EDUCATION
GEORGIA AQUARIUM

Lesson Plan
9-12 HURRICANE HUNTERS

Essential Questions:

1. How are maps used to track hurricanes?
2. How do atmospheric conditions affect the path of hurricanes?

GSE Standards:

- **SM3:** Obtain, evaluate, and communicate information about the science of weather forecasting.
- **SM3.b:** Construct an argument supported by evidence for the type of weather expected for a specific location using weather maps and knowledge of the movement of air masses, fronts, and weather systems.

NGSS Standards:

- **MS-ESS2-5:** Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.

Materials:

- Hurricane Steering video
- Atlantic Map Printout
- Writing Utensil

Vocabulary:

- Latitude and Longitude
- Hurricane
- High Pressure
- Low Pressure
- Front
- Sea surface temperature

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Background:

- A **hurricane** is a massive storm centered around an area of low pressure that occurs in the Atlantic Ocean, Gulf of Mexico, Caribbean Sea, or Eastern Pacific with a minimum sustained wind speed of 74 miles per hour or greater.
  - In the Western Pacific, these storms are called **typhoons** but are the same kind of storm.
- Hurricanes form when a small group of thunderstorms begin to rotate around an area of low pressure and gradually build in strength.
- The strengthening of hurricanes can be correlated to sea surface temperature. The warmer the ocean, the more energy storms have to increase in intensity.
- Hurricanes are rated on a scale of 1-5. This scale, called the **Saffir-Simpson Scale**, measures sustained wind speed only.
  - A category 5 storm is the most intense, with a sustained wind speed of 157 or more miles per hour.
- **Sustained wind** is different than a wind gust.
  - Sustained winds are the average highest wind over a one minute span of time.
  - A gust of wind is a brief increase in wind speed, not lasting for more than a minute.
- Once a hurricane is over land for too long, it can weaken into a post-tropical low pressure system.
- A **low pressure system** is characterized by the letter “L” on a weather map.
  - Low pressure systems rotate with the Earth as a cyclone.
  - Areas of low pressure are associated with cloudy, rainy, or otherwise unsettled weather.
- Areas of **high pressure** are associated with clearer weather and are considered anticyclones.
  - High pressure is notated as a capital “H” on weather maps.

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Background:

- As hurricanes drift West across the Atlantic Ocean, multiple factors can contribute to the steering of these storms.
  - A hurricane cannot interact with an area of high pressure and will be “steered” around it.
  - High pressure areas spin clockwise and will carry a hurricane around them.
- **Fronts** are boundaries of different air masses. As they travel East, they can steer hurricanes North or East, or be absorbed by the front.
- If a hurricane interacts with another area of low pressure, they can begin to rotate around each other in a process called the Fujiwhara Effect.
- Hurricanes generally travel West to East due to trade winds that travel in this direction over the Atlantic Ocean year round.
- **Sea surface temperature** has a direct relationship to the intensity of hurricanes. As such, the later months of the year (June through October) tend to be the most active months for hurricanes, during the aptly named Hurricane Season.
  - Due to the increase in average yearly ocean temperatures caused by climate change, hurricanes are becoming more intense over shorter periods of time.
- Forecasters at the National Hurricane Center, a branch of the National Weather Service, issue watches and warnings for hurricanes based on their forecasted track and intensity.
- The center of rotation, also called the eye of the hurricane, can be pinpointed using the latitude and longitude.
  - From there, forecasters can anticipate where a storm might go based on atmospheric conditions ahead of the storm.
- Latitude is the North-South divide across the planet, whereas Longitude is the East-West divide.
- Working as a grid, a combination of latitude and longitude can be used to mark a specific point on the Earth’s surface.

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Lesson Structure:

1. Show students the "Hurricane Steering" video from YouTube.
2. Ask students leading questions such as, "How can we predict where hurricanes will go based on where they will form?" and "How can we describe the location of hurricanes over the ocean?"
3. Introduce the concepts of latitude and longitude to students as well as the atmospheric conditions that steer a hurricane.
4. Pass out the hurricane data sheets, the Atlantic sea surface temperature map, and the blank Atlantic Base Maps.
5. Explain to students the instructions of the activity.
6. Students will graph the coordinates of the hurricane at different locations.
7. Students should then assign a hurricane intensity rating from the provided Saffir-Simpson scale at each point of the hurricane track.
8. After graphing the location of the hurricanes, students should be able to answer the Knowledge Check questions provided.

