Notes from the Field

Young Scientist Newsletter

Tropical Cyclones

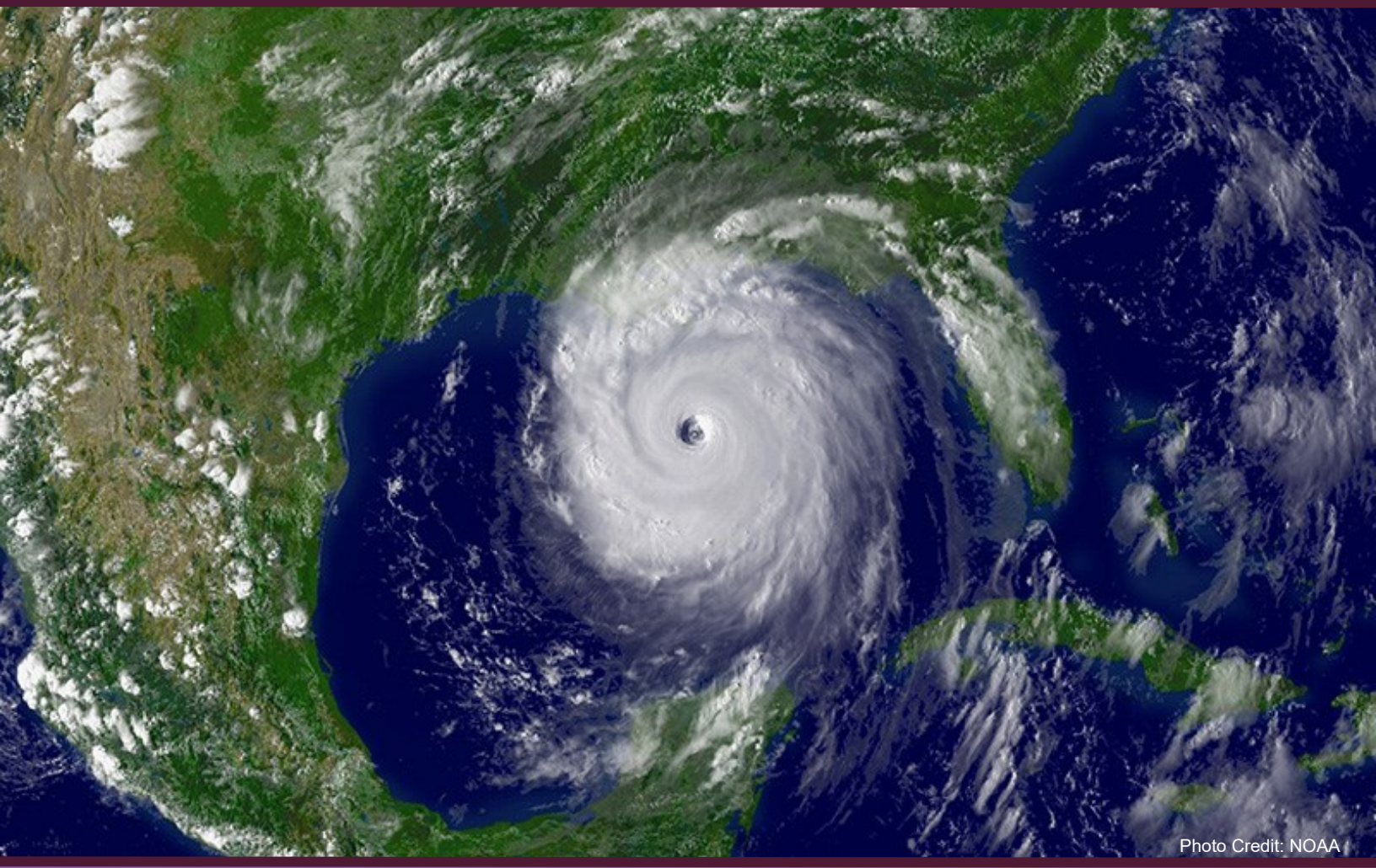


Photo Credit: NOAA

August 2017

Tropical storm, hurricane, cyclone, typhoon – many names for one of the planet's most destructive forces. The name depends on where the storm is located but the formation and required atmospheric conditions are the same worldwide. **Tropical cyclones** (that is the scientific term) form over equatorial waters and use the warm, humid air as fuel. As the warm air rises away from the surface of the water it creates an area of low pressure below it. Cooler, high-pressure air pushes in to fill this space and is warmed by the surface water. This process continues creating a swirling pattern of moving air. As the warm, humid air cools at higher altitude, it forms clouds and the physical structure of the storm begins to take shape. The whole system of clouds continues to spin and grow as it gains energy from the evaporation of warm ocean water. Storm systems that form in the Northern Hemisphere will rotate in a counter-clockwise direction while storms in the Southern Hemisphere spin clockwise. If the storm gains enough rotational speed, a central area of very low pressure will form. This calm, clear space in the center of the chaos is called the **eye** of the storm.

