

Spacegate Station

Hurricanes



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Curriculum Lesson Plan

Grade Band: Middle School (6–8)

Focus Areas: Weather, Climate, Global Patterns, Energy Transfer, Natural Hazards

Episode Length: 11 minutes

Learning Objectives Students will analyze how hurricanes form, develop, and impact Earth systems while applying scientific inquiry, data interpretation, and engineering thinking. After viewing this episode, students will be able to:

- Explain the difference between **weather** and **climate**.
- Describe how **global wind patterns**, including the **jet stream**, influence storm movement.
- Identify the conditions required for **hurricane formation**.
- Describe the **structure** of a hurricane (eye, eyewall, rainbands).
- Explain how **energy from the Sun** drives convection and fuels severe weather.
- Interpret satellite imagery and understand how meteorologists use **space-based data**.
- Classify hurricanes using the **Saffir–Simpson Hurricane Wind Scale**.
- Evaluate how natural disasters impact humans and how communities prepare for them.

Lesson Procedure

1. Engage (10 minutes) MS-ESS2-5, SC.6.E.7.4

- Video Segment: 00:00:56 – 00:01:44 (Weather, Climate, Meteorology)
- Play the opening clip
- Distribute Guided Notes – Section 1
- Discussion Prompt (Whole Class) Why is it important to distinguish between weather and climate?
- Teacher Focus: Activate prior knowledge - Emphasize satellite data and observation as scientific tools

2. Explore (15 minutes) Standards: MS-ESS2-4, MS-ESS2-6, SC.6.E.7.3

- Video Segment 1: 00:02:58 – 00:03:35 (Jet Stream)
- Guided Notes – Section 2
- Video Segment 2: 00:04:22 – 00:07:10 (Hurricane Formation)
- Guided Notes – Section 3
- Optional Group Task: Students build a Hurricane System Map:

3. Explain (15 minutes) Standards: MS-ESS2-6, SC.7.E.7.2

- Video Segment: 00:07:10 – 00:07:58 (Hurricane Structure)
- Guided Notes – Section 4
- Discussion Questions:
 - Why is the eyewall the most dangerous part of a hurricane?
 - How does energy transfer drive storm intensity?

4. Elaborate (20 minutes) Standards: MS-ESS3-2, SC.6.E.7.5

Part A: Mini Hurricane Lab (10–15 min)

- Activity: Students or teachers perform the convection demonstration:
- Student Lab Analysis

Part B: Human Impact & Engineering Discussion

- Video Segment: 00:08:02 – 00:09:21 (Classification) 00:09:22 – 00:09:59 (Human Impact)
- Guided Notes – Sections 6 & 7
- Discussion Questions (Higher-Order)
 - What is the most important hurricane safety step? Why?
 - What factors should be considered when ordering evacuations?
 - How could technology improve hurricane predictions?

5. Evaluate (10 minutes) Standards: MS-ESS3-2, SC.6.E.7.7

Student Tasks: Complete exit-style questions:

1. What powers hurricanes?
2. Which part is strongest?
3. Why do hurricanes weaken over land? (short response)
4. Final Reflection Prompt: What is one thing YOU would do differently if a hurricane were approaching and why?

Hurricanes Guided Notes

WORD BANK

atmosphere	eye	rotation
category	eyewall	Saffir–Simpson Scale
climate	flooding	satellites
convection	global patterns	storm surge
Coriolis effect	hurricane	tradition
Cyclonic	hurricanes	typhoon
Climate	jet stream	water cycle
cyclone	pressure	warm water
evacuation plans	prediction	weather
evaporation	rainbands	wind

SECTION 1 — Weather, Climate, and Meteorology (00:00:56 – 00:01:44)

1. Meteorology is the scientific study of the _____ and how we forecast weather.
2. _____ provide a bird’s-eye view of Earth and help scientists track storms.
3. _____ describes what the atmosphere is doing right now.
4. _____ is the long-term pattern of weather over many decades.
5. Space-based data improves storm _____ and public safety.