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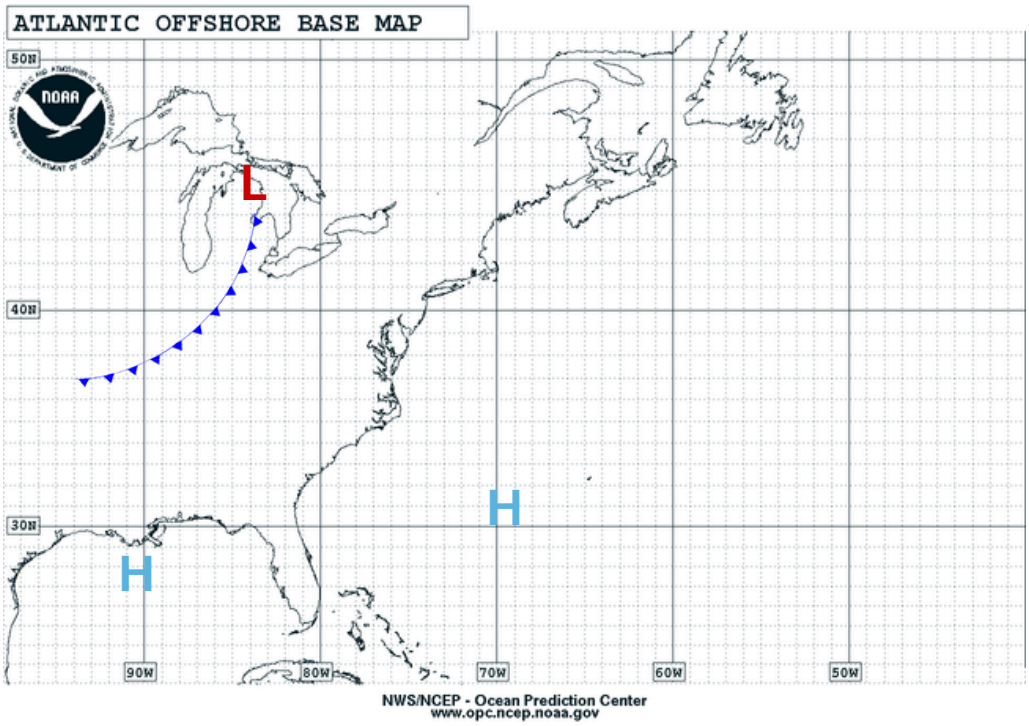
Evaluate:

1. Review the students' maps as a class and ask if everyone plotted the same coordinates. If not, review the process of plotting coordinates.
2. Ask students to share their responses to the Knowledge Check questions.
    - Ask extending questions such as: "What might happen if these conditions were different?"

Extend:

1. For further practice with this concept, try this activity from the National Oceanic and Atmospheric Administration (NOAA).
2. An increase in average annual ocean temperature due to climate change has the potential to generate stronger, longer lasting, and more frequent hurricanes. To learn more about this topic, check out this video from PBS.