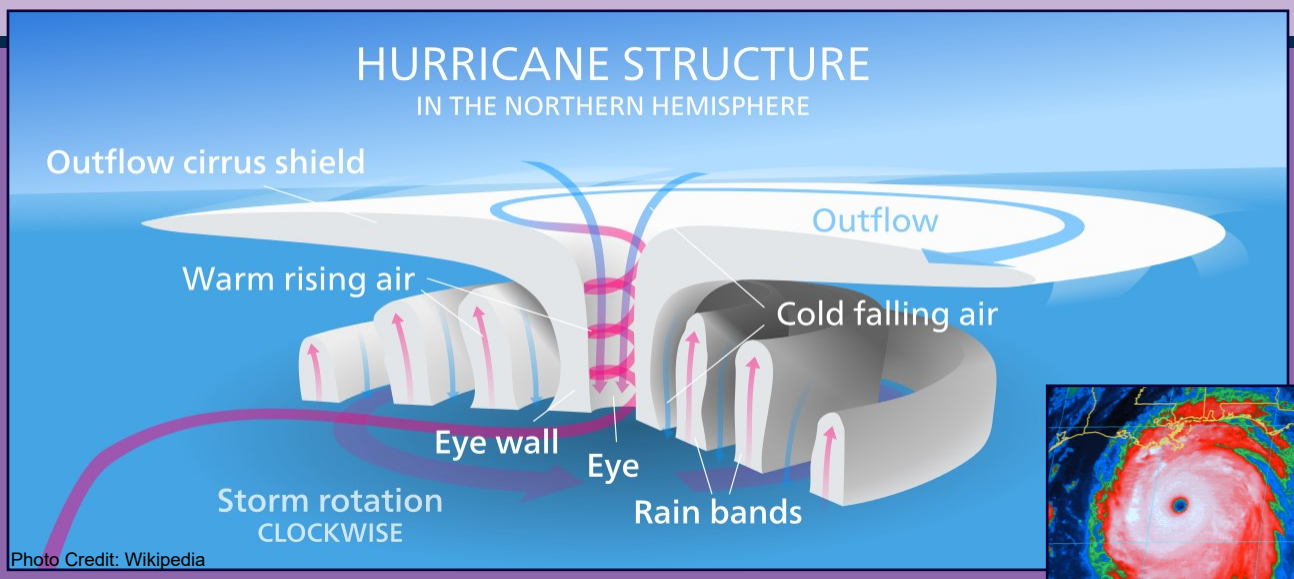


Photo Credit: Wikipedia

Photo Credit: Yahoo News

Tropical cyclones in the Atlantic Ocean and the Central and Eastern Pacific Ocean are called **hurricanes**. In the Western Pacific a well-developed system is called a **typhoon** while those in the Indian Ocean and South Pacific are **cyclones**. Each region also uses a different scale to classify the intensity of individual storms.

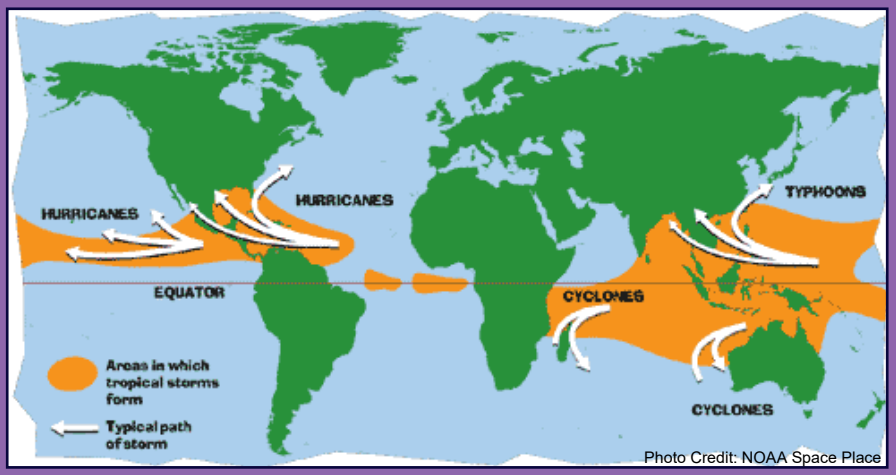


Photo Credit: NOAA Space Place

★ **Bold words** can be found in the Glossary on page 7

Meteorologists and oceanographers are always observing surface temperatures but they start paying especially close attention during warmer summer months. This is the time of year when water temperature increases and the likelihood of a tropical cyclone developing is high. There is a lot of terminology thrown around when we start talking about storm formation and development and certain characteristics will determine how a storm is described. The title given to a storm system depends primarily on sustained wind speeds but also the level of organization of the clouds. We will focus on terminology and classifications used with Atlantic and Central/Eastern Pacific storms since those are the ones that directly impact the United States.

