My NASA Data - Lesson Plans

Hurricanes as Heat Engines - Lesson Plan

Grade Band

- 6-8
- 9-12

Time

- 90 minutes

Overview

This Lesson Plan provides some generic maps, graphs, and data tables for use with the Data Literacy Cubes. Because it is a differentiated resource, this Lesson Plan is appropriate for multiple grade bands.

Materials Required

(Can be displayed or distributed to student groups as hard copies)

- Path of Hurricane Matthew September 28 – October 9, 2016 (See file in Student Datasheets)
- Progression of Matthew, https://coast.noaa.gov/hurricanes/
- Saffir-Simpson Hurricane Wind Scale, http://www.nhc.noaa.gov/aboutsshws.php
- My NASA Data, https://mynasadata.larc.nasa.gov/
- CYGNSS Mission, https://www.nasa.gov/cygnss

Per Student:

- “Hurricanes as Heat Engines” Student Datasheet

Per Group:

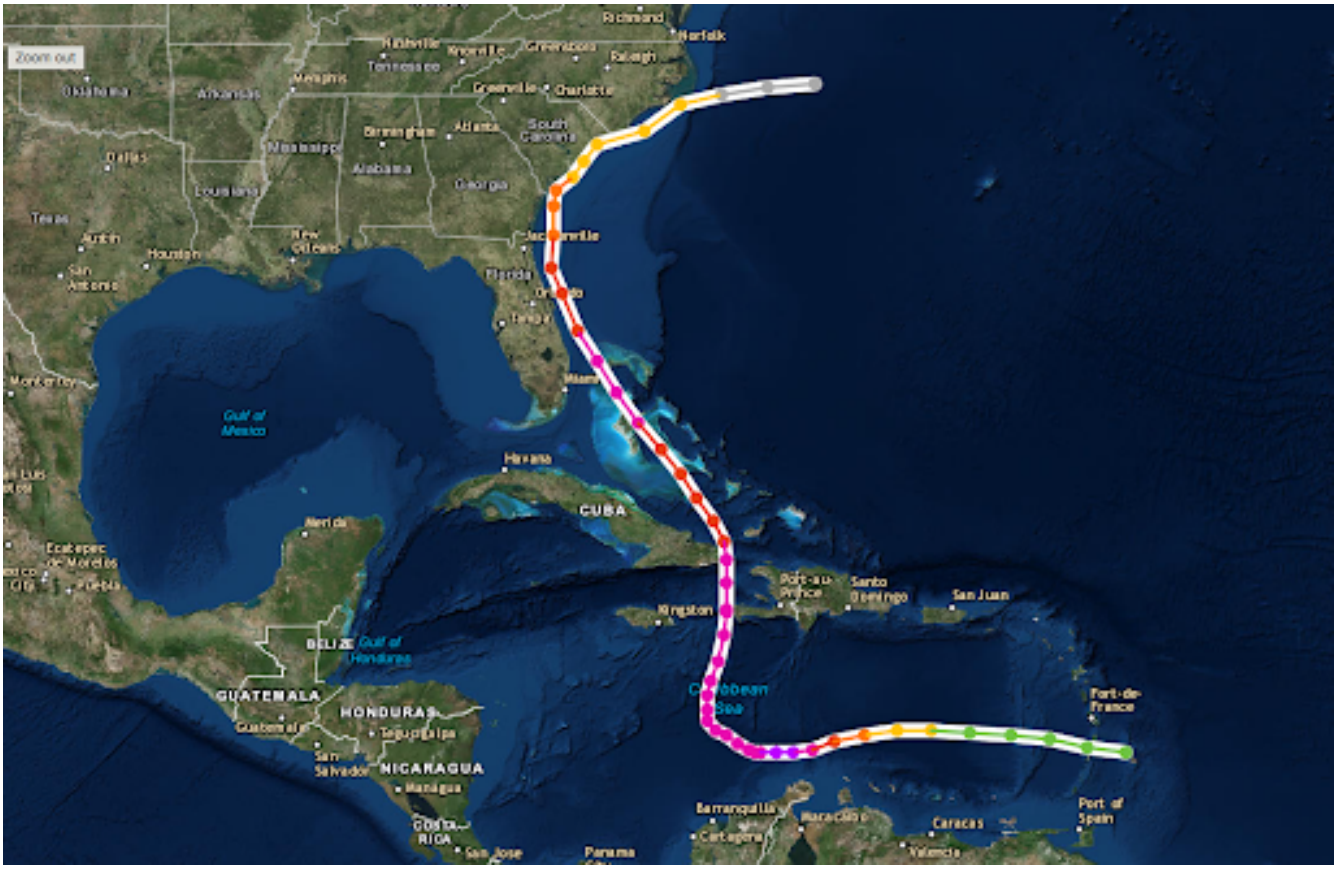
- Numerous sticky notes in four different colors
- Markers
- Laptop
- Internet Access

- Data Visualization Pages: Daily Sea Surface Temperature for Oct. 4th, Oct. 8th, 12th
- Line Graph of Data: Sea Surface Temperature Graph for Oct. 1-16, 2016

Procedure

Setting the Stage:

1. Display “Path of Hurricane Matthew September 28 – October 9, 2016 Map” to students.



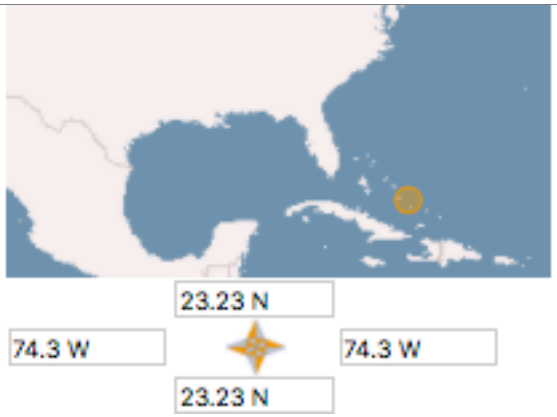
Path of Hurricane Matthew September 28 – October 9, 2016 Map

Legend

2. Display the “Progression of Matthew” table to the students.

3. Draw a timeline to include each day on the board, starting with Sept. 28, 2016, and ending with Oct. 9th on the board taking up at least two meters or more. Label as Hurricane Matthew.

4. Break students into seven groups and distribute sticky notes using a different color for each category and markers.



Coordinates

1. Divide the categories by each team: TS, H1, H2, H3, H4, H5, ET

2. In teams, have students research their category identifying how many of these dates correspond with their category. They should research the effects of their category and write these effects on the correct color of sticky note. (Note, this step may need to be duplicated based on how many dates this category was experienced (e.g., Hurricane Matthew was a H1 on 9/29/2016, as well as on 10/8/2016 so these sticky notes will need to be made for each day.) Once completed, have students place their sticky notes on the date/s where these effects happened and present their findings.

Review the following questions with students:

1. How many days did it take Tropical Storm Matthew to become a category 5 hurricane?
2. How many days did it take Hurricane Matthew to no longer be classified as a hurricane?
3. Where does the energy come from that causes a tropical storm to become a category 5 hurricane?

Looking at the Data

1. Distribute the Daily Sea Surface Temperature for Oct. 4th with students.
2. Repeat with Oct. 8th and 12th.
3. Next show the location selected as a point of interest.
4. Display the Daily Sea Surface Temperature for Hurricane Matthew for Oct. 1-16, 2016
5. Distribute “Hurricanes as Heat Engines” Datasheet and review the instructions.

Analyze the Data

1. Examine the three data sets of Daily Sea Surface Temperature (SST) for October 4, 2016, October 8, 2016, and October 12, 2016 and describe your observations and inferences in the question below.
2. What evidence of lowered sea surface temperature (SST) do you observe in the map

visualizations?

3. Examine the line graph of SST for the selected location and answer the questions below:

- What effect do you observe regarding the temperature in the line plot after the hurricane passed?
- How long did it take for the SST to return to the previous temperature?
- What conclusion can you make about the relationship of hurricanes and the ocean?
- What other spheres besides the Atmosphere and Hydrosphere are affected?

Going Further

1. Using the same procedure, students will examine the SST data during and after Hurricane Harvey 2017 or any of the historical hurricanes from an area near where you live. (Note: Data is not available for the week after Hurricane Katrina because the hurricane interrupted data processing at the Naval Oceanographic Office at Stennis Space Center, Mississippi.)
2. Review the instructions for Part B.

Going Further

1. Name of Hurricane:
2. Date of landfall:
3. How is SST affected by the hurricane that you selected?
4. What effect do you think these differences in the Hydrosphere might have on other spheres within the Earth system?
5. Pose three additional questions that you might have for further research. Identify other kinds of data would need to explore these questions?

New Research Question	New Datasets Needed to Explore this Question
1.	
2.	
3.	

Answer Key:

Teachers who are interested in receiving the answer key, please complete the Teacher Key Request and Verification Form. We verify that requestors are teachers prior to sending access to the answer keys as we've had many students try to pass as teachers to gain access.

NGSS Three Dimensional Learning

NGSS Disciplinary Core Ideas

- PS1A: Structure and Properties of Matter
- PS3B: Conservation of Energy and Energy Transfer

NGSS Crosscutting Concepts

- Cause and Effect

NGSS Science and Engineering Practices

- Developing and Using Models
- Engaging in Argument from Evidence

Learning Objectives

- Students will analyze NASA sea surface temperature data to use as evidence to explain a phenomenon.
- Students will explore how hurricanes gain energy from the ocean surface.

Essential Questions

1. How is sea surface temperature affected by the development of a hurricane?
2. How is thermal energy transferred within a hurricane system?
3. How does a hurricane affect the different spheres within the Earth system?

Why Does NASA Study This Phenomenon?

Hurricanes are the most violent storms on Earth. They are like giant engines that use warm, moist air as fuel, which is why they form only over warm ocean waters near the equator. The warm, moist air over the ocean rises upward and as the air continues to rise the surrounding air swirls in to take its place. As the warm, moist air rises and cools off clouds form creating a system of clouds and wind that spins and grows, fed by the ocean's heat and water evaporating from the surface. NASA satellites gather sea surface temperature data that can be used to explore changes that occur.

Teacher Background Information

The passage of a hurricane causes a large transfer of heat between the ocean surface and the atmosphere. It also causes surface waters to diverge, bringing cooler water from below to the surface (upwelling). These effects are so large that they can be seen by a drop in sea surface temperature (SST) in satellite data observations along the path of the storm. The cooler water conditions may last for a week or longer after the storm.

Student Resources

- Student Datasheets