

1. TARGET CLASS AND LOGISTICS

- a. 6th Grade students
- b. 5 day lesson framework (55 minute classes)
- c. Materials
 - i. Computers/Laptops
 - ii. Hard Copies of Articles (resources) or Google Classroom Upload
 - iii. Hard Copies of Rubric, Data Set, Convection Graphic, Gallery Guide Brochure and Tracking Map (resources)
 - iv. Graphing paper

2. JUSTIFICATION

In the Climate and Weather Unit, students engage with content surrounding the influence of air and water with respect atmospheric and oceanic conditions. Focus is brought to the water cycle, convection cycle, differential heating, heat transfer, global ocean and wind currents as well as catastrophic events. As a way of bringing a well-documented phenomenon to light, this series of lessons attempts to provide a contextual lens through which students can apply prior knowledge while delving deeper into a complicated expression of weather. Through the course of these lessons, students will be assessed on their understanding of hurricane warning tools, formation and impact and well as their ability to graphically represent the relationship between air pressure and wind speed.

3. STANDARDS

- a. MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions
- b. MS-ESS3-2 Analyze and interpret data of natural hazards to forecast future catastrophic events and inform the development of technology to mitigate their effects
- c. MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
- d. CCSS.MATH.CONTENT.6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
- e. CCSS.ELA-LITERACY.W.6.1.B. Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text.

4. STUDENT OBJECTIVES

- a. Students will be able to explain air mass movement relative to low and high pressure differences using both language and mathematical expressions (graphing)
- b. Students will be able to model the convection cycle and make critical connections to the formation of a hurricane.

- c. Students will be able to synthesize information from various texts and collaborate in creating an educational tool on hurricanes.
- d. Students will be able to make claims about hurricane technology, formation, impact, and human influence using clear reasoning from credible sources and data via team and individually generated tools (Hurricane Tool, Graphs)

5. STEM INTEGRATION

- a. Science- Atmospheric components responsible for weather and climate (pressure, temperature, differential heating)
- b. Technology- NOAA Data/Hurricane Tracking Center, Various Lab Demos,
- c. Engineering- Exploration of devices used in monitoring hurricanes, connections to history of hurricane tracking
- d. Math- Graphical analysis of variables pulled from NOAA

6. PRIOR KNOWLEDGE

- a. Students will have learned about the water cycle and have explored some hands on activities relating temperature to pressure.
- b. Students will have read excerpts from Zeitoun (Eggers, 2007), a book detailing life in New Orleans through the lens of the response to Hurricane Katrina and the war on terror.
- c. Students will have learned to plot data on an X/Y graph.
- d. Students will have practiced using CER language (Claim, Evidence Reasoning) in terms of writing and speaking.

7. LESSON PLAN

5E Lesson Plan	FA= Formative Assessment
<p>Engage</p>	<p>Day 1- Hurricane Tracker Site (https://coast.noaa.gov/hurricanes/)- (Resource)</p> <ol style="list-style-type: none"> 1) Have students use computers and pull up the website from NOAA 2) Model the usage to find a hurricane from the list on the board (Katrina 2005, Hugo, Irma, Sandy, etc.) and demonstrate the data provided based on path shown 3) Ask students to choose one hurricane and assess data provided 4) Student discuss at table and share out on observed relationship between wind speed and pressure. 5) Students discuss how they might graphical represent the data. 6) Model two graphs (one proportional and one inversely proportional) and ask for explanations of relationships. Ask student to choose which one best represents the data from their hurricane.
<p>Explore</p>	<p>Day 1- Jigsaw Read</p> <p>Students will be grouped up in teams of four. Each team will be assigned one of the areas listed below.</p> <ol style="list-style-type: none"> a) Hurricane Warning Technology (https://www.livescience.com/39678-incredible-tech-track-hurricanes.html) b) Hurricane Formation (https://www.vox.com/science-and-health/2016/10/6/13191010/how-hurricanes-form-tropical-storms-guide) c) Hurricane Impact (https://geography.tamu.edu/academics/camps-and-outreach/hurricane/impacts/index.html) d) Human Impact on Climate (https://www.gfdl.noaa.gov/global-warming-and-hurricanes/) <p>Students will begin to design/outline their educational tool choosing from options listed in the Hurricane Tool Rubric. (Resources)</p>