The first level of development is a **tropical depression**. This is when a low-pressure area, partnered with thunderstorms, creates a circular wind flow with sustained wind speeds less than 39mph. A tropical depression appears like a grouping of thunderstorms rather than a rotating, unified storm. The system is upgraded to a **tropical storm** when its maximum sustained winds are between 39 and 74mph. At this point, the rotating winds are more organized, it starts to look distinctly circular in shape, and it can produce substantial amounts of rain. This is also when a storm receives a name (see "What's in a Name?" for more on this). When the tropical storm reaches sustained wind speeds above 74mph it is declared a hurricane and meteorologists begin using the **Saffir-Simpson Hurricane Wind Scale** for classification:

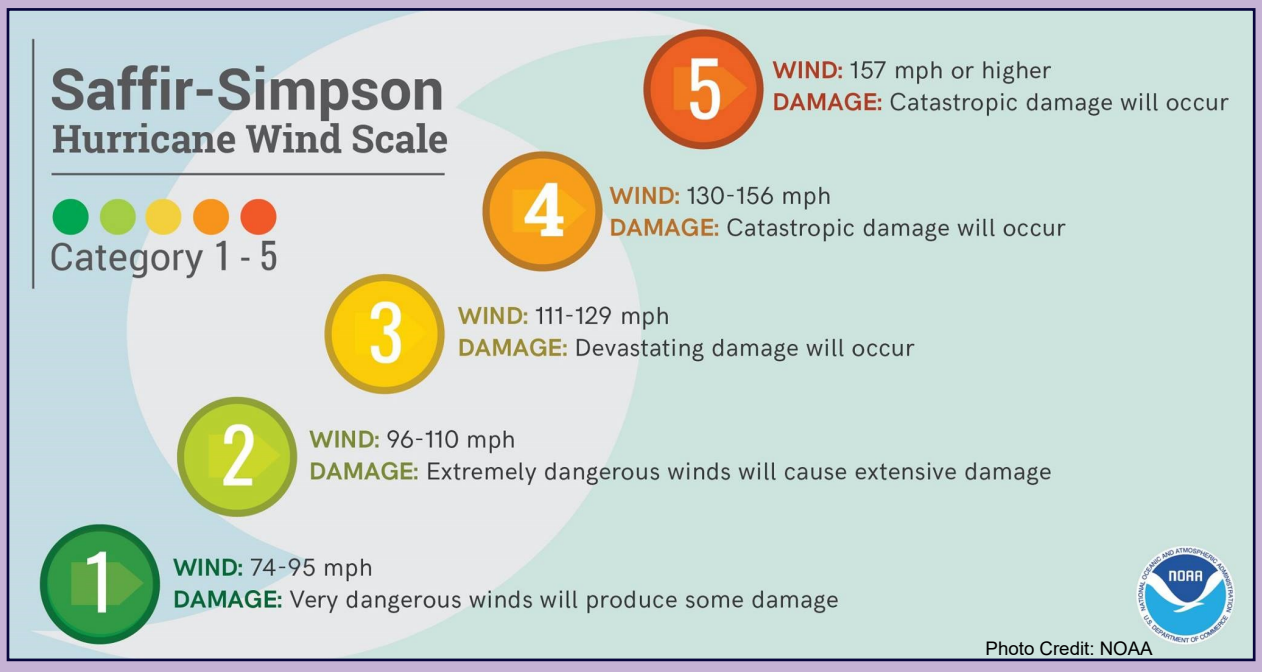


Photo Credit: NOAA

Wind speed and **storm surge** are the characteristics most often used to describe the intensity of a tropical cyclone but a smaller, slower storm can also cause immense damage due to the amount of rainfall in produces. **Flash floods** and pure accumulation of water can have widespread and long term consequences for an area not directly hit by high winds.

