?
3. What are the risk factors for the biosphere and geosphere?