Engage/Explore

Day 2- Can Crush Demo- (<https://www.aps.org/programs/outreach/guide/demos/can crush.cfm>)

- 1) Open with the setup as described in link
- 2) Have students half a piece of paper and share with neighbor
- 3) Ask them to think of ways in which the Coke can could be crushed without directly touching it and have them briefly discuss at table. **(FA-if a student/table seems to come up with a good solution, move forward. If not, explain the apparatus and give them another minute to talk)**
- 4) Poll the class for suggestions/ideas.
- 5) Demo the can crush
- 6) Run 4 corners-Have students explain their thinking from each corner to the rest of the class
 - 1) All the water escaped through vapor and the can became empty.
 - 2) The cold water made the can shrink.
 - 3) The vapor condensed to the walls of the can and no air could get back in.
 - 4) The tongs were closed when the can was placed in the cold water.
- 7) Debrief the basics of low pressure/high pressure as it relates to air movement and temperature.
- 8) Ask for a volunteer to come to the board and plot out a graph with pressure lines versus temperature lines.

Isaac’s Storm documentary on 1900 Hurricane in Galveston, Tx.

(<https://www.youtube.com/watch?v=WHTcPxATzm0>)

- 1) Show the segment that builds on the science behind the hurricane.
- 2) Have students focus on these questions. What is presented that relates to hurricane formation and impact? How does any of it relate to temperature, pressure and wind speed?
- 3) Have a scribe at each table capture key ideas from short table discussion after video and turn in **(FA- if tables seem to generate good connections, move forward. If not, take time for a brief class discussion so all can benefit from a sharing of ideas)**
- 4) Project pressure/wind data from 1900 hurricane (<https://coast.noaa.gov/hurricanes/>) on the board and ask students to create a graph showing the relationship.

Explain

Day 2- Hurricane Tool

- 1) The teams of four will collaborate using the information from the article they read the day before.
- 2) Plans for the tool will be verified by teacher during class. **(FA- this is a time to see the level of teamwork and critical thinking. Coach as needed)**
- 3) Teams may proceed with the construction/development of their tool once teacher has verified.

Engage/Explore

Day 3- Bernouli’s Principle Demo- Fill a Bag

- 1) Provide several students with a long plastic bag
- 2) Ask them to try to fill it with air (give them a minute or so to make an attempt)
- 3) Take out a separate bag and demo filling it by blowing a gentle and continuous breath into the bag from a distance of 10-12 inches. (Bag should fill up)
- 4) Ask for ideas from students as to what happened and why?- (air movement in bag creates low pressure and outside air pressure becomes higher and moves air into the bag)
- 5) Ask students to connect this concept of low pressure being created by moving particles of air to the hurricane information they have gathered so far

Isaac’s Storm documentary on 1900 Hurricane in Galveston, Tx.

(<https://www.youtube.com/watch?v=WHTcPxATzm0>)

- 1) Show the segment that focuses on technology involved in monitoring hurricanes.
- 2) Have students focus on these questions. What was the main technology of the time (how did it work)? What additional data do you believe would be helpful to assess a hurricane’s size, movement and potential impact? How would these tools possibly work?
- 3) Have a scribe at each table capture key ideas from short table discussion after video and turn in **(FA- if tables seem to generate good connections, move forward. If not, take time for a brief class discussion so all can benefit from a sharing of ideas)**

Explain

Day 3- Hurricane Tool

- 1) Students build/finalize their educational tool.

Engage/Explore

Day 4- Aquarium Convection Cycle Demo

- 1) Materials- Aquarium with water, 2 ice cube trays with ice, 3 votive candles, 2 color of food dyes
- 2) Set Up- Model convection cycle by supporting the aquarium with the ice tray on either end and sliding lit candles into the middle below the tank.
- 3) Hold red dye and place hand in middle of tank near bottom- release some dye
- 4) ??- Ask students to predict what will happen before you release
- 5) Hold blue dye and place hand on either end near bottom and release blue dye
- 6) ??- Ask students to predict what will happen before you release
- 7) As student watch the dynamic that ensures, ask them to make connections to what they have learned so far about hurricane formation.
- 8) Students will use provided graphic to note observations and solidify learning after discussion.
Convection Graphic (Resources)