★ **Bold words** can be found in the Glossary on page 7

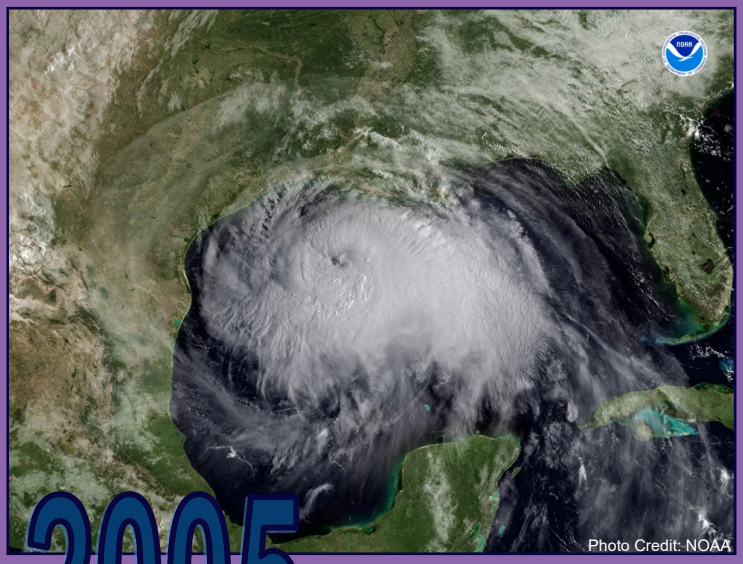
What's in a Name?

The practice of naming tropical cyclones began as a practical measure to make tracking and warning systems easy to follow. It is far easier for people to remember a name than an alphanumeric combination or a technical term. Originally, a hurricane was named for a place it hit particularly hard or a famous ship it damaged. As the naming system became more organized, storms were named alphabetically (i.e. Anne would be the first storm of the year, Betty was the second, etc.) with female names used in the Northern Hemisphere and male names used in the Southern Hemisphere. Yearly lists were written by the National Hurricane Center starting in 1953 and in 1979, under the control of the World Meteorological Center, six lists of alternating female and male names were developed. The lists are used in rotation (2017's list will be used again in 2023) with names occasionally being retired if a storm with that name is particularly deadly or costly (Floyd, Isabel, Katrina, Ike, and Sandy are all retired names). A replacement name starting with the same letter is then chosen by a committee and added to the list. If there are more than 21 named tropical cyclones in a season, additional storms use Greek letters.

Atlantic tropical storm name lists, 2016-2021

2016	2017	2018	2019	2020	2021
Alex	Arlene	Alberto	Andrea	Arthur	Ana
Bonnie	Bret	Beryl	Barry	Bertha	Bill
Colin	Cindy	Chris	Chantal	Cristobal	Claudette
Danielle	Don	Debby	Dorian	Dolly	Danny
Earl	Emily	Ernesto	Erin	Edouard	Elsa
Fiona	Franklin	Florence	Fernand	Fay	Fred
Gaston	Gert	Gordon	Gabrielle	Gonzalo	Grace
Hermine	Harvey	Helene	Humberto	Hanna	Henri
Ian	Irma	Isaac	Imelda	Isaias	Ida
Julia	Jose	Joyce	Jerry	Josephine	Julian
Karl	Katia	Kirk	Karen	Kyle	Kate
Lisa	Lee	Leslie	Lorenzo	Laura	Larry
Matthew	Maria	Michael	Melissa	Marco	Mindy
Nicole	Nate	Nadine	Nestor	Nana	Nicholas
Otto	Ophelia	Oscar	Olga	Omar	Odette
Paula	Philippe	Patty	Pablo	Paulette	Peter
Richard	Rina	Rafael	Rebekah	Rene	Rose
Shary	Sean	Sara	Sebastien	Sally	Sam
Tobias	Tammy	Tony	Tanya	Teddy	Teresa
Virginie	Vince	Valerie	Van	Vicky	Victor
Walter	Whitney	William	Wendy	Wilfred	Wanda

Source: National Oceanic and Atmospheric Administration CNBC



2005

The most active hurricane season since 1851 with 28 named storms! Every name on the list was used as well as six Greek letters (Alpha, Beta, Gamma, Delta, Epsilon, Zeta). Five names were retired at the end of the season: Dennis, Katrina, Rita, Stan, and Wilma.

Louisiana & Hurricanes


Photo Credit: NOAA

Louisiana has a long history with tropical cyclones. The earliest known reference to a storm in the Gulf of Mexico is from Spanish Conquistadors on an exploratory mission in 1527. However, storms were not well documented until the early 18th century when a hurricane caused the destruction of 36 huts and the local hospital and a storm surge of over eight feet was seen on the Mississippi. Known as the "Great Hurricane of 1722", the storm was the final proof that New Orleans was an unsuitable location for the state capitol.

In August of 1779, a large hurricane made landfall at New Orleans devastating the Spanish ships gathering to surprising the British port in Baton Rouge. It was a huge blow to the Spanish war effort but what should be remembered is the observations made by the Scottish-American explorer and naturalist **William Dunbar** about the structure and movement of tropical storms. Over the next 20 years, Dunbar gathered observations about the forward movement of storms, the circular motion of winds around a central vortex, the calm center of a well-formed storm and the link between tropical storms and tornadoes. He would present his findings at the American Philosophical Society in 1801.

