

Optional Teaching Method Suggestion

Teachers may choose to “jigsaw” Lessons 2-5. Smaller groups of students would become “experts” in the lesson they are assigned and would teach the rest of the class the information they have learned.

NOTE: Using this option would mean that some groups of students will not be able to participate in hands-on activities. The teacher also needs to be aware of and prepare for additional safety issues that will arise when conducting multiple labs/activities.

Lesson Preparation:

- For Jigsaw: Before starting to jigsaw, read over Lessons 2-5. Students may choose from a variety of presentations, such as, a PSA, poster, brochure, museum display, skit, etc., limited only by availability of equipment and supplies. Each group will be responsible for introducing the vocabulary for their lesson.

I. Jigsaw Instructions

A. Divide students into four groups and assign each group a lesson.

- 1) Group 1 will investigate the technologies that NOAA uses to monitor hurricanes (buoys, ships, satellites, radiosondes, reconnaissance aircraft, and radar). They will prepare flashcards for their presentation. Each student will be given a worksheet, “*How Do We Watch Hurricanes,*” which will help them take notes.
- 2) Group 2 will investigate how hurricanes form, beginning with how water and oceans affect weather and climate, to the formation of a tropical depression, a tropical storm and a hurricane. Students in this group will model the three stages of hurricane formation by doing a demo lab. Each student will be given a worksheet, “*Hurricane Formation Stages of Hurricanes,*” to do after the presentation. Revise and add to K-W-L Chart. A poster featuring the water cycle can be found at http://www.srh.noaa.gov/srh/jetstream/atmos/hydro_cycle.htm.
- 3) Group 3 will investigate hurricane hazards (storm surge, inland flooding and powerful winds) and hurricane preparedness. Students will use flashcards of photos showing results of a storm surge, inland flooding and strong winds. They will show a *Hurricane Hazard Video* “Storm Surge July 9, 2005.” <http://www.srh.noaa.gov/key/HTML/gallery.htm> At the end of the presentation, students will make a list of the actions they would need in a family disaster plan and a list of what would go into a disaster kit. Revise and add to K-W-L Chart.
- 4) Group 4 will investigate hurricane watch, hurricane warning and an actual hurricane as they go over news reports and radar and satellite images. Presenters will use three slides to assist them. At the end of the presentation, all students will write a story about the approach of a hurricane using the vocabulary they have learned in this unit, including hurricane watch, hurricane warning and an actual hurricane. Revise and add to K-W-L Chart.

B. All groups will present their findings using a variety of methods, such as, a PSA, poster, brochure, museum display, skit, etc., limited only by availability of equipment and supplies. Each group will be responsible for introducing the vocabulary for their lesson.

LESSON 2 Hurricane Formation

Lesson at a Glance

Students model a tropical depression and a hurricane using a glass of water and their own breath. They then monitor a tropical depression on screen as it turns into a hurricane. These observations allow students to illustrate and describe a tropical depression, tropical storm, and hurricane. Students complete part of a K-W-L chart to record what they learned in this lesson.

Lesson Duration

Two 45-minute periods

Essential Question(s)

How are hurricanes formed and classified?

How do hurricanes move?

Key Concepts

- A hurricane forms from a tropical depression, turns into a tropical storm, and finally a hurricane.
- A hurricane can be categorized as class 1, 2, 3, 4 and 5.

Instructional Objectives

- I can describe how a hurricane forms.
- I can add descriptions and details to an illustration to expand its meaning.
- I can use observational skills to create an illustration of a tropical depression, tropical storm, and hurricane.

Related HCPS III Benchmark(s):

Science SC.3.1.2
Safely collect and analyze data to answer a question.

Science SC.3.8.2
Describe how the water cycle is related to weather and climate.

Language Arts LA.3.5.1
Add details, descriptions, and information from different sources to elaborate meaning.

Fine Arts FA.3.1.3
Use observational skills in creating an original work of art.