<p>Elaborate/Extend</p>	<p>Day 4- Hurricane Tool</p> <ol style="list-style-type: none"> 1) Students share tools in 2 cohorts (each cohort has one of each team) 2) Each team in a cohort presents to the other teams in an informal circle (i.e. Hurricane Warning Technology team presents to the other 3 teams (Hurricane Formation, Impact, and Human Influence on Climate)) 3) Students who are not presenting note key concepts on Gallery Guide Brochure (Resources) 4) After one group has presented, the next team presents. 5) After all teams have presented, students regroup in Hurricane Tool teams and link studied area to the three new ones and establish connections.
<p>Elaborate/Extend</p>	<p>Day 5 Hurricane Tool</p> <ol style="list-style-type: none"> 1) Finish Day 4- Hurricane Tool procedures 2) Hurricane Tool teams share out specific connections to the class.
<p>Evaluate</p>	<p>Day 5- Application</p> <ol style="list-style-type: none"> 1) Students will be given several hurricane data sets of wind speed, latitude/longitude, and time for multiple hurricanes. 2) They will use the information to plot the path of the hurricane on a tracking map. (Resources) 3) They will also predict what patterns would exist in terms of pressure based on the provided wind speed data. 4) Students will check their work against NOAA Hurricane Tracker Tool (https://coast.noaa.gov/hurricanes/) 5) Students will graph the relationship they analyze between wind speed and pressure using data from set provided and pressures collected from the site

8. RESOURCES

- 1) **Hurricane Tracking Site** (<https://coast.noaa.gov/hurricanes/>) **Day 1/5**
- 2) **Articles Day 1**
 - a. **Hurricane Warning Technology** (<https://www.livescience.com/39678-incredible-tech-track-hurricanes.html>)
 - b. **Hurricane Formation** (<https://www.vox.com/science-and-health/2016/10/6/13191010/how-hurricanes-form-tropical-storms-guide>)
 - c. **Hurricane Impact** (<https://geography.tamu.edu/academics/camps-and-outreach/hurricane/impacts/index.html>)
 - d. **Human Impact on Climate** (<https://www.gfdl.noaa.gov/global-warming-and-hurricanes/>)
- 3) **Hurricane Tool Rubric Day 1*** see below
- 4) **Can Crush Demo-** (<https://www.aps.org/programs/outreach/guide/demos/can crush.cfm>) **Day 2**
- 5) **Isaac's Storm** documentary on **1900 Hurricane in Galveston, Tx.** (<https://www.youtube.com/watch?v=WHTcPxATzm0>)
Day 2/3
- 6) **Convection Graphic** Day 4* see below
- 7) **Gallery Guide Brochure** Day 4* see below
- 8) **Tracking Map** https://www.nhc.noaa.gov/pdf/tracking_chart_atlantic.pdf **Day 5**
- 9) **Hurricane Data Set Day 5** (<https://aambcelebrating200.blob.core.windows.net/celebrating200-prod/media/edufun/book/FollowthatHurricane.pdf>)

HURRICANE TOOL RUBRIC

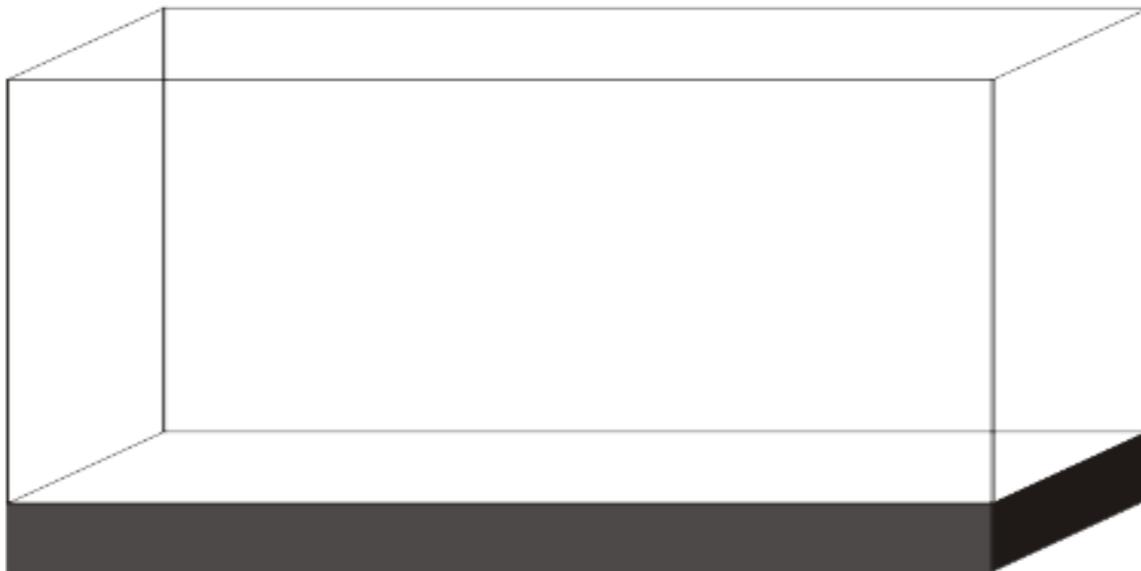
In teams of four, develop an educational tool that represents a synthesis of the knowledge you acquired from your article as well as discussions along the way. The tool/product may be any of the following: poster, model, cartoon/story, rap, etc. If you have your own idea, please contact me for approval. All tools need to be thorough, shared in production and presentation among team members as well as creative/graphic.