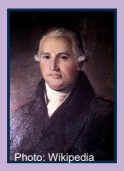


Photo: Wikipedia

The 19th century was a period of growth and development for the young state of Louisiana. Large plantations lined the banks of the Mississippi and the population density within cities was increasing each year. The area's wealthiest citizens took advantage of the nearby barrier islands to avoid the stale air and rampant disease within New Orleans and Baton Rouge. This movement of people to the unprotected shoreline of Isle Dernieres (Last Island) set the stage for of the most famous hurricanes in Louisiana history. In August of 1856 the resort and fishing community on Isle Dernieres was hit head on by a large hurricane that destroyed everything on the beach and killed over 200 people. The island, once the "it spot" for the state's wealthy families to relax, was split in half and cleared of its vegetation. It is now a chain of shrinking islands known for the pelican populations and good fishing.

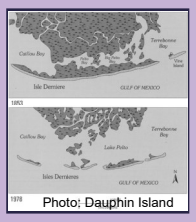


Photo: Dauphin Island

1893's Chenier Caminanda is considered to be the deadliest hurricane in Louisiana history. Named for the community where it made landfall, the hurricane reached sustained winds of at least 135mph and brought a **storm surge** of over 16 feet. It is estimated that around 2,000 people died, mostly due to the high water.

Photo: Find A Grave

Hurricane Camille (1969) was the second of three Category 5 hurricanes to make landfall in the United States. The precise wind speed at landfall is unknown because the wind gauges were destroyed as the storm came ashore, but measurements from offshore reached 190mph making it one of the most intense storms to directly hit the Gulf Coast. The **Saffir-Simpson Hurricane Wind Scale** was introduced following Camille because residents felt the current warning systems were inefficient.


Photo Credit: NY Daily News

The 2005 hurricane season was the most active Atlantic hurricane season ever recorded - Louisiana and the Gulf Coast were hit by two huge storms within a month. The damage from Hurricane Katrina was catastrophic (an estimate of over $81 billion) and widespread. A 30ft storm surge broke through levees causing significant flooding in New Orleans. Hurricane Rita made landfall at the Texas-Louisiana border bringing more water and devastation. The approach of Rita, and it close timing to Katrina, prompted one of the largest urban evacuations in U.S. history.

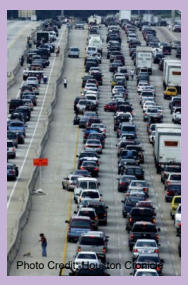


Photo Credit: Houston Chronicle

Hurricanes Gustav and Ike hit the Gulf Coast within 10 days of each other in late August and early September 2008. Gustav made landfall near Cocodrie (home of LUMCON), caused significant flooding in Baton Rouge and produced 41 tornadoes. Ike made landfall in Galveston, TX but its path through the Gulf helped it gain size and power resulting it flooding along the entire Gulf Coast. The effects of Ike were felt in Canada where increased humidity caused electrical failures and record rainfall.

Bold words can be found in the Glossary on page 7

Hurricane Isaac causes re-oiling along Gulf Coast

The Deepwater Horizon oil spill in 2010 was an environmental disaster. Thousands of marine animals and birds were killed and the Gulf coastline was severely damaged. Louisiana's Barataria Bay was one the hardest hit areas and in turn has been the site for countless scientific studies looking at the short and long-term effects of the oil. The Coastal Waters Consortium is one of several groups of scientists that have spent the last six years focused on gathering data about the impact of the spill. CWC scientists look specifically at nearshore waters and the marshes of the Gulf of Mexico when assessing these impacts.

In 2012, CWC scientist, and Louisiana State University chemist, Dr. Ed Overton conducted tests on oil found on Elmer's Island and Grand Isle following Hurricane Isaac. The oil, which was a match for the Macondo oil spilled in 2010, had been uncovered due to the storm's wave action and washed up in both Louisiana and Alabama. Dr. Overton emphasized that this "re-oiling" did not mean the Gulf was experiencing a repeat of the summer of 2010. Rather, it meant there was probably still a lot of oil trapped in the sediment below the Gulf that cleanup crews were not able to get[1]. At the time, BP sent additional workers to clean up the affected areas. Formal cleanup efforts stopped in the spring of 2014 despite claims from the U.S. Coast Guard and Gulf Coast residents that there was still work to be done.

Today, seven years after the spill, there is evidence that the Gulf of Mexico and its coastlines are showing some signs of recovery. Animals with long life spans and generation times, such as marine mammals and sea turtles, may need decades to recover fully but commercial fisheries have seen a remarkable rebound. However, continued studies show that damage to the marshes is irreversible and will eventually affect commercial species. A CWC study published last year provided evidence that the oil had entered terrestrial food webs and was effecting marsh birds. Researchers tested carbon from a small number of Seaside Sparrows and were able to match its signature to that of the Macondo oil. Dr. Andrea Bonisoli Alquati, CWC researcher and professor at LSU, told BBC News that this is evidence that "oil doesn't stay where it's spilled - there's potential for it to move into other ecosystems"[2].