Hurricane Martha
WORK SHEET



HURRICANE MARTHA DATA

SAFFIR-SIMPSON WIND SCALE

Tropical Storm: 39-73mph

Category 1: 74-95mph

Category 2: 96-110mph

Category 3: 111-129mph

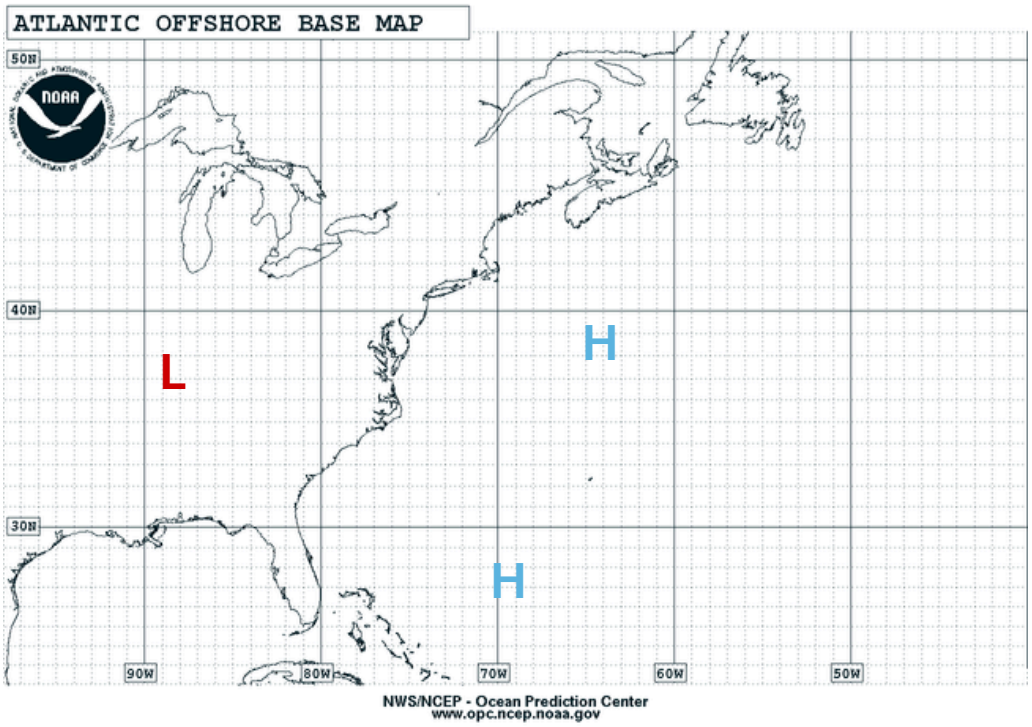
Category 4: 130-156mph

Category 5: 157+ mph

HURRICANE DATA

Location	Wind Speed
23N, 61W	45mph
24N, 67W	79mph
25N, 72W	115mph
26N, 77W	130mph
27N, 79W	125mph
28N, 82W	75mph
29N, 84W	82mph
32N, 84W	45mph
35N, 81W	35mph
38N, 78W	35mph
41N, 75W	35mph

Hurricane Dave
WORK SHEET



HURRICANE DAVE DATA

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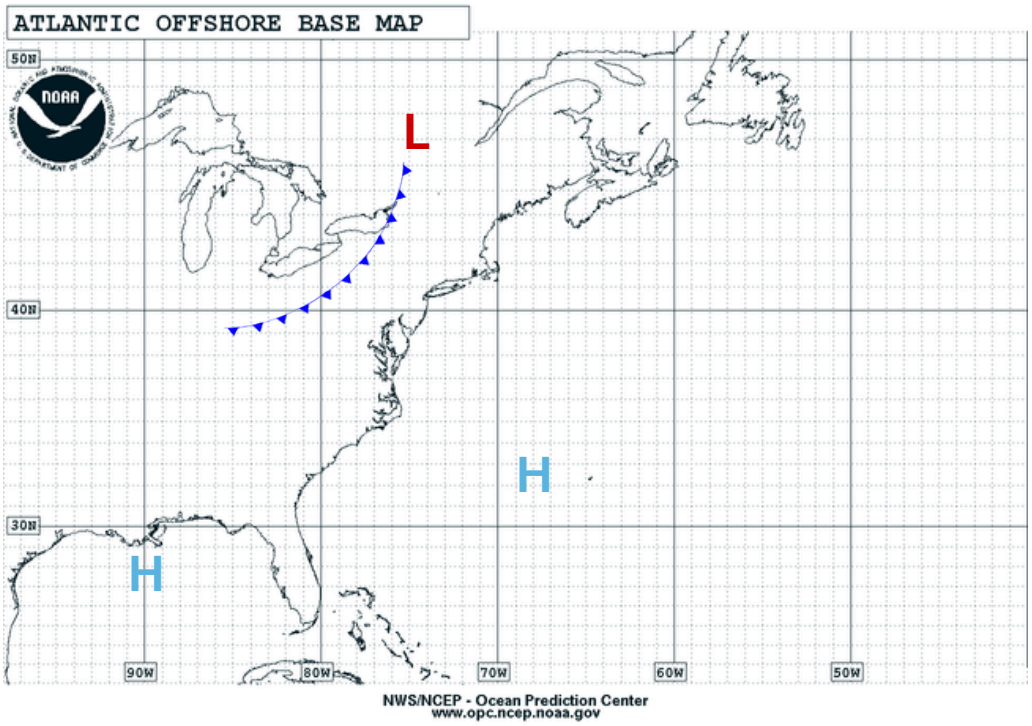
Category 2: 96-110mph
Category 3: 111-129mph
Category 4: 130-156mph
Category 5: 157+ mph

HURRICANE DATA

Location	Wind Speed
23N, 55W	40mph
25N, 59W	48mph
28N, 62W	75mph
32N, 62W	67mph
35N, 59W	45mph
39N, 53W	40mph