SECTION 2 — Global Patterns and the Jet Stream (00:02:58 – 00:03:35)

6. The _____ is a narrow band of strong winds high in the atmosphere that moves storms across continents.
7. It forms where warm air meets cold air, creating differences in temperature and _____.
8. These _____ influence local weather and help meteorologists track storm movement.

SECTION 3 — How Hurricanes Form (00:04:22 – 00:07:10)

9. Hurricanes need _____ (at least 80°F / 27°C) to begin forming.
10. Heat from the Sun causes _____, turning ocean water into warm, moist air.
11. Rising warm air creates _____ currents that power the storm.
12. Earth's _____ causes the storm to spin, a process called the _____.
13. This entire process is connected to the _____.

SECTION 4 — Structure of a Hurricane (00:07:10 – 00:07:58)

14. The center of the storm is called the _____, where winds are calm.
15. The _____ surrounds the eye and contains the strongest winds and heaviest rain.
16. Spiral _____ stretch outward and can cause flooding and tornadoes far from the center.
17. Hurricanes are _____ storms fueled by heat and moisture.

SECTION 5 — Hurricane Names Around the World (00:04:57 – 00:05:59)

18. In the Americas, this type of storm is called a _____.
19. In Asia, it is known as a _____.
20. In the Indian Ocean and Australia, it is called a _____.
21. These names differ because of geography, language, and cultural _____.

SECTION 6 — Hurricane Classification (00:08:02 – 00:09:21)

22. Hurricanes are ranked using the _____ Hurricane Wind Scale.
23. A _____ 1 storm has winds between 74–95 mph.
24. A Category 5 storm has winds over 157 mph and can cause catastrophic damage, including _____ and flooding.
25. The scale measures _____ speed, but hurricanes also cause damage through rain, tornadoes, and _____.

SECTION 7 — Human Impact and Safety (00:09:22 – 00:09:59)

26. Meteorologists warn communities so people can prepare _____ and protect homes.
27. Understanding storms helps reduce the impact of natural disasters such as hurricanes, tornadoes, and _____.
28. Space-based meteorology supports transportation, agriculture, and _____ research.

Guided Notes Answer Key

SECTION 1

1. atmosphere
2. satellites
3. weather
4. climate
5. prediction

SECTION 2

6. jet stream
7. pressure
8. global patterns

SECTION 3

9. warm water
10. evaporation
11. convection
12. rotation
13. Coriolis effect
14. water cycle

SECTION 4

15. eye
16. eyewall
17. rainbands
18. cyclonic

SECTION 5

19. hurricane
20. typhoon
21. cyclone
22. tradition

SECTION 6

23. Saffir–Simpson Scale
24. Category
25. storm surge
26. wind
27. flooding

SECTION 7

28. evacuation plans
29. hurricanes
30. climate

Hurricane Unit Glossary

Air Pressure: The force exerted by the weight of air; differences in pressure drive wind.

Atmosphere: The layer of gases surrounding Earth where weather occurs.

Category (Storm): A ranking that indicates hurricane strength and potential damage.

Cause and Effect: Relationships where one event leads to another (ex: warm water → stronger storm).

Climate: The long-term pattern of weather in a region over many years.

Convection Current: A continuous loop of rising warm fluid and sinking cool fluid that moves energy through the atmosphere.

Convection: The movement of warm air rising and cool air sinking, creating a cycle that transfers energy.

Coriolis Effect: The apparent deflection of moving objects (like air) due to Earth's rotation, causing storms to spin.

Cyclonic: Rotating in a circular motion around a center.

Data Analysis: Examining information (like satellite data) to understand patterns.

Emergency Preparedness: Actions taken to prepare for a disaster (supplies, plans, communication).

Energy Transfer: The movement of energy from one place to another (ex: Sun → ocean → air).