Tar washed up on Louisiana's Elmer Island after Hurricane Isaac (above).

Photo Credit: The Daily Mail

Tar balls found on Grand Isle on local fishermen (right).

Photo Credit: CBS News

Puzzles & Activities

Word Search

X	J	H	R	A	Z	T	S	I	G	O	L	O	R	O	E	T	E	M	K	R	I	H
P	O	U	A	W	A	C	O	R	X	D	Q	C	W	L	Y	I	N	D	I	A	N	Q
N	B	R	E	T	A	F	R	I	Q	J	Q	F	R	A	P	N	V	V	F	Y	T	F
O	N	R	C	Y	L	A	N	D	F	A	L	L	E	C	R	O	S	W	X	X	F	G
I	E	I	Q	N	E	A	K	U	J	U	E	E	H	I	D	S	F	C	A	M	H	A
T	G	C	X	O	W	R	N	L	H	D	O	Z	P	P	P	P	F	Y	N	E	N	N
A	R	A	J	O	I	O	K	T	F	Z	V	Y	A	O	Z	M	G	C	A	Q	E	R
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J	G	C	I	F	I	C	A	P	H	Q	W	J	I	Q	O	Q	J	B	X	I	H	M

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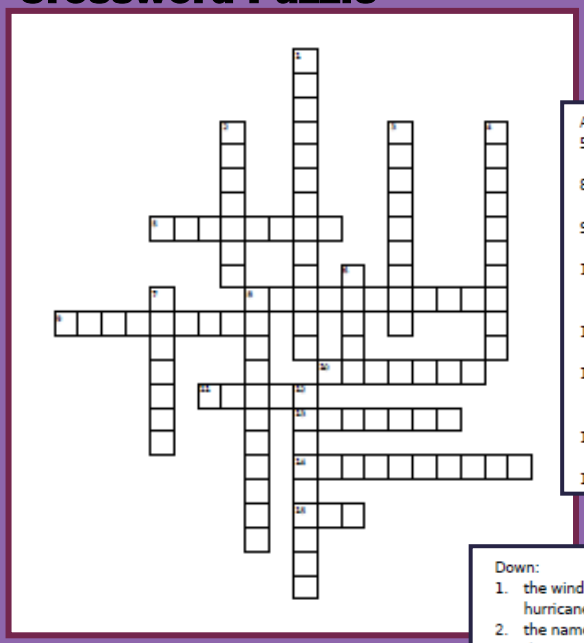
Find the following words in the puzzle.
Words are hidden ↑ ↓ → ← and ↘ .

ATLANTIC	INDIAN	PRECIPITATION	TROPICAL
CYCLONE	LANDFALL	ROTATION	TYPHOON
EQUATOR	LOUISIANA	SAFFIR	WIND
EYE	METEOROLOGIST	SIMPSON	
FLOOD	NORTHERN	SOUTHERN	
GULF	OCEAN	STORM	
HEMISPHERE	OCEANOGRAPHER	SURGE	
HURRICANE	PACIFIC	TORNADO	

Crossword Puzzle



Generated by: Education.com

Across:
5. a small fishing community and home to LUMCON
8. the large North American river that empties into the Gulf of Mexico
9. a well-developed tropical cyclone in the Atlantic or Central/Eastern Oceans
10. both the scientific name for tropical storms and what they are called in the Indian Ocean
11. an overflow of water that submerges land that is usually dry
13. an imaginary line that is drawn equally distant between the North and South Poles
14. a former capital of Louisiana and the birthplace of jazz (two words)
15. the calm center of a hurricane

Down:
1. the wind scale used to categorize hurricanes (two words)
2. the name for a tropical storm system in the Western Pacific
3. the direction a tropical cyclone rotates in the Southern Hemisphere
4. an early stage in hurricane development when the wind speed is less than 39mph
6. the third name on the 2017 Atlantic Hurricane Name List
7. as in the explorer who first studied tropical cyclones in the late 1700's or the British prince second in line for the throne
8. the study of atmospheric science with a focus in predicting the weather
12. Isle _____; the Louisiana barrier island that was hit by a large hurricane in 1856

Puzzle answers can be found on page 9

Storm Tracking

When a tropical cyclone forms in the Atlantic or Eastern North Pacific, the National Oceanic and Atmospheric Administration (NOAA) begins its monitoring procedures. Scientists at the National Hurricane Center (part of NOAA) use aircrafts, satellites, radar, supercomputers, atmospheric gauges, and even drones to track the development of each potential storm and make updates to the public at least every 6 hours. All of the information they gather is used to predict the movement and strength of the storm so that they can release accurate warnings and keep the public safe.

