

Tracking Hurricanes: Activities on Velocity and Mapping

Subject: Science

Grade Level: 6th - 8th Grades

Rational or Purpose: This exercise will lead students through the process of using maps for locating the approximate position of a hurricane. Students will plot the path of Hurricane Isidore and calculate its velocity within certain time intervals. Hurricane Isidore had an extraordinary path and speed during its emergence to the Gulf of Mexico. This phenomenon will help students know more on general trends of Atlantic hurricanes.

Source of Lesson: *Hot Science – Cool Talks* CD-ROM # 44: “Is Climate Change Increasing Hurricane Activity?”

Materials:

- Ruler
- Protractor
- Hurricane tracking chart
- Color pens

Lesson Duration: 45 - 55 minutes

TEKS Objectives:

6th Grade Science 111.22

(6A) identify and describe the changes in position, direction of motion, and speed of an object when acted upon by force

(6B) demonstrate that changes in motion can be measured and graphically represented

7th Grade Science 112.23

(2A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting and using equipment and technology

(2B) collect data by observing and measuring

(2C) organize, analyze, make inferences, and predict trends from direct and indirect evidence

(2D) communicate valid conclusions

(2E) construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data

8th Grade Science 112.24

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Background Information¹:

A tropical cyclone is a low pressure system that usually forms in the tropics. The cyclone is accompanied by powerful thunderstorms, and in the Northern Hemisphere, a counterclockwise circulation of winds near the Earth's surface. Tropical cyclones are also called hurricanes, tropical storms, and tropical depressions, depending upon intensity.

Regardless of what they are called, there are several environmental conditions that must be in place before a tropical cyclone can form:

- Warm ocean waters (at least 80°F / 27°C) throughout a depth of about 150 ft (46 meters (m)).
- An atmosphere which cools fast enough with height such that it is potentially unstable to moist convection.
- Relatively moist air near the mid-level of the troposphere (16,000 ft / 4,900 m).
- Generally a minimum distance of at least 300 miles (480 km) from the equator.
- A pre-existing near-surface disturbance.
- Low values (less than about 23 mph / 37 km/h) of **vertical wind shear**, the change in wind speed with height, between the surface and the upper troposphere.

Tropical Cyclone Formation Basin²

Given that sea surface temperatures need to be at least 80°F (27°C) for tropical cyclones form, it is natural that they form at the equator. However, although they form in the tropics near the equator, they cannot form on the equator. This is due to the lack of sufficient **Coriolis Force**, the force that causes the cyclone to spin.

The Coriolis effect is an apparent deflection of a moving object in a rotating frame of reference. The Coriolis effect caused by the rotation of the Earth is responsible for the direction of rotation of cyclones. In general, the effect deflects objects moving along the surface of the Earth to the right in the Northern hemisphere and to the left in the Southern hemisphere. As a consequence, winds around the center of a cyclone rotate counterclockwise on the northern hemisphere and clockwise on the southern hemisphere. However the Coriolis effect is not a determining factor in the rotation of water in toilets or bathtubs.

1 From National Oceanic and Atmospheric Administration (NOAA): <http://www.noaa.gov>

2 Wikipedia, the free encyclopedia: en.wikipedia.org

Activity: Tracking Hurricane Isidore

Situation: You are now a meteorologist working at National Hurricane Center. You are asked to write a brief report on Hurricane Isidore. Before writing, you have to collect information. Below is a copy of tracking information of Hurricane Isidore. This will reveal a lot of useful information in your report.