Assessment Tools

Benchmark Rubric:

Topic		Scientific Inquiry	
Benchmark SC.3.1.2		Safely collect and analyze data to answer a question	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Summarize and share analysis of data collected safely to answer a question	Safely collect and analyze data to answer a question	With assistance, safely collect and analyze data	With assistance, safely collect data and attempt to analyze data

Topic		Forces that Shape the Earth	
Benchmark SC.3.8.2		Describe how the water cycle is related to weather and climate	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Describe how the phases of the water cycle relate to weather and climate	Describe how the water cycle is related to weather and climate	Give an example of how the water cycle is related to weather or climate	Recognize that the water cycle is related to weather and climate

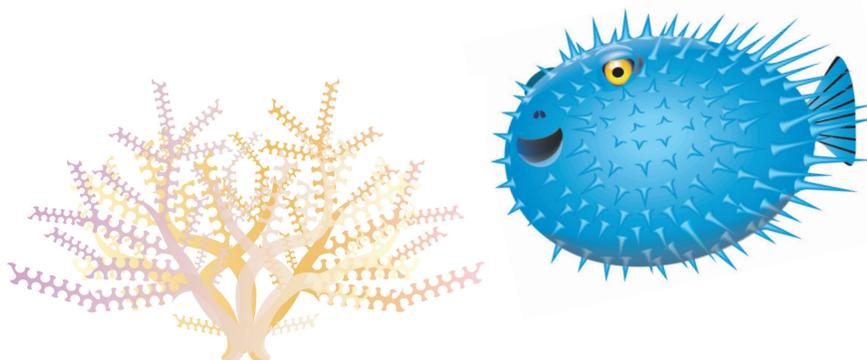
Topic		Meaning	
Benchmark LA.3.5.1		Add details, descriptions, and information from different sources to elaborate meaning	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Add relevant details, descriptions, and information from different sources that insightfully elaborate meaning	Add relevant details, descriptions, and information from different sources that elaborate meaning	Add some trivial details, descriptions, and information from different sources that relate to but do not elaborate meaning	Add irrelevant or very few details, descriptions, and information from different sources that do not elaborate meaning

Topic		How the Arts Communicate	
Benchmark FA.3.1.3		Use observational skills in creating an original work of art	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Consistently use observational skills in creating an original work of art	Usually use observational skills in creating an original work of art	Sometimes use observational skills in creating an original work of art	Rarely use observational skills in creating an original work of art

Assessment/Evidence Pieces

Lesson

- Student Worksheet *Hurricane Formation Activity*
- Student Worksheet *Hurricane Formation-Stages of Hurricanes*



Materials Needed

Teacher	Class	Group	Student
<ul style="list-style-type: none"> Method to present PowerPoint PowerPoint <i>Hurricane Formation</i> 	<ul style="list-style-type: none"> Mop Towels or Paper towels 	<ul style="list-style-type: none"> Small bowl or pan (5" – 8" diameter) Goggles 	<ul style="list-style-type: none"> Worksheet: <i>Simulating the Formation of a Hurricane</i> Worksheet: <i>Stages of Hurricane Formation</i> KWL sheet from Lesson 1

Instructional Resources

Teacher Reading: *Hurricane Formation*

Student Worksheet: *Hurricane Formation Activity*

Student Worksheet: *Hurricane Formation-Stages of Hurricanes*

Supplemental Resource: *Predicting and Tracking Hurricanes Interactive Game*

Microsoft Clip Art or the FEMA image library for hurricane images:

<http://www.photolibary.fema.gov/photolibary/index.jsp> or the USGS

<http://www.usgs.gov/newsroom/photos.asp>

Optional - Student Worksheet: *Unit Self-Assessment* (found at beginning of unit)