And all of this is available to the public if you know where to look! Tracking a developing storm alongside the professionals can be a fun and educational experience that can help keep you better informed about what is happening around you. Here are a few resources for the budding meteorologist:

National Hurricane Center (www.nhc.noaa.gov): the department within the National Oceanic and Atmospheric Administration that tracks tropical cyclones and releases watches/warnings to the public. This site can get really technical and scientific but it also has great resources to keep you informed and help you make smart decisions when a storm is approaching.

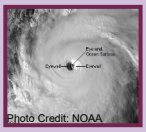
Intellicast (www.intellicast.com): a user-friendly website that covers all things weather. With pages dedicated to storms, interactive radar maps, satellite imagery and global atmospheric conditions, a storm enthusiast has all the information they need to start tracking.

Mike's Weather Page (www.spaghettimodels.com): the bright and colorful homepage can be a little overwhelming at first but there is a treasure trove of useful information at your fingertips. The left column displays current atmospheric conditions with a series of well-labeled maps. The center columns typically show any active or developing storms and all their associated models. And if you scroll down, the right column is full of helpful definitions and additional links. Look for red highlighted headers to help guide you as you explore.

Always check with an adult before checking out new websites and remember that these are tips on tracking storms from your computer, not chasing storms in the field!

Glossary of Terms

Eye— the region of mostly calm weather at the center of a strong tropical cyclone.



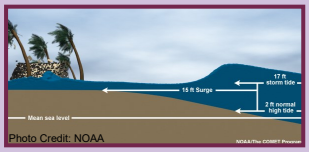
Flash flood— a sudden local flood, typically due to heavy rain.

Hurricane— a tropical storm system with sustained winds of at least 74mph located in the Atlantic Ocean or Central/ Eastern Pacific Ocean.

Meteorologist— a scientist that studies atmospheric sciences with an focus in weather forecasting.

Saffir-Simpson Hurricane Wind Scale— classifies hurricanes based on the intensity of their sustained wind speed.

Storm surge— an abnormal rise of water generated by a storm, over and above the predicted astronomical tide.



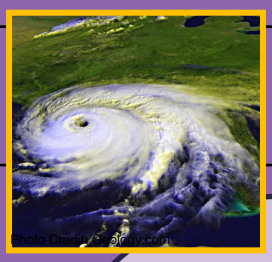
Tropical cyclone— a generic, scientific term used my meteorologists to describe a rotating, organized system of clouds and thunderstorms originating over tropical or sub-tropical waters; cyclone is also used to describe a well-developed storm in the Indian Ocean or South Pacific with sustained winds greater than 73mph.

Tropical depression— an organized system of clouds and thunderstorms with a distinct rotation and maximum sustained winds below 38mph.

Tropical storm— an organized system of thunderstorms with defined rotation and sustained winds of 39-73 mph.

Typhoon— a mature tropical cyclone originating in the Western Pacific.

William Dunbar— a Scottish-American explorer and naturalist (1784-1810) known for make some of the first detailed observations of tropical cyclones in the United States, specifically about the forward movement of storms, the circular motion of winds around a central vortex, the calm center of a well-formed storm and the link between tropical storms and tornadoes.



For More Information:

- About Tropical Cyclones—Australian Bureau of Meteorology

  http://www.bom.gov.au/cyclone/about/

- [2]BP Deepwater Horizon oil in land-animal food chain—BBC News

  http://www.bbc.com/news/science-environment-37988438

- How Do Hurricane Form—NASA Space Place

  https://spaceplace.nasa.gov/hurricanes/en/

- Hurricanes—UNCW Island Ecology 2015

  https://sites.google.com/site/islandecologyuncw2015/coastal-and-barrier-island-ecosystem-factors/hurricanes-storms

- Hurricanes—WW2010 University of Illinois

  http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/hurr/home.rxml

- Hurricanes: Science and Society— University of Rhode Island

  http://www.hurricanescience.org/science/science/

- Louisiana Hurricane History—National Hurricane Center (NOAA)

  http://www.wpc.ncep.noaa.gov/research/lahur.pdf

- NHC Outreach Resources—National Hurricane Center (NOAA)

  http://www.nhc.noaa.gov/outreach/

- [1]Tests confirm oil stirred up by Hurricane Isaac came from BP spill— The Times-Picayune

  http://www.nola.com/hurricane/index.ssf/2012/09tests_confirm_oil_stirred_up_b.html