Evacuation Plan: A plan for leaving an area safely before a hurricane arrives.

Evaporation: The process where liquid water changes into water vapor due to heat energy from the Sun.

Eye: The calm center of a hurricane with light winds.

Eyewall: The most dangerous part of a hurricane, with the strongest winds and heaviest rain.

Flooding: Overflow of water onto normally dry land, often caused by heavy rain.

Global Wind Patterns: Large-scale movement of air across Earth that helps distribute heat and move weather systems.

Hurricane: A large, rotating storm that forms over warm ocean water with strong winds and heavy rain.

Jet Stream: A fast-moving band of air high in the atmosphere that influences weather and storm movement.

Low Pressure System: An area where air pressure is lower than surrounding areas, causing air to rise and storms to develop.

Meteorology: The scientific study of the atmosphere and how weather is predicted.

Mitigation: Steps taken to reduce the impact of a natural disaster.

Model: A simplified representation used to explain how something works (ex: hurricane diagram or lab).

Moist Air: Air containing water vapor that fuels storm development.

Natural Hazard: A naturally occurring event that can cause damage (ex: hurricanes).

Prediction (Forecasting): Using data and models to estimate future weather or storm behavior.

Rainbands: Spiral bands of clouds and storms extending outward from the hurricane.

Rotation (Earth's Rotation): The spinning of Earth on its axis, which influences weather patterns and storm direction.

Saffir–Simpson Hurricane Wind Scale: A scale used to classify hurricanes based on wind speed (Category 1–5).

Satellite Imagery: Images taken from space used to track storms and weather patterns.

Storm Surge: A rise in ocean water caused by strong winds pushing water onto land; often the deadliest effect.

System: A group of interacting parts working together (ex: ocean + atmosphere + energy).

Tropical Cyclone: A rotating storm system that forms over warm water (includes hurricanes, typhoons, cyclones).

Warm Ocean Water: Water above $\sim 27^{\circ}\text{C}$ (80°F) that provides the energy needed for hurricanes to form.

Water Cycle: The movement of water on Earth through evaporation, condensation, and precipitation.

Weather: The condition of the atmosphere at a specific time and place, including temperature, wind, and precipitation.

Wind Damage: Destruction caused by strong hurricane winds.

Higher-Order Discussion Sheet

1. Systems Thinking — How Parts Interact (00:04:22 – 00:07:58)

Hurricanes depend on warm water, rising air, Earth's rotation, and global wind patterns. Which of these factors do you think has the greatest influence on hurricane strength, and why?

2. Human Impact — Evaluating Preparedness (00:09:22 – 00:09:59)

What do you think is the most important step people should take when preparing for a hurricane? What evidence supports your choice?

3. Cause and Effect — Climate Change Connection (00:04:22 – 00:04:40)

How might warmer oceans change future hurricanes?

4. Cross-Cultural Understanding — Names and Geography (00:05:12 – 00:05:59)

Why do you think it's important for scientists around the world to understand each other's terminology?

5. Data Interpretation — Satellite Imagery (00:03:55 – 00:04:07)

What advantages do satellites provide that ground-based tools cannot?

6. Ethical Decision-Making — Evacuation Choices (00:09:22 – 00:09:59)

What factors would you consider before recommending evacuation for a coastal city?

7. Engineering and Technology — Improving Forecasting (00:02:11 – 00:02:56)

If you could design a new tool or technology to help meteorologists predict hurricanes more accurately, what would it be and how would it work?

8. Language and Science — Idioms in STEM(00:01:01 – 00:01:44)

Why is it important for scientists and communicators to use clear language when explaining severe weather to the public?

9. Real-World Application — Community Safety (00:07:44 – 00:07:52)

What local features might make hurricanes dangerous where you live?

10. Reflection — Personal Responsibility (00:09:22 – 00:09:59)

What is one thing YOU would do differently if a hurricane were approaching? Why?

