

Engage

Learning Target: _____

Do Now:

	See What do you observe?	Think What does each observation make you think?	Wonder What questions do you have about each observation?
Image 1: H Lee	<hr/> <hr/> <hr/> <hr/> <hr/>	<hr/> <hr/> <hr/> <hr/> <hr/>	<hr/> <hr/> <hr/> <hr/> <hr/>
Image 2: TS Franklin	<hr/> <hr/> <hr/> <hr/> <hr/>	<hr/> <hr/> <hr/> <hr/> <hr/>	<hr/> <hr/> <hr/> <hr/> <hr/>
Video of H/TS Ophelia	<hr/> <hr/> <hr/> <hr/> <hr/>	<hr/> <hr/> <hr/> <hr/> <hr/>	<hr/> <hr/> <hr/> <hr/> <hr/>

Explore

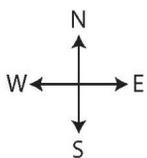
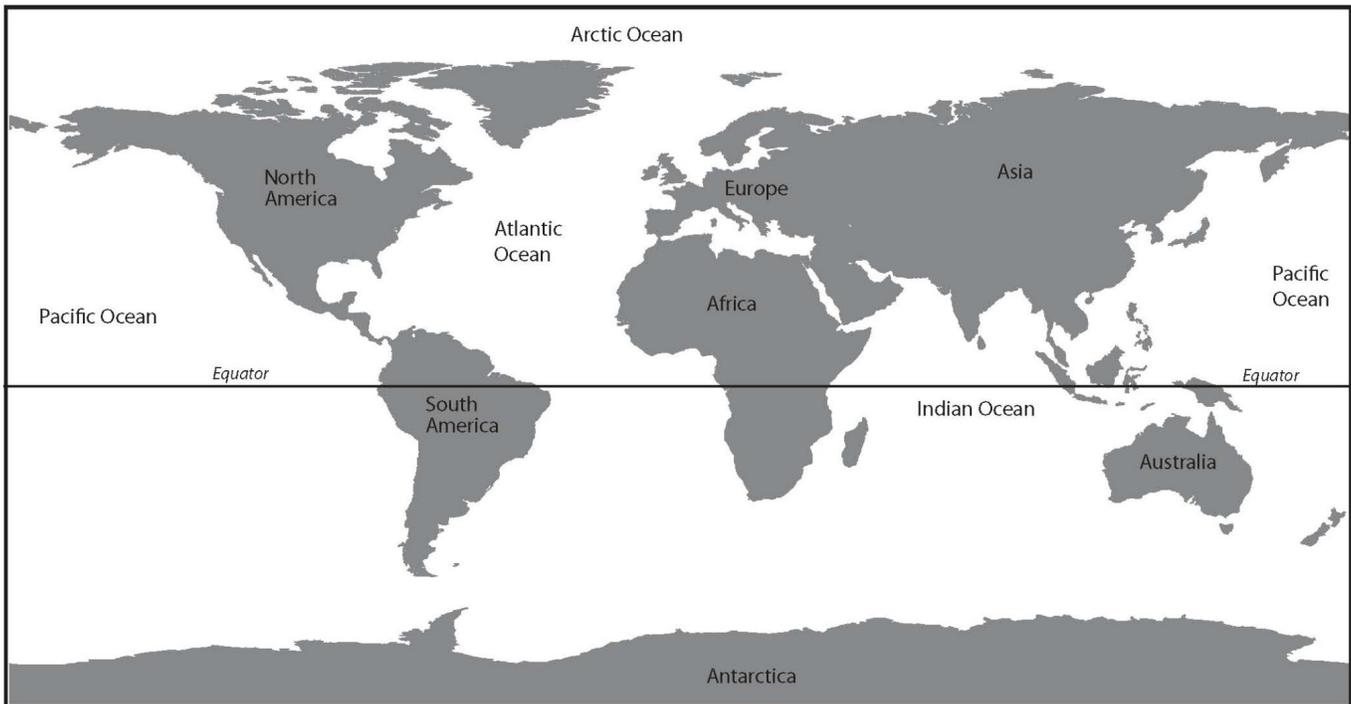
Learning Target: _____

Do Now:

Where do hurricanes happen?

(modified from https://www.windows2universe.org/teacher_resources/hurricane_climate/teach_hurricane_climate.html&nl=6)

There are six regions of the world where hurricanes (tropical cyclones) are likely to occur. Label these on the map below after you look at the “Map of Tropical Cyclones 1985–2005”. Choose a different color for each region and color the part of the ocean where hurricanes are likely to occur. Fill the colors into the key below.



- | | | | |
|--------------------------|--------------------|--------------------------|----------------------|
| <input type="checkbox"/> | East Pacific Ocean | <input type="checkbox"/> | Southwestern Pacific |
| <input type="checkbox"/> | West Pacific Ocean | <input type="checkbox"/> | North Indian Ocean |
| <input type="checkbox"/> | North Atlantic | <input type="checkbox"/> | South Indian Ocean |

What do you think?

1. Does the same number of hurricanes happen in each region?
 - Yes
 - No

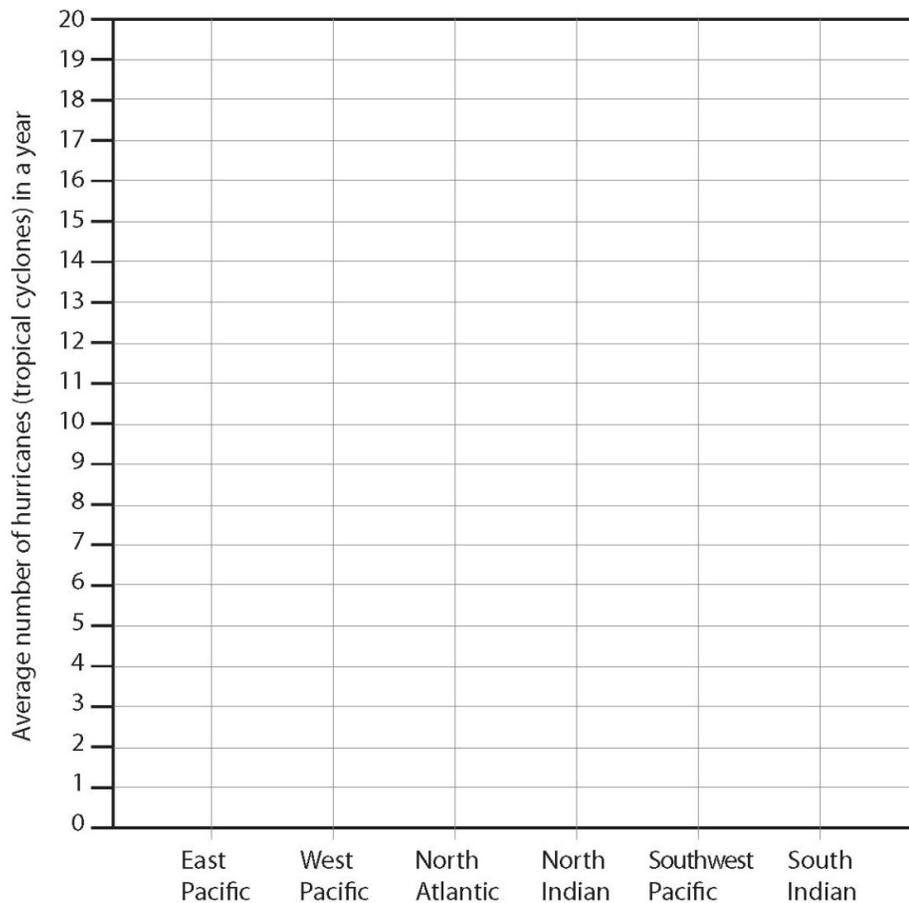
How many hurricanes happen?

The number of hurricanes (tropical cyclones) that happen varies a bit from year to year. But the average number can tell you how many are likely. Take a look at the data table below. This shows the time of hurricane season and the average number of hurricanes in each region. What do you think? Do regions get the same number of hurricanes?

Hurricane Region	Hurricane Season	Number of Hurricanes per Year (average)
East Pacific Ocean	May - November	9
West Pacific Ocean	April - January	17
North Atlantic Ocean	June - November	6
Southwestern Pacific Ocean	October - May	5
North Indian Ocean	April - December	2
South Indian Ocean	October - May	10

Average hurricanes data from NOAA based on data from 1968-1989 and rounded to the closest whole number.

Make a bar graph! A bar graph is a great way to show relative differences in numbers. Each bar is the amount of hurricanes for each region. Draw each bar using the same colors that you used for the map on the previous page.



Now what do you think?

- Does the same number of hurricanes happen in each region? (Look at your bar graph to help you answer this question.)
 - Yes
 - No

Explore Continued

Learning Target: _____

Do Now:

Where's the warm water?

The temperature of the ocean surface is different everywhere and it has an impact on hurricanes. Based on what you see in the "Sea Surface Temperatures" map, use a red or orange pencil to color the parts of the ocean where the water is the warmest during the Northern Hemisphere's summer. Then use the same colored pencil to color the parts of the ocean where the water is the warmest during the Northern Hemisphere's winter.

A world map with the following labels: Arctic Ocean, North America, Atlantic Ocean, Europe, Asia, Pacific Ocean, Equator, South America, Africa, Indian Ocean, Australia, and Antarctica. A compass rose is located at the bottom left, showing North (N), South (S), East (E), and West (W).

What do you think?
Do hurricanes happen in places where the ocean temperature is warm? (Compare your map of warm water to your map of the six hurricane regions to answer this.)

YES NO

Hurricanes and Climate - A Windows to the Universe Classroom Activity
www.windows.ucar.edu

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Question:

1. How does the warm water during the Northern Hemisphere's summer and winter relate to the times of year that hurricanes occur most frequently in different regions?

Tracking Hurricane Sandy



Part A: Hurricane Classification

The Saffir-Simpson scale, which rates hurricanes by their wind speeds, is shown below. The table shows the wind speeds and predicted damage from different categories of storms. Use the data in the chart to classify Sandy on the “Hurricane Sandy Data Table” on page 2.

Type of Storm	Wind Speeds (mph)	Likely Damage
Tropical Depression	Less than 39	Soaking rains causing flooding
Tropical Storm	39-73	Torrential rains cause flooding. Wind causes light to moderate damage, especially to outdoor furniture, tree limbs, and mobile homes.
Hurricane: Category 1	74-95	Dangerous winds remove roof shingles and gutters from houses and damage power lines and poles. Power outages could last several days.
Hurricane: Category 2	96-110	Extremely dangerous winds cause extensive damage to houses' roofs and siding. Some trees and electric poles are uprooted. Power outages could last several days to weeks.
Hurricane: Category 3	111-130	Devastating damage occurs even to well-built houses. Many trees are uprooted. Major disruption to electricity and running water is expected for several days to weeks.
Hurricane: Category 4	131-155	Catastrophic damage occurs, with well-built houses losing their roofs and outer walls. Most trees and electric poles are snapped or uprooted. Power outages could last weeks or months.
Hurricane: Category 5	Greater than 155	Catastrophic damage with many homes completely destroyed. Most of the area will be uninhabitable for weeks or months.

**Hurricane Sandy Data
(Recorded at 4p.m. each day)**

Date	Latitude (°N)	Longitude (°W)	Air Pressure (mb)	Wind Speed (mph)	Storm Classification
October 23	14	78	993	50	
October 24	18	77	970	80	
October 25	25	76	963	110	
October 26	27	77	971	75	
October 27	30	75	961	75	
October 28	33	71	952	75	
October 29	39	74	940	90	
October 30	41	79	988	45	

Part B: Hurricane Tracking

1. Use the latitude and longitude information from the "Hurricane Sandy Data Table" above to plot the track of Hurricane Sandy on the map "Hurricane Sandy Tracking October 23-30" on the last page.
2. Label each point you have plotted with the date.
3. Connect the points you have plotted and draw an arrowhead to indicate the direction of Hurricane Sandy's movement.
4. Use a colored pencil to trace over the track for when Sandy was classified as a hurricane.
5. Use the data table and map to answer the questions below.

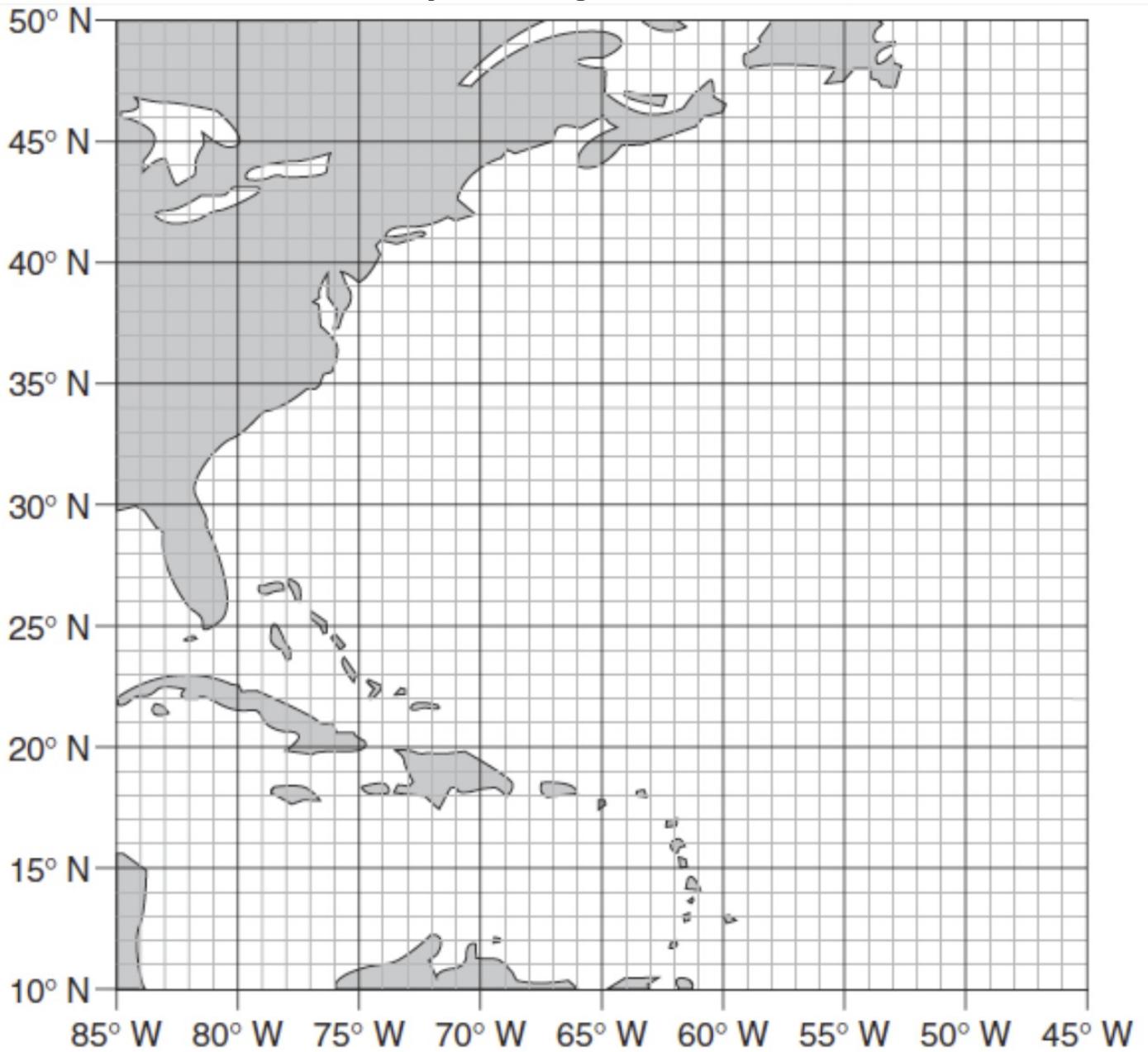
Part B Analysis Questions:

1. On what date did Hurricane Sandy make landfall near New York?

2. On what date did Sandy change from a tropical storm to a hurricane? _____
3. On what date did Sandy change from a hurricane to a tropical storm? _____
4. Where was Hurricane Sandy located when wind speeds were the highest? _____
5. What is the relationship between air pressure and wind speed? _____

6. How did the direction of Hurricane Sandy change after it passed 30°N? How is this different from the expected path of a hurricane?

Hurricane Sandy Tracking October 23 – 30, 2012



Explain 1

Learning Target: _____

Do Now:

Modified from Earth Science Interactive Textbook (by Holt, Rinehart and Winston) and [CK-12 Earth Science Concepts for High School](#)

How Do Hurricanes Form?

A hurricane is a large, rotating tropical weather system. Hurricanes have wind speeds of over 120 km/h. They can be 160 km to 1,500 km in diameter and can travel for thousands of miles. They are the most powerful storms on Earth. Hurricanes are also called typhoons and cyclones.

Most hurricanes form between 5°N and 20°N latitude or between 5°S and 20°S latitude. They form over the warm, tropical oceans found at these latitudes. The warm seas create a large humid air mass. At higher latitudes, the water is too cold for hurricanes to form.

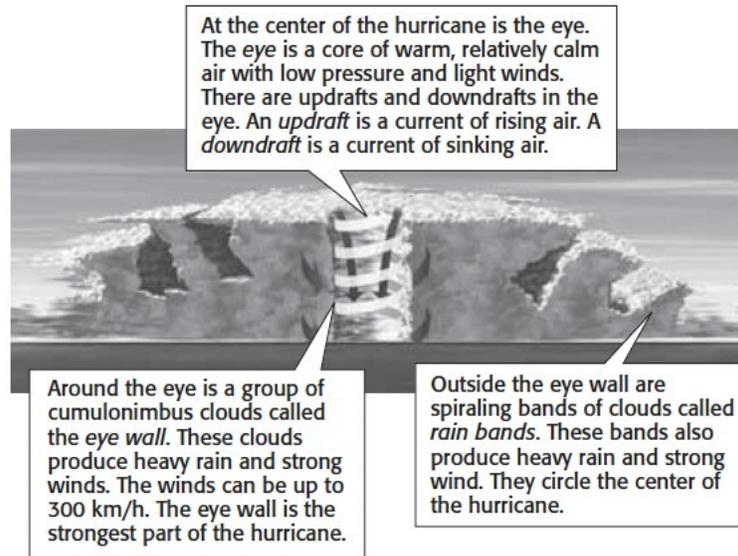


Hurricanes can be so large that they are visible from space. This photograph of a hurricane was taken by a satellite.

HOW HURRICANES FORM

The warm air that rises in the tropical latitudes forms a low-pressure cell, if the low-pressure cell is large enough it will be known as a **tropical depression**. Thunderstorms materialize around the tropical depression which travels over tropical ocean waters. Winds traveling in two different directions meet and cause the storm to spin. Because of the Coriolis effect, hurricanes rotate counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere. As the air rises, water vapor condenses, releasing energy from latent heat. If wind shear is low, the storm builds into a hurricane within two to three days.

Hurricanes are powered by solar energy. The sun's energy causes ocean water to evaporate. As the water vapor rises in the air, it cools and condenses. A group of thunderstorms form and produce a large, spinning storm. A hurricane forms as the storm gets stronger.



The hurricane will continue to grow as long as it is over warm ocean water. Hurricanes are huge and produce high winds. The exception is the relatively calm eye of the storm, where air is rising upward. Rainfall can be as high as 2.5 cm (1") per hour, resulting in about 20 billion metric tons of water released daily in a hurricane. The release of latent heat generates enormous amounts of energy, nearly the total annual electrical power consumption of the United States from one storm. Hurricanes can also generate tornadoes.

Hurricanes move with the prevailing winds. In the Northern Hemisphere, they originate in the trade winds and move to the west. When they reach the latitude of the westerlies, they switch direction and travel toward the north or northeast. Hurricanes may cover 800 km (500 miles) in one day.

When the hurricane moves over colder waters or over land, the storm loses energy. This is why hurricanes are not common in the middle of continents. The storms lose their energy quickly when they move over land.

Reading Comprehension Questions:

1. Where do hurricanes get their "energy" from? Why don't hurricanes form at high latitudes?
2. What causes hurricanes to rotate in different directions in the Northern and Southern Hemispheres?
3. What is the eye of the hurricane? Why is it safer than the "walls" of the hurricane?

Explain 2

Learning Target: _____

Do Now:

Question: *What is the scientific question you are investigating?*

Why are hurricanes more frequently experienced in the Gulf of Mexico/the Caribbean than in New York state?

Claim: *What claim can you make based on the evidence?*

Evidence <i>What are the science observations or data that address the question?</i>	Science Concepts <i>What concepts connect to the evidence and explain the claim?</i>	Reasoning <i>How do the science concepts relate to the evidence?</i>
The evidence that led to my claim is ...	The scientific concept that relates to the evidence and supports my claim is...	This science concept supports my claim because...

Scientific Explanation

Use the information in the boxes you completed above to write a scientific explanation **in one paragraph**.

Elaborate

Learning Target: _____

Do Now:

Video Notes:

Researched Ideas

Draft of Hurricane Safe building

Evaluate

Learning Target: _____

Do Now:

Reflection Questions After Testing Your Prototype:

1. Describe what happened to your model when the wind machine (fan) was turned on.
2. What aspects of your model worked well in the wind?
3. What would you revise or change in your model if you were to try to make it even better?
4. Why do you think it is important to design hurricane safe structures for hurricane prone areas?