Hurricane Wilson
WORK SHEET



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HURRICANE DATA

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24N, 45W	40mph
24N, 52W	74mph
25N, 61W	90mph
25N, 67W	105mph
26N, 73W	115mph
27N, 78W	130mph
28N, 80W	135mph
29N, 82W	118mph
31N, 83W	75mph
34N, 82W	45mph
38N, 80W	35mph
41N, 77W	25mph

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Knowledge Check
WORK SHEET

1. What environmental factors caused Hurricane Martha to track directly into Florida?

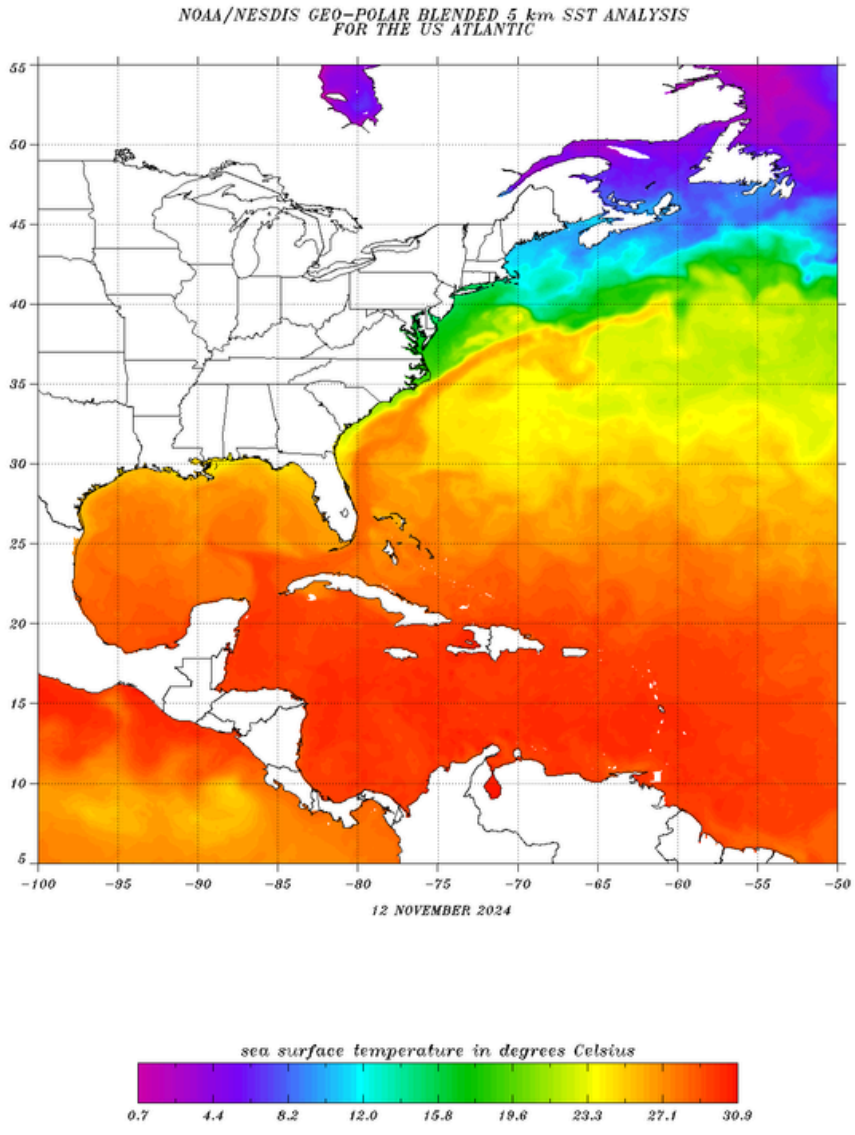
2. What environmental conditions caused Hurricane Dave to steer out to sea? Why did this cause the storm to weaken?

3. What might occur if Hurricane Wilson interacted with the cold front over the Northeastern United States, assuming it weakened into a post-tropical center of low pressure?