Discussion Questions Sample Responses

1. Thinking Systems: How Parts Interact (SC.6.E.7.5, SC.7.E.7.2, SC.7.E.7.3)

Sample Response: The factor with the greatest influence on hurricane strength is warm ocean water, because it provides the heat energy that fuels evaporation and convection. Without that constant heat source, the storm cannot intensify. Earth's rotation and global winds shape the storm, but warm water is what powers it.

2. Human Impact — Evaluating Preparedness (SC.6.E.7.7)

Sample Response: The most important step is following evacuation orders. Evidence shows that storm surge and flooding cause most hurricane related deaths. Leaving early reduces risk and gives emergency crews room to work safely.

3. Cause and Effect — Climate Change Connection (SC.7.E.7.2, SC.7.E.7.3)

Sample Response: Warmer oceans add more heat energy to storms, which can lead to stronger hurricanes, heavier rainfall, and faster intensification. Even if the number of storms doesn't increase, the most powerful ones may become more common.

4. Cross Cultural Understanding — Names and Geography (SC.7.E.7.3)

Sample Response: Scientists need shared terminology so they can compare data and communicate clearly during emergencies. If one region calls a storm a hurricane and other calls it a cyclone, they still need to understand they're discussing the same type of system.

5. Data Interpretation — Satellite Imagery (SC.6.E.7.3, SC.6.E.7.7)

Sample Response: Satellites provide a global, continuous view of storms. Ground tools can't see over oceans or through clouds, but satellites can track storm size, movement, and intensity from space, giving earlier warnings.

6. Ethical Decision Making — Evacuation Choices (SC.6.E.7.7)

Sample Response: I would consider storm surge risk, population density, evacuation routes, and how quickly the storm is strengthening. Vulnerable groups, such as hospitals or coastal neighborhoods, would need priority.

7. Engineering & Technology — Improving Forecasting (SC.6.E.7.7, MSESS3-2)

Sample Response: I would design a drone network that flies into storms at different altitudes to collect real time temperature, humidity, and wind data. This would improve models and help predict rapid intensification.

8. Language and Science — Idioms in STEM (**SC.6.E.7.4, SC.6.E.7.7**)

Sample Response: Clear language prevents confusion. During severe weather, people need direct instructions, not idioms or technical jargon. Misunderstanding a warning can put lives at risk.

9. Real World Application — Community Safety (**SC.6.E.7.3, SC.6.E.7.7**)

Sample Response: Local features like low lying land, coastal bays, or rivers can increase flooding risk. Areas with strong building codes or higher elevation may be safer. Geography shapes how dangerous a hurricane becomes.

10. Reflection — Personal Responsibility (**SC.6.E.7.7**)

Sample Response: I would prepare an emergency kit earlier with water, batteries, medications, and important documents. Being ready ahead of time reduces stress and keeps my family safe if the storm changes direction.

Name: _____ Period: _____ Date: _____

Student Exit Ticket Tasks

Part 1 Multiple Choice

1. What powers hurricanes?

- Cold air
- Warm Ocean water + Sun

2. Which part is strongest?

- Eye
- Eyewall

Part 2 Short response

3. Why do hurricanes weaken over land?

4. One way people can prepare for hurricanes is:

5. What is one thing YOU would do differently if a hurricane were approaching? Why?

Exit Ticket Teacher Key

1. What powers hurricanes? Correct Answer: Warm ocean water + energy from the Sun

Explanation: Hurricanes are fueled by heat energy from warm ocean water, which causes evaporation and convection that drive the storm system

2. Which part of a hurricane is the strongest? Correct Answer: Eyewall

Explanation: The eyewall surrounds the eye and contains the strongest winds, heaviest rain, and most destructive conditions.