Student Vocabulary Words

hurricane: a severe tropical cyclone with heavy rains and high wind speeds in excess of 73 mph or 119 km/hr, enormous waves, and subsequent flooding that can damage buildings and beaches. It is an area of low pressure around which winds blow counterclockwise in the Northern Hemisphere. The term hurricane is used for Northern Hemisphere tropical cyclones east of the International Dateline to the Greenwich Meridian. The term typhoon is used for Pacific tropical cyclones north of the Equator west of the International Dateline. The term cyclone is used for tropical cyclones in the Indian Ocean.

tropical depression: a tropical cyclone in which the maximum sustained surface wind speed (using the U.S. 1-minute average) is 38 mph or 62 km/hr or less.

tropical storm: a tropical cyclone in which the maximum sustained surface wind speed (using the U.S. 1-minute average) ranges from 39 mph or 63 km/hr to 73 mph or 118 km/hr.

Lesson Plan

Lesson Preparation

- Review the Science Background provided in the Unit's Overview, and the Teacher Reading *Hurricane Formation*.
- Write the "I can" statements on chart paper and post them for ready reference.
- Preview the PowerPoint *Hurricane Formation* and make arrangements to project it.
- Preview and make copies of the Student Worksheets *Hurricane Formation Activity* and *Hurricane Formation- Stages of Hurricanes*, one copy per student.
- Add to the Word Wall if you've created one.
- Preview the interactive piece *Predicting and Tracking Hurricanes* to be completed at the end of Step III.

I. *Model Hurricane Formation*

- A. Review with students the key elements of hurricanes: high winds, heavy rains, and damage to property when hurricanes reach land. Emphasize to students that as the amount of energy in the system increases, the winds grow stronger and more water is involved.

Teacher Note: You may want to use this information to help lead the discussion with the students: A scientific model is an idea used to help scientists understand or explain some part of natural systems or processes. The idea can be represented as a physical or computer-based model. Simulations use models to better understand events, solve problems, infer information, and use data to make predictions.

- B. Explain to students that one way that scientists study big natural events like hurricanes is to conduct experiments in their laboratories using small-scale simulations. Mention to students that the simulations (models) create conditions that are similar, but not the same to real-life conditions. Similar conditions help scientists make predictions. Tell students that in this simulation they will be using a bowl with water, making predictions and carrying out tests to simulate (model) what happens when wind speed increases.

Safety Note:

During the lesson students may spill water onto the floors. This may cause slippery conditions. ALL students should be using covered shoes to do this lab activity.

Remind students to walk carefully (NO running and/or horseplay) and to follow all classroom safety rules. Students should also tell the teacher when they see water on the ground so that the teacher can clean it up.

- 1) Distribute the Student Worksheet *Hurricane Formation Activity*, and group students into pairs. Point out the three tests, and demonstrate with a bowl of water how hard the students are to blow into the bowl (without actually doing the tests). Ask students to record their predictions for all three tests.
- Group students into pairs.
 - Give each student goggles to use through the duration of the lab. Instruct students on the proper way to wear goggles.

Safety Note:

Goggles should be worn over the eyes at all times and should not be removed until the end of the lab when the teacher instructs them to.

- Give each pair a bowl of water.
- Ask students to predict what will happen if they blow gently across their bowls of water, and to write or draw their predictions. Then, have one student blow while another observes and records what happens. Remind students that observations may be written words or drawings. Also explain that their blowing represents the wind.

- Repeat the predictions and simulation, this time blowing a bit harder across the bowl of water. Remind students to record observations.
- Repeat again, asking students to blow the hardest, yet across their bowls of water. Again remind students to record observations.
- When finished, collect the bowls of water.

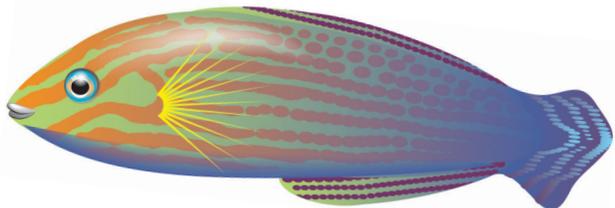
C. Bring the whole class back together. Lead a discussion by asking students what they observed.