HURRICANE ISIDORE 2002 SEPT 12-26

ENTRY	LAT	LON	TIME	WIND	PR	STATUS
1	10.10	-61.50	09/14/21Z	25	1009	TROPICAL DEPRESSION
2	10.70	-65.10	09/15/09Z	25	1009	TROPICAL DEPRESSION
3	12.60	-70.20	09/15/21Z	25	1009	TROPICAL DEPRESSION
4	16.30	-77.60	09/17/21Z	30	1006	TROPICAL DEPRESSION
5	17.20	-78.30	09/18/09Z	35	1006	TROPICAL STORM
6	19.00	-78.80	09/18/21Z	50	999	TROPICAL STORM
7	20.00	-80.80	09/19/09Z	55	990	TROPICAL STORM
8	20.60	-82.00	09/19/21Z	65	984	HURRICANE-1
9	21.30	-83.30	09/20/09Z	90	967	HURRICANE-2
10	21.90	-84.30	09/20/21Z	85	965	HURRICANE-2
11	22.40	-85.50	09/21/09Z	85	964	HURRICANE-2
12	21.90	-86.20	09/21/21Z	110	946	HURRICANE-3
13	22.00	-87.90	09/22/09Z	110	936	HURRICANE-3
14	21.50	-89.20	09/22/21Z	110	934	HURRICANE-3
15	20.40	-89.80	09/23/09Z	65	954	HURRICANE-1
16	20.30	-89.40	09/23/21Z	45	968	TROPICAL STORM
17	21.30	-89.70	09/24/09Z	45	985	TROPICAL STORM
18	22.40	-89.80	09/24/21Z	50	988	TROPICAL STORM
19	24.80	-89.80	09/25/09Z	50	990	TROPICAL STORM
20	26.80	-90.50	09/25/21Z	55	989	TROPICAL STORM
21	29.70	-90.40	09/26/09Z	55	986	TROPICAL STORM
22	33.00	-89.70	09/26/21Z	30	988	TROPICAL DEPRESSION

WIND SPEED IN KNOTS

1 KNOTS = 1.15 MPH

TIME IN UNIVERSIAL TIME

LAT = LATITUDE

LON = LONGITUDE

PR = PRESSURE (IN MILLIBARS - MB)

Procedure:

1. Plot the location of Hurricane Isidore on the tracking chart as it travels from Northern South America to the Gulf of Mexico.
2. Locate the storm with proper symbols to indicate its status:
Use "X" when it is at tropical depression status.
Use an "X" within a circle when it is at tropical storm status.
Draw  (the hurricane symbol) in GREEN when it is a Category 1 hurricane, in ORANGE when it is a Category 2 hurricane, and in RED when it is at Category 3 hurricane.
Draw a star to locate the places where Hurricane Isidore reaches land.
3. Answer the following questions.

Questions

1. Velocity (for the following questions, assume that the storm travels in a straight line between the two points in question)

a. What is the distance (in miles) traveled by Isidore from 09/14/21Z to 09/17/21Z?

b. How many hours does Isidore take to travel such distance?

c. Hence, calculate the velocity of the storm in mile per hour ($V=D/T$).

d. Calculate the distance (miles), time (hours), and velocity (mph) of Hurricane Isidore from 09/20/09Z to 09/21/21Z.

2. Hurricane Strength

a. How many hours does Isidore take to strengthen from Category 1 to Category 3?

b. What is the level of its strength when it reaches the United States?

3. Hurricane Motion and Location

a. What happened to Hurricane Isidore between 09/22/21Z and 09/24/21Z?

- b. Where did Hurricane Isidore first reach the United States? (Use a ruler to measure the distance and direction of the location from the nearest labeled city. For example, 37 miles Southeast of New Orleans)

4. Hurricane Patterns (see Figure 1 to answer the following questions)

- a. What patterns do you notice in the geographic locations of global tropical cyclone tracks?

- b. Based on what you have learned, what are plausible explanations for these patterns?

5. Report You are now ready to write your brief report. Write about the most interesting facts you learned about Hurricane Isidore.

Additional Facts on Hurricane Isidore:

Casualty and Damage Statistics¹

Press reports indicate that there were 2 indirect deaths attributable to Isidore in Merida, Mexico. One was electrocuted by a downed power line and the other died in a weather-related car crash. Four direct and one indirect deaths occurred in the United States. One was a marine fatality drowning from a rip current near Port Fourchon, LA on the 22nd of September when Isidore was still over the Yucatán Peninsula. Another one was a drowning in a vehicle parked near a casino in Mississippi when storm surge inundated the parking lot. A third died when a tree fell across his car in eastern Mississippi, and the fourth one died after driving into 10 feet of water in Clarksville, Tennessee. The indirect death occurred in Mississippi when a man suffered from a cardiac arrest and could not be reached by rescuers due to floodwaters.

Damage from Isidore in Jamaica was mainly related to torrential rains. Western Cuba and Yucatan were severely damaged by the hurricane primarily the agriculture and cattle industry. According to Tropical Cyclone Reports from the weather services of Cuba and Mexico, numerous houses and power lines were damaged by wind.

In the United States, the Property Claim Services Division of the Insurance Services Office reports that insured losses due to Isidore totaled 165 million dollars. Using a two to one factor for insured to overall damage gives a total damage estimate of \$330 million. Most of the damage occurred in Louisiana.

Resources:

Hurricane Archive

<http://www.nhc.noaa.gov/pastall.shtml>

Hurricane Data by UNISYS (including Pacific and Indian Ocean)

<http://weather.unisys.com/hurricane/index.html>

Hurricane Names

For U.S.: <http://www.nhc.noaa.gov/aboutnames.shtml>

NOAA National Hurricane Center

<http://www.nhc.noaa.gov/>

NOAA Tropical Cyclone Formation Regions

http://www.srh.noaa.gov/srh/jetstream/tropics/tc_basins.htm

NOAA Storm Prediction Center

<http://www.spc.noaa.gov/products/>

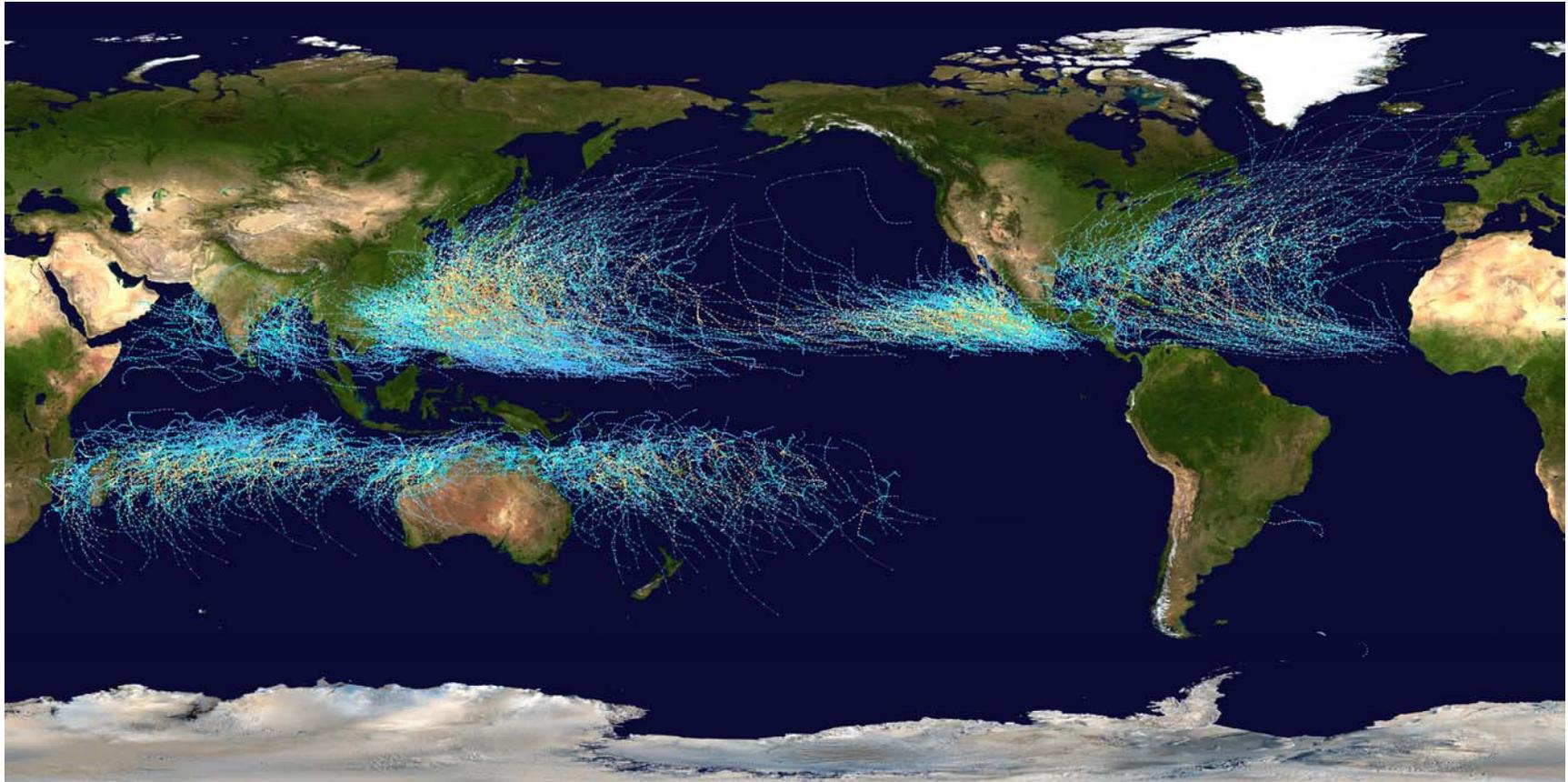
Moving Path of Hurricane Wilma in October 2005

http://www.srh.noaa.gov/srh/jetstream/tropics/images/wilma_sst_clouds_320x240.mpeg

Tropical Cyclone Modification and Myths

<http://www.aoml.noaa.gov/hrd/tcfaq/tcfaqHED.html>

¹ From National Oceanic and Atmospheric Administration (NOAA): <http://www.noaa.gov>



Saffir-Simpson Hurricane Scale

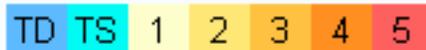
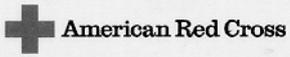


Figure 1. Global Tropical Cyclone Tracks from 1985 to 2005. From Wikipedia, the free encyclopedia (en.wikipedia.org/wiki/Hurricanes).



ATLANTIC HURRICANE TRACKING CHART

Always remember

If you live along the coast or in a low-lying area, if you live in a mobile home in an area subject to hurricane water or wind, or if authorities tell you to... Go!

Storm Surge

A storm surge is a dome of water often 50 miles wide that comes sweeping across the coastline near the area where the eye of the hurricane makes landfall. The surge, aided by the hammering effect of breaking waves, acts like a giant bulldozer sweeping away everything in its path. Nine out of ten hurricane deaths are caused by storm surge. That's why it's important to leave well before a hurricane may come your way.

Wind Damage

Hurricane winds can cause significant damage to homes and businesses far from the shore. If you live in an area anywhere near the path of a hurricane, you should take steps to protect property from high winds. Bring in anything from outside that may become airborne in high winds, including toys, lawn chairs, trash cans, coconuts, etc. Cover all windows of your home. If shutters are not installed, use 3/4" marine plywood panels. Tape does not work, so it is not recommended. Remain inside until authorities tell you the danger has passed.

Other Hurricane Effects

Hurricanes can produce flooding far inland, especially if the storm "stalls" or produces a lot of rain. Also, tornadoes can form when hurricanes come on shore. Ask your American Red Cross, National Weather Service, or emergency management office what to do in case of a flood or tornado.

More Information

More information about hurricanes, protection from wind damage, floods, and tornadoes is available from your local American Red Cross chapter, National Weather Service Office, or emergency management agency.