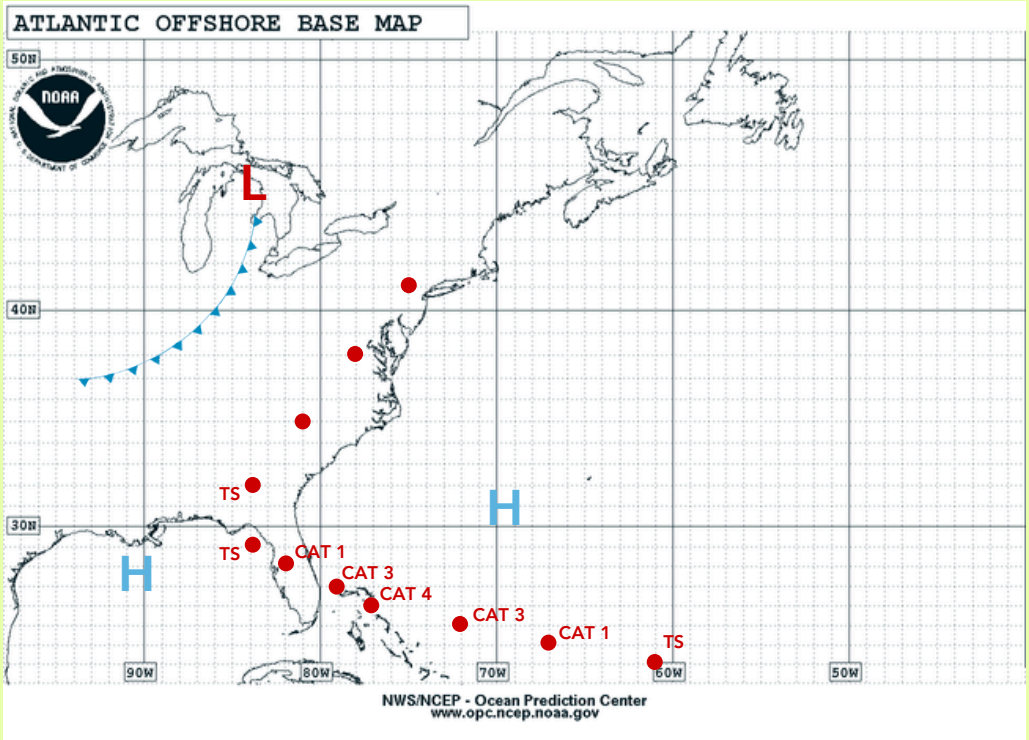
4. Imagine that a hurricane formed at 15N, 70W, then tracked due west before making landfall in Central America. How would the sea surface temperatures affect that hurricane?

Knowledge Check Data
WORK SHEET

Use this data map of sea surface temperatures to help answer the questions on the Knowledge Check worksheet.



Hurricane Martha
ANSWER KEY



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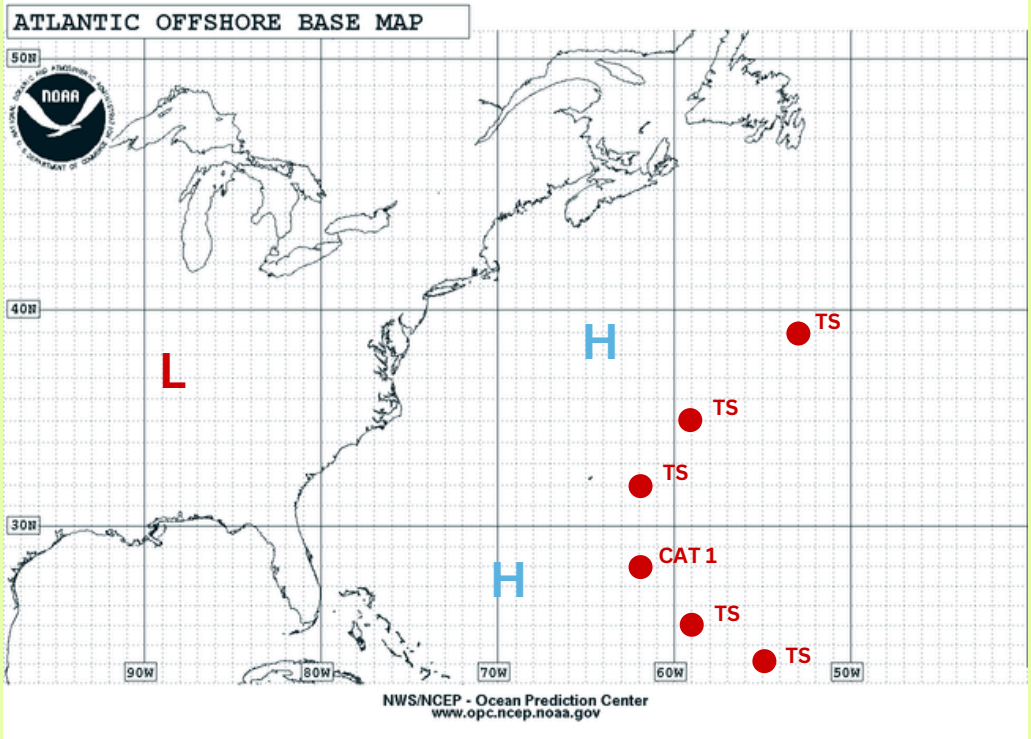

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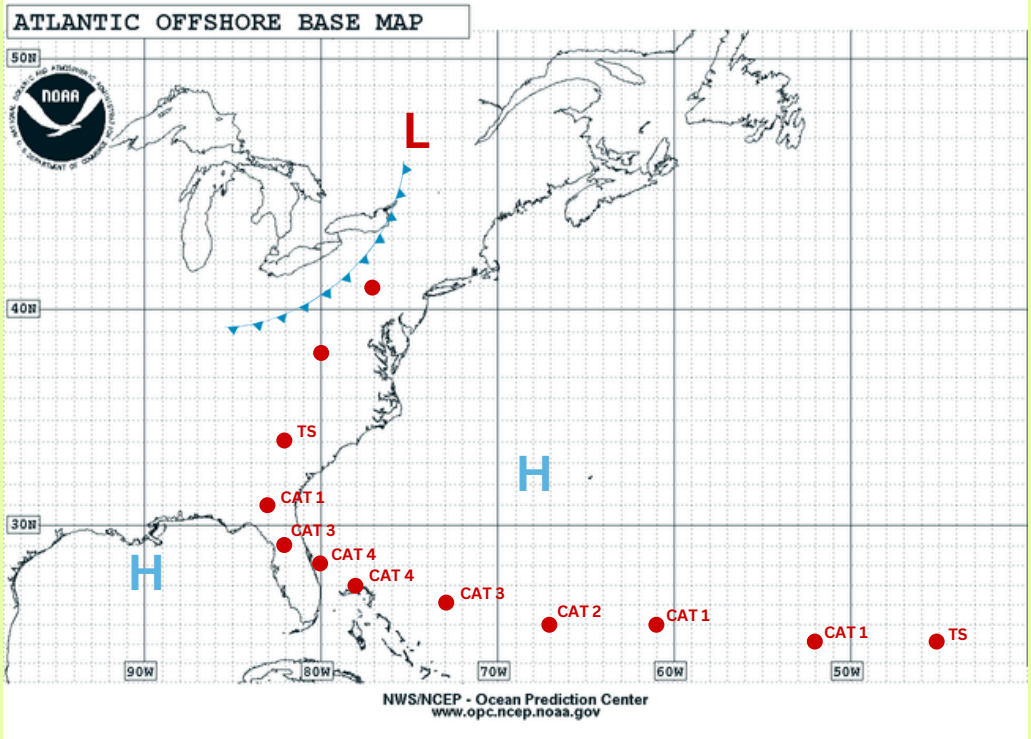

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38N, 80W	35mph
41N, 77W	25mph

Knowledge Check
ANSWER KEY

1. What environmental factors caused Hurricane Martha to track directly into Florida?

The high pressure system off the East Coast of Florida prevented the storm from tracking north, causing the storm to continue heading west.

2. What environmental conditions caused Hurricane Dave to steer out to sea? Why did this cause the storm to weaken?

The two areas of high pressure prevented Hurricane Dave from traveling in a westerly direction, forcing the storm to turn north before making it to North America.

3. What might occur if Hurricane Wilson interacted with the cold front over the Northeastern United States, assuming it weakened into a post-tropical center of low pressure?

Likely, Hurricane Wilson would have been pushed north, then east by the cold front before becoming absorbed by the system.

4. Imagine that a hurricane formed at 15N, 70W, then tracked due west before making landfall in Central America. How would the sea surface temperatures affect that hurricane?

A hurricane forming in these waters would likely intensify as it traveled west due to the warmer sea surface temperatures in this part of the ocean.

Sources Cited

- FWWU Lesson: Why do hurricanes steer towards the US? What environmental factors caused Hurricane Martha to track directly into Florida?
- “Follow That Hurricane!” From NOAA: What environmental factors caused Hurricane Martha to track directly into Florida?
- “Is Global Warming Causing All Of These Hurricanes?” From PBS: What environmental factors caused Hurricane Martha to track directly into Florida?