

Sharks and Tropical Weather

Target Audience: Middle - High School (8-12)

Resources:

Research data based on “Running before the Storm: blacktip sharks respond to falling barometric pressure associated with Tropical Storm Gabrielle” by M. R. Heupel, C. A. Simpfendorfer and R. E. Hueter of Mote Marine Laboratory, Sarasota, Florida.

Supplies needed to complete the graph include colored pencils and a ruler

National Standards Addressed:

Content Standard A - Science as Inquiry
Content Standard C - Life Science
Content Standard E - Science and Technology
Content Standard G - History and Nature of Science

Sunshine State Standards Addressed:

Middle (grade 8)

Standard 2, Energy, (.1) Understand energy forms, sources and transformations.

Standard 7, Ecology, (.1) Understand how living things interact with each other and the environment.

Standard 8, The Nature of Science, (.2) Utilize the scientific method to complete tasks related to the study of science, (.3) understand the interrelationship of science and technology and the contributions and responsibilities of scientists.

High (grades 9-12)

Standard 8, Biology-Ecology, (.2) Identify characteristics of self-sustaining systems of the biosphere.

Standard 7, Physical Science-Energy, (.2) Investigate transformations in energy.

Standard 8, Physical Science-The Nature of Science, (.2) understand the development of scientific ideas.

Student Goals and Objectives:

The student will...

1. read information given about weather and shark movement
2. complete questions relating to shark movement.
3. plot given data on graph.
4. answer questions related to article and graph.

Steps to Accomplishment:

1. Students read written article.
2. Students answer reading comprehension questions.
3. Students plot given data on a graph.
4. Students analyze graphed data.

Research on Shark Movement in Terra Ceia Bay, Florida

We all know that tropical storms develop as low-pressure systems offshore. How do sharks respond to the pressure of an approaching tropical storm? Here is some interesting information that might surprise you.

Many of us have weathered a tropical storm or severe thunderstorm, perhaps even a tornado or hurricane. We are aware of the changes in the atmosphere that take place before, during and immediately after a storm. Think of some of those changes.

What did you come up with?

Perhaps you thought of wind gusts, some rain, darkening skies, cloudiness, distant thunder or lightning. How might these factors affect the water in oceans, bays or estuaries?

In the ocean, these factors probably do not have as much influence as in, say, an estuary. After all, the oceans are deep, typically have good wave and current action, and gradually fade in light at certain depths anyway. The estuary, on the other hand is quite different. Water in an estuary is usually quite shallow and fluctuates in amount and salinity due to run-off and tidal action. It is also often affected by wind and wave action. Turbidity is common as well.

Estuaries are considered nurseries of the sea. Here, where rivers meet the sea, sea grasses and mangrove trees flourish. Juvenile animals find refuge against predators. Depending on where in the estuary an animal lives, it can acclimate gradually from a lower to a higher salinity. In essence, an animal can practice for its eventual life in the sea. Can you think of another way that living in the estuary may aid juvenile animals?

Research scientists at Mote Marine Laboratory utilized a special type of acoustic telemetry technology to track the movements of juvenile blacktip sharks in an estuarine area called Terra Ceia Bay, Florida. The researchers attached transmitters to the juvenile sharks. The transmitters relayed the relative position of each shark to an underwater receiver once per minute. It was noted that on the advance of Tropical Storm Gabrielle, in September 2001, the juvenile sharks proceeded to leave their protected area.

What do you think caused the juvenile sharks to leave?

Let's explore some of the changes that occurred before, during and after the tropical storm.

Changes that occurred with Tropical Storm Gabrielle, September 2001.

Rainfall and salinity.

All of the sharks in the study left the research area **prior** to the heaviest rainfall being received. As you know, fresh water from rain lowers salinity. It was interpreted then, that the sharks were not leaving the area because of the noise associated with the rain or changes in salinity. Let's therefore rule out rainfall and salinity change as the main factors for the sharks leaving.

Wind speed.

In summer, thunderstorms in the research area are common. These storms frequently reach wind speeds of 45 km/hr. Interestingly enough, the sharks in the study group did not show "flight" with these storms. As far as the approach of Tropical Storm Gabrielle, 10 out of the 13 sharks being studied left the research area **before** the wind speed reached 40 km/hr.

Tides.

Although the tides were hampered a bit by the water surging, they were well within the normal range for this research area, when the sharks left. Therefore, tides should not have been a factor.

Barometric Pressure.

As the Tropical Storm approached, the barometric pressure began to drop. Just prior to the first shark's departure from the area, the barometric pressure was 1012 mb. During the sharks' departure, the barometric pressure dropped from 1008 to 999 mb. Barometric pressure has an effect on hydrostatic pressure (pressure from water). The lower the tides, the lower the hydrostatic pressure. The higher the tides, the higher the hydrostatic pressure on the organisms that live in the water. Could the juvenile sharks sense that the hydrostatic pressure was not right for what the tides were at the time? Could this be the environmental stimulus required to trigger some life-saving mechanism in these sharks?

For what reason(s) might the juvenile sharks want to leave the protection of their nursery, with the approach of Tropical Storm Gabrielle?

The data from before, during and after Tropical Storm Gabrielle, were compared to data obtained from Hurricane Gordon, which came ashore as a weak tropical storm the year before. In both cases, it seems that the falling barometric pressure was the main influence on the sharks' decision to leave (even though the effects of Hurricane Gordon were not as intense as those of Tropical Storm Gabrielle, at the research site).

Graphing Tropical Storm Gabrielle Data Activity

Instructions: Using the data below, graph the results for wind speed, barometric pressure, and rainfall coinciding with the approach & landfall of Tropical Storm Gabrielle. Put each factor's data in a different color on the same graph. When your graph is complete, answer questions at the end of the activity.

Wind Speed in km/hr (Graph using left vertical axis. Connect each point with straight lines.)

13 September	12:00am	12 km/hr	14 September	12:00am	18 km/hr
	3:00am	25 km/hr		3:00am	15 km/hr
	6:00am	10 km/hr		6:00am	64 km/hr
	9:00am	14 km/hr		9:00am	80 km/hr
	12:00pm	15 km/hr		12:00pm	18 km/hr
	3:00pm	13 km/hr		3:00pm	35 km/hr
	6:00pm	15 km/hr		6:00pm	42 km/hr
	9:00pm	16 km/hr		9:00pm	24 km/hr

15 September	12:00am	16 km/hr
	3:00am	12 km/hr
	6:00am	40 km/hr
	9:00am	30 km/hr
	12:00pm	24 km/hr
	3:00pm	22 km/hr
	6:00pm	14 km/hr
	9:00pm	10 km/hr

Barometric Pressure in millibars (mb) (Graph using inside right vertical axis. Connect points with a straight curve.)

13 September	12:00am	1012 mb	14 September	12:00am	1007 mb
	3:00am	1011 mb		3:00am	1000 mb
	6:00am	1012 mb		6:00am	995 mb
	9:00am	1010 mb		9:00am	997 mb
	12:00pm	1010 mb		12:00pm	1001 mb
	3:00pm	1010 mb		3:00pm	1003 mb
	6:00pm	1009 mb		6:00pm	1004 mb
	9:00pm	1008 mb		9:00pm	1005 mb

15 September	12:00am	1006 mb
	3:00am	1007 mb
	6:00am	1008 mb
	9:00am	1008 mb
	12:00pm	1009 mb
	3:00pm	1009 mb
	6:00pm	1010 mb
	9:00pm	1011 mb

Rainfall in cm: (Make a bar graph to show the rainfall amounts. Measure and mark one of the vertical axes in centimeters. Plot the following data, **USING A HIGHLIGHTER**, by coloring up to the amount of received rainfall, for each time period measured. Trace amounts are so small that they should be plotted just above zero.)

13 September	12:00am	0 cm	14 September	12:00am	trace
	3:00am	0 cm		3:00am	.25 cm
	6:00am	0 cm		6:00am	.25 cm
	9:00am	0 cm		9:00am	3 cm
	12:00pm	trace		12:00pm	4 cm
	3:00pm	trace		3:00pm	5 cm
	6:00pm	.25 cm		6:00pm	3 cm
	9:00pm	0 cm		9:00pm	.5 cm
			15 September	12:00am	0 cm
				3:00am	0 cm
				6:00am	0 cm
				9:00am	.25 cm
				12:00pm	0 cm
				3:00pm	trace
				6:00pm	0 cm
				9:00pm	0 cm

Analysis questions relating to the completed graph.

1. During what time and on which day was wind speed the highest?

2. During what time and on which day was barometric pressure the lowest?

3. Looking at your graph, what correlation do you see between the two sets of data above?

4. When was rainfall the highest?

5. During what time period do you think most sharks left the protection of the estuary?

INDICATE this on the prepared graph in yet another color, with diagonal lines running from top to bottom of the graph in a column.

Graph of Weather Conditions from 13 - 15 September 2001, in Terra Ceia Bay, Florida