Here are suggested guiding questions.

1. What happened when you blew gently on the water?
 2. What happened to the water when you blew harder?
 3. How did the water react when you blew as hard as you could?
 4. How much energy did you use when you blew gently?
 5. How much energy did you use when you blew as hard as you could?
 6. What is a model or a simulation?
- D. Help the students to use their observations to explain how hurricanes form. From the simulation and discussion, students should be able to connect the amount of energy that students expended to the amount of wind and water movement. Students should understand also that the harder they blew, the more energy was in the system and the more water moved. If necessary, make an explicit connection for students by explaining to them that the more wind in a hurricane, the more water movement, and the greater the damage caused by storm surge when a hurricane reaches land.

II. Explain How and Where Real-World Hurricanes Form

- A. Teach students that hurricanes form in warm tropical seas and have winds that rotate counterclockwise in the Northern Hemisphere. This will be important in their drawings. Tell students that hurricanes form in predictable areas of the Atlantic and Pacific Oceans, so they are not left with the misconception that hurricanes form everywhere there are strong winds. (Teaching suggestion: review origins of low pressure systems at http://www.weatherquestions.com/What_causes_low_pressure.htm)
- B. Explain that a hurricane begins as a tropical depression, which is a group of tropical thunderstorms. A tropical depression can turn into a tropical storm if the winds are over 38 mph. A tropical storm can turn into a hurricane when the winds are over 74 mph. Make sure that you have written these terms and figures on the board or overhead for students to see:
- 1) Tropical Depression – Winds under 38 mph
 - 2) Tropical Storm – Winds between 39-73 mph
 - 3) Hurricane – Winds over 73 mph



III. *Hurricane Formation PowerPoint Animation*

- A. Review with students the Instructional Objective “*I can*” statements posted on the wall.
- B. Click on this link to go to the “Animated Guide: Hurricanes.”
<http://news.bbc.co.uk/2/hi/science/nature/4588149.stm> This animation will show students how hurricanes form and the kinds of damage caused to coastal communities for hurricanes of different magnitudes.
- C. Show the various hurricane formation loops from the *Hurricane Formation PowerPoint* or directly from the source websites on screen. Ask students to describe what they are seeing out loud. Emphasize on slide #4 that students are seeing a hurricane grow in size. This means that the wind speed and the amount of water involved have increased.
- D. Take students through the list on the board (from II B, 1. Tropical Depression, 2. Tropical Storm and 3. Hurricane) of hurricane formation in light of visualizations in the PowerPoint. Emphasize that hurricanes form first as Tropical Depressions, then as Tropical Storms, and then as Hurricanes. They are classified by their wind speed.
- E. Distribute Student Worksheet: *Hurricane Formation- Stages of Hurricanes*. Ask students to draw a three-frame illustration showing the growth of a hurricane. Encourage them to use descriptive words for each stage of hurricane formation, including the wind speed. You may wish to show them a variety of images from Microsoft Clip Art (available in MS Word under Insert-Image), FEMA, or the USGS (web site addresses listed in Instructional Resources) for more ideas.
- F. Have students share and explain their *Hurricane Formation-Stages of Hurricanes*.
- G. In order to reinforce student learning, have the class work in pairs on the computer using the *Predicting and Tracking Hurricanes Interactive Game*.

IV. *Extend the K-W-L Chart*

- A. Discuss with students what they learned about how hurricanes are formed. Encourage students to add to or modify what they wrote in the L column. You may want to have them date what they write so that their progress may be tracked over the course of the unit.
- B. Students may also want to add more questions to their W section. You may also want them to date these additions as well to monitor their progress over the course of the unit.