	5	4	3	2/1
Work Habits	<ul style="list-style-type: none"> <input type="checkbox"/> I consistently used my class time to work on this project. <input type="checkbox"/> I made sure every day I came to class with the necessary materials for this project. <input type="checkbox"/> I never needed redirection. <input type="checkbox"/> When/if I got stuck, I found a way through without wasting any time 	<ul style="list-style-type: none"> <input type="checkbox"/> Usually I used my class to work on this project. <input type="checkbox"/> Usually I came to class with the necessary materials <input type="checkbox"/> Occasionally I needed redirection to get back to work. <input type="checkbox"/> When/if I got stuck, I found a way through without causing distractions to others. 	<ul style="list-style-type: none"> <input type="checkbox"/> Sometimes I used my class time to work on this project. <input type="checkbox"/> I frequently had to leave the classroom to get materials. <input type="checkbox"/> I frequently needed redirection to work. <input type="checkbox"/> When/if I got stuck, I caused minimal distractions to others. 	<ul style="list-style-type: none"> <input type="checkbox"/> I frequently did not use class time to complete this project. <input type="checkbox"/> I frequently did not have the necessary materials at school to work on this project. <input type="checkbox"/> When/if I got stuck, I caused distractions
Product Content	<ul style="list-style-type: none"> <input type="checkbox"/> Accurately represents all key elements of hurricane theme and makes connections to others <input type="checkbox"/> Attention to detail is evident. Tool is neat, well-organized, creative and colorful 	<ul style="list-style-type: none"> <input type="checkbox"/> Accurately represents all key elements of hurricane theme. <input type="checkbox"/> Tool is neat, organized, colorful and creative. 	<ul style="list-style-type: none"> <input type="checkbox"/> Accurately represents many of the key elements of hurricane theme <input type="checkbox"/> Tool is inconsistently neat/organized. Wording is not work processed and cutting/gluing could be neater. 	<ul style="list-style-type: none"> <input type="checkbox"/> Limited to no representation of key elements of hurricane theme <input type="checkbox"/> Tool lacks craftsmanship. Lack of organization and neatness makes it difficult to follow.

Convection Graphic

1. Label locations on tanks where we place the ice trays as well as the candles- mark locations either hot or cold
2. Predict what will happen when we place food dye at the bottom in the center of the tank:
 - a. I believe _____ will occur because _____

3. Predict what will happen when we place food dye at the bottom at each end of the tank:
 - a. I believe _____ will occur because _____



4. Diagram what you observed about the steps that were taken and how the dyes behaved in the tank.
5. Explain what you think is happening:

6. How does this demonstration relate to the formation and structure of a hurricane?

GALLERY GUIDE BROCHURE

HURRICANE DETECTION TECHNOLOGY		HURRICANE FORMATION
DEVICE/BASICS OF HOW IT WORKS	MEASUREMENT/VALUE TO TRACKING, ETC.	KEY COMPONENTS
Barometer	Air Pressure	1)
		2)
		3)
		4)
		5)
		6)
		HURRICANE RATING SYSTEM

GALLERY GUIDE BROCHURE

HURRICANE IMPACT		HUMAN INFLUENCE ON HURRICANES/CLIMATE	
ISSUE	DIAGRAM	ACTIVITIES	IMPACTS
		CHANGES THAT CAN BE IMPLEMENTED	