Part 2: Short Response

3. Why do hurricanes weaken over land? Expected Answer: Hurricanes weaken over land because they lose their energy source (warm ocean water). Without heat and moisture from the ocean, the storm cannot maintain its strength. Acceptable Elements:

- Loss of warm water energy
- Reduced evaporation/convection
- Increased friction from land

4. One way people can prepare for hurricanes is: Acceptable Answers Include:

- Creating evacuation plans
- Stocking emergency supplies
- Boarding up windows
- Following weather warnings
- Preparing emergency kits

Sample Answer: People can prepare by following evacuation plans and gathering supplies before the storm arrives

5. What is one thing YOU would do differently if a hurricane were approaching?

Why? Scoring Guidance: Accept any reasonable, well-explained response. Strong Responses Include:

- Early preparation (food, water, batteries)
- Following evacuation orders
- Communication with family
- Securing property

Sample Answer: I would prepare an emergency kit earlier so my family is ready and safe if the storm gets stronger

Mini “Hurricane” Demonstration Convection Lab

Purpose of the Lab

This lab provides a simple, visual model of convection, the key atmospheric process that powers hurricanes. By observing how warm and cool water moves in a container, students see how heat energy from the Sun drives rising motion, circulation, and storm intensification. The model reinforces the episode’s explanation of how hurricanes form and why warm ocean water is essential for their strength.

What the Lab Demonstrates

1. Convection Currents

Warm water (colored red) rises because it is less dense, while cool water (colored blue) sinks because it is denser. This creates a circular flow pattern, or convection current.

2. Energy Transfer

The lab models how the Sun heats ocean water, which then heats the air above it. This rising warm air is the engine that drives hurricanes.

3. Storm Structure and Intensification. Although simplified, the lab helps students visualize:

- Rising warm air near the storm center
- Cooler air rushing in to replace it
- Continuous circulation that strengthens the storm
- This mirrors the real-world process of hurricane development.

Why This Lab Supports the Episode: The Spacegate Station hurricane episode emphasizes:

- Warm water as the fuel source
- Evaporation and rising humid air
- Convection as the main driver of storm energy
- Global patterns that steer storms

This lab directly reinforces those concepts through a hands-on model that is safe, inexpensive, and easy to run in a middle school classroom.

Lab Standards Alignment

Florida B.E.S.T. Science Standards

SC.6.E.7.3: Describe how global patterns such as the jet stream and ocean currents influence local weather. Connection: Convection currents are foundational to global circulation patterns.

SC.6.E.7.4: Differentiate between weather and climate. Connection: Lab models short-term atmospheric processes (weather).

SC.6.E.7.5: Explain how energy from the Sun drives convection within the atmosphere and oceans. Directly taught: Students observe convection driven by temperature differences.

SC.6.E.7.6: Differentiate between radiation, conduction, and convection. Connection: Lab provides a concrete example of convection.

SC.6.E.7.7: Investigate how natural disasters impact humans and how humans prepare for and respond to these events. Connection: Understanding hurricane formation supports preparedness discussions.

SC.7.E.7.2: Analyze the causes of weather patterns and climate, including the role of the Sun's energy, Earth's rotation, and the water cycle. Connection: Lab models the Sun's energy and rising warm air.

SC.7.E.7.3: Relate the formation of severe weather events (hurricanes, tornadoes) to global weather patterns. Connection: Convection is the core mechanism behind hurricane formation.

Teacher Notes

- This model does not include rotation (Coriolis effect), pressure gradients, or wind.
- It is meant to illustrate one key component of hurricane formation: convection.
- Use the lab as a bridge to discuss additional factors such as Earth's rotation, global wind belts, and warm ocean temperatures can combine to create cyclonic storms.

Name: _____ Period: _____ Date: _____

STUDENT LAB SHEET

TOPIC: Mini “Hurricane” Lab: How Warm Water Powers Storms

Purpose: To observe how warm and cool water moves and model how hurricanes get their energy.

Question: How does warm water create convection currents that help power hurricanes?

Materials

- Clear plastic container
- Cold water
- Warm water (about 100–110°F)
- Food coloring (blue and red)
- Two small cups
- Paper towels
- Optional: thermometer

Procedure

1. Fill the container halfway with cold water. Add 2 drops of blue food coloring.
2. In a small cup, mix warm water with 2 drops of red food coloring.
3. Gently place the cup of warm red water into one corner of the container.
4. Observe how the warm and cool water moves.
5. Record your observations below.

Observations

A. Draw what you see: (Students sketch convection movement)

B. Describe the motion:

Where does the warm (red) water move?

Where does the cool (blue) water move?

Analysis Questions

What is a convection current?

How is this model similar to how hurricanes form?

How is this model different from a real hurricane?

Why do hurricanes need warm water to grow stronger?

Conclusion

Write 2–3 sentences explaining how this lab helps you understand hurricane formation.

TEACHER ANSWER KEY

Subject: Mini “Hurricane” Lab — Teacher Key

Expected Observations

- Warm red water rises to the top.
- Cool blue water sinks and moves toward the warm area.
- A circular convection current forms.

Sample Answers

1. Convection current:

A loop where warm water rises and cool water sinks, creating continuous movement.

2. Similar to hurricanes:

Hurricanes form when warm ocean water heats the air, causing it to rise. Cooler air rushes in, creating a convection cycle that powers the storm.

3. Different from hurricanes:

- The model uses water instead of air.
- No rotation or Coriolis effect.
- No clouds, wind, or pressure changes.

4. Why warm water matters:

Warm water provides the heat energy that fuels evaporation and rising air, which strengthens the storm.

Conclusion (example):

This lab shows how warm water creates rising motion that drives storms. Hurricanes use the same process, warm ocean water causes rising air and convection, which gives the storm energy.

Unit NGSS Alignment (Middle School)

MS-ESS2-4-Develop a model to describe the cycling of water through Earth's systems driven by energy from the Sun and gravity.

Episode Connection: Evaporation, rising humid air, convection, water cycle.

MS-ESS2-5 -Collect data to provide evidence for how air mass interactions result in weather conditions.

Episode Connection: Warm/cold air interactions, storm intensification, cloud formation.

MS-ESS2-6-Develop and use a model to describe how unequal heating and Earth's rotation cause atmospheric and oceanic circulation patterns.

Episode Connection: Jet stream, Coriolis effect, global storm movement.

MS-ESS3-2 - Analyze and interpret data on natural hazards to forecast future events and inform technologies to mitigate their effects.

Episode Connection: Hurricane categories, storm surge, forecasting, evacuation planning.

Science & Engineering Practices (SEPs)

- Analyzing satellite data
- Using models (storm structure, convection)
- Constructing explanations
- Engaging in argument from evidence

Unit Florida B.E.S.T. Science Standards Alignment

SC.6.E.7.3- Describe how global patterns such as the jet stream and ocean currents influence local weather.

Episode Connection: Jet stream explanation and storm steering.

SC.6.E.7.4-Differentiate between weather and climate.

Episode Connection: Aurora’s explanation of weather vs. climate.

SC.6.E.7.5-Explain how energy from the Sun drives convection within the atmosphere and oceans.

Episode Connection: Warm water, evaporation, convection currents.

SC.6.E.7.6- Differentiate between radiation, conduction, and convection.

Episode Connection: Convection explicitly; radiation implied via solar heating.

SC.6.E.7.7 - Investigate how natural disasters impact humans and how humans prepare for and respond to these events.

Episode Connection: Hurricane impacts, storm surge, evacuation, meteorologist role.

SC.7.E.7.2 - Analyze the causes of weather patterns and climate, including the role of the Sun’s energy, Earth’s rotation, and the water cycle.

Episode Connection: Coriolis effect, Sun’s energy, evaporation, convection.

SC.7.E.7.3- Relate the formation of severe weather events (hurricanes, tornadoes) to global weather patterns.

Episode Connection: Hurricane formation, global naming conventions, cyclonic activity.