- Tropical Cyclone Names—National Hurricane Center (NOAA)

  http://www.nhc.noaa.gov/aboutnames.shtml

- Tropical Cyclone Naming— World Meteorology Organization

  https://public.wmo.int/en/About-us/FAQs/faqs-tropical-cyclones/tropical-cyclone-naming


Photo Credit: WKMG Orlando

Puzzle Answers

Word Search

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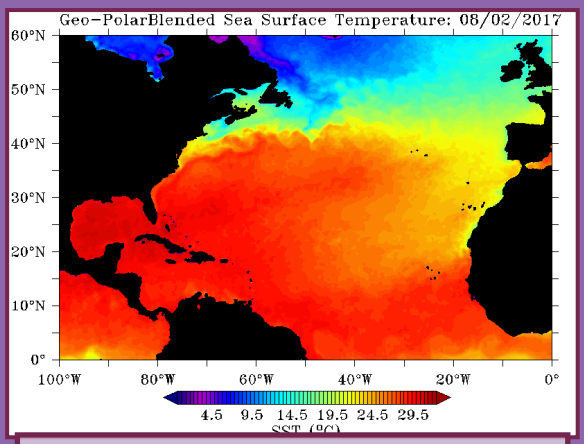
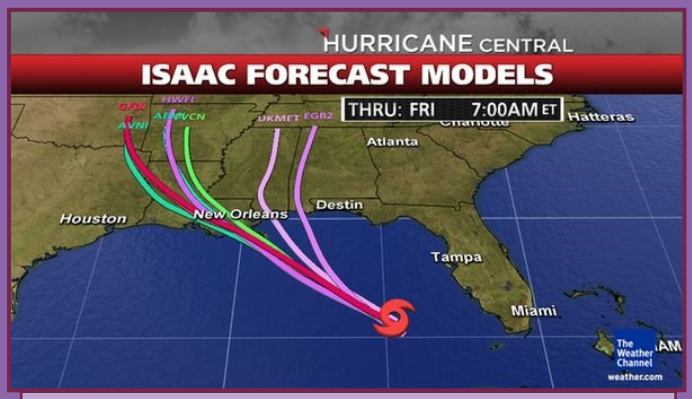


A map of the Atlantic Basin showing sea surface temperatures (in degrees Celsius) from August 2nd, 2017.

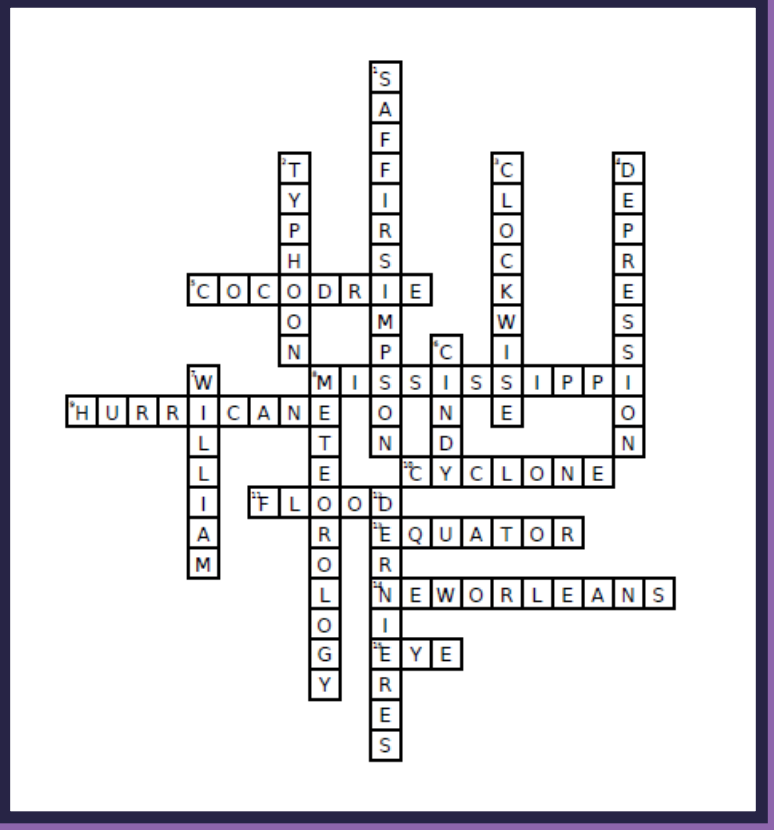
Photo Credit: Mike's Weather page



Spaghetti plots show where a developing tropical cyclone might go. Each colorful line is created by a computer model based on atmospheric conditions, statistics or a multitude of other elements. A spaghetti plot is a tool for meteorologist to use to predict the movement of a storm and is not always accurate.

Photo Credit: The Weather Channel

Crossword Puzzle



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