Extended Activities

1. National Environmental Visualization Laboratory hurricane animations -
<http://www.nnvl.noaa.gov/MediaHome.php?MediaTypeID=2&CategoryID=30>
2. Students may want to act out the role of a weather reporter and give a weather report to the audience in which a storm at sea is gaining strength and may become a hurricane.
3. Students may want to research Hawaiian hurricanes including:
 Iniki (scroll down): <http://www.prh.noaa.gov/cphc/summaries/1992.php> and
<http://www.washingtonpost.com/wp-srv/weather/hurricane/poststories/iniki.htm>
 Iwa (scroll down): <http://www.prh.noaa.gov/cphc/summaries/1982.php> and
<http://www.honolulu.gov/ocda/hurric2.htm>
4. Students can research the hurricanes using the links above, as well as interview survivors of the hurricanes for firsthand accounts. They can make a report that includes both research and interviews.

LESSON 2 Teacher Reading

Hurricane Formation

Hurricanes are a type of low pressure weather system in warm tropical seas. Hurricanes are the most severe tropical cyclones. Tropical cyclones are categorized as:

Tropical Depressions, a system of clouds and thunderstorms with defined circulations and maximum sustained winds of less than 39 mph.

Tropical Storms, a system of strong thunderstorms with defined circulations and maximum sustained winds of 39-73 mph.

Hurricanes, a system of strong thunderstorms with well-defined circulations and maximum sustained winds higher than 73 mph

Teacher Resources: Hurricane Formation PowerPoint

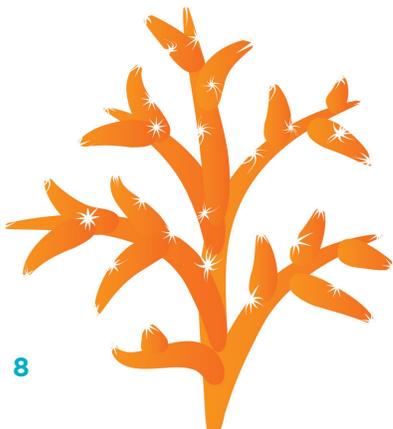
Teachers may run animation directly from the web as well. Use websites

1. <http://www.aoml.noaa.gov/hrd/>
2. National Environmental Visualization Laboratory hurricane animations - <http://www.nnvl.noaa.gov/MediaHome.php?MediaTypeID=2&CategoryID=30>

(Teacher Notes: Ask students to describe out loud what they see in the picture. You will want to draw out two key points from their observations:

1. Hurricane structure includes spiraling circular winds, rain bands and a central area called an eye.
2. Hurricane severity changes as it forms, grows in strength, and eventually ends. Hurricane strength is categorized by wind speed.

(In order to make the points above, you may want to replay the animation a number of times.)



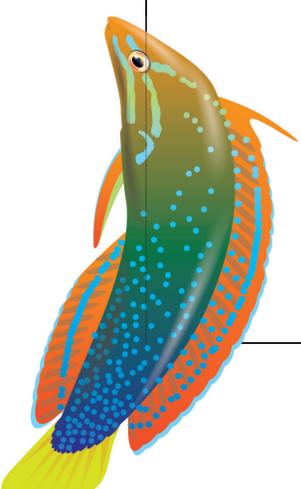
LESSON 2 Hurricane Formation Activity

NAME: _____ DATE: _____

Test:	PREDICTION:	OBSERVATION DATA:
What I will do?	What I think will happen?	Describe what you observed in words and/or a labeled drawing
Test 1 – Blow gently across the water		
Test 2 – Blow stronger across the water		
Test 3 – Blow as hard as you can across the water		

Question: What does the data tell you about how storms progress from tropical depression to tropical storm to a hurricane?

Answer:



LESSON 2

Hurricane Formation - Stages of Hurricanes

Directions:

Stages: Add a few words to describe each kind of storm, including wind speeds.

Drawings: Make a picture to show the strength of each kind of storm including wind, rain, and damage.

Stages of Storms	Drawing
Tropical Depression	Wind Speed:
Tropical Storm	Wind Speed:
Hurricane	Wind Speed: