Hurricane Activity Key

*** For ease of use during class the Teacher Key pages are numbered the same as the Student Activity Book pages.

I. Introduction

Did you know that hurricanes are the largest, most destructive storms on Earth? Hurricanes can produce tornadoes, large hail, severe flooding and erosion as well as strong winds.

We know how bad the hurricane is and we can predict where it will go with reasonable accuracy. This is possible because of satellite technology and both Air Force and NOAA Hurricane Hunter aircraft flying directly into the storms themselves. Hurricane Hunters and the staff of the National Hurricane Center have saved thousands of lives. People living in areas likely to be hit by a hurricane have time to prepare for these huge powerful storms long before they strike.

Get Info Objectives

1. Describe when and where hurricanes form.
2. Describe what is necessary for hurricanes to strengthen.
3. Describe what parts of the hurricane are most damaging.

Gather Data Objectives

1. Graph information on wind speed, atmospheric pressure, and storm tide.
2. Convert miles per hour to knots. (Knots are like miles per hour for boats.)
3. Trace the path of the worst hurricane in the year you were born.

Application Objectives

1. Use the graphs you make to find the approximate wind speed and storm tide of other hurricanes.
2. Determine the effect of storm tide on coastal areas.
3. Hypothesize what would happen if a major hurricane occurred where you live.

Before doing anything else, add the NOAA Research "Hurricanes" page to Bookmarks or Favorites on your browser.

- From the Hurricanes main page, click "Get Info."

II. Get Info

A. What is a Hurricane?

- Click on the "Hurricane Definition" site.
- Click on "Defining a Hurricane".
- Read the information and answer the following questions.

1. What is a hurricane?

A hurricane is a type of tropical cyclone over tropical waters. It is an intense tropical weather system with a well-defined circulation and minimum sustained winds of 74 miles per hour (64 knots) or higher. In the western Pacific, hurricanes are called typhoons and similar storms in the Indian Ocean are called cyclones.

- Click "Back" to return to the "Hurricane Definition" site.
- Scroll down to the "Saffir-Simpson Hurricane Scale."

B. Intensity

The Saffir-Simpson Scale is used to classify hurricanes based on sustained (long-lasting) wind speed. Hurricanes are classified in this way because it is the most accurate method of describing a storm that affects such a large area.

1. Fill in the chart with the Saffir-Simpson Scale of hurricane intensities.

Category	Winds MPH	Damage	Examples
1	74-95	Minimal	Florence, 1988, LA
2	96-110	Moderate	Kate, 1985, Bob, 1991
3	110-130	Extensive	Alicia, 1983, TX
4	131-155	Extreme	Andrew, 1992, FL
5	>155	Catastrophic	Camille, 1969, MS

- Click back to return to the "Hurricane Definition" site.
- Scroll down and click on "Storm Structure."

C. Storm Structure

1. What three things must occur for a hurricane to get stronger?

   a. Warm water and moist air are required.

   b. Light winds at higher levels of the atmosphere are required.

c. A wind pattern near the surface that spirals air inward is _____ required. _____

- Click "Back" to return to the "Get Info.1" web page
- Click "Forward" at the bottom of the page.

D. Hurricane Season

- Return to the "Hurricane Definition" site.
- Scroll down to and click on "Breeding Grounds."

1. In what time of year do most hurricanes form?

   Most hurricanes form during summer and fall. Hurrican season is June-November. _____

2. Where do hurricanes form?

   Hurricanes form only over warm water. _____

   _____

- Click "Back" to return to the "Hurricane Definition" site.
- Scroll down to and click on "Storm Fury."

E. Storm Surge

1. Explain what storm surge is and how it occurs.

A storm surge is a large dome of water 50 to 100 miles wide that rushes in along the coastline where a hurricane makes landfall. The shallower the water and the stronger the hurricane, the worse the storm surge will be. The storm surge combines with the usual tide to form the storm tide. _____

- Click "Back" to return to the "Hurricane Definition" site.
- Scroll down to and click on "Storm surge, floods and winds."

2. Describe the effects of storm surge on coastal areas during a hurricane.

A wall of water up to 25 feet above normal sea level washed everything out of its way.

- Click "Back" to return to the "Get Info.2" web page.
- Click on the NOAA "Hurricane Basics" PDF file.
- Go to the section on "Structure" beginning on Page 8 to learn about the different features of hurricanes. Read the section "Hurricane Size."

F. Size of Hurricanes

1. Describe a hurricane in terms of land area covered and forward speed.

Hurricanes cover tens of thousands of square miles. Hurricanes can travel from 0 to 50 miles per hour.

- Go back to Page 7 and read the section "Storm's End."

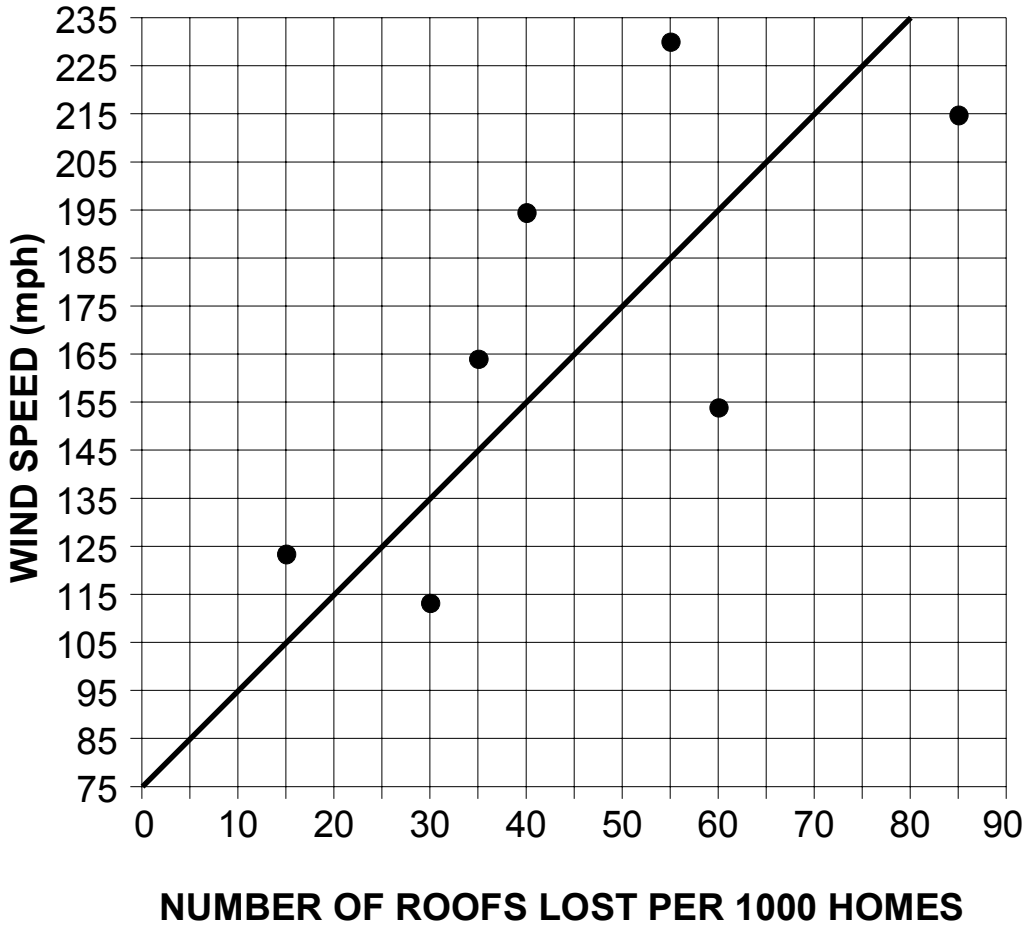
2. Why does a hurricane die out?

It gets over land and the source of energy is cut off. Hurricanes need warm water to evaporate into them to keep them going.

- Click "Back" to return to the NOAA Research "Hurricanes" main page, or choose "Hurricanes" from Bookmarks or Favorites.
- Click "Gather Data."

III. Gather Data

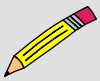
None of the sets of points that you will place on the graphs on the next few pages will form perfect lines. You will have to determine where the line should be to best fit the data points.
Example: Below is a sample data set (a collection of information) to show you the best-fit line idea. Notice on the graph below that there is a perfectly straight line that comes as close as possible to all the data points but doesn't actually touch any data points.



A. Graph Storm Tide vs. Pressure

- Click on the "Tropical Cyclone Reports" site.
- Select "Atlantic" for the basin.
- Select "2003" for the year.
- Select "Claudette."
- Follow the "Hurricane Claudette (Atlantic)" link to see the report in a new browser window.

- Scroll to the bottom of Table 1 to find the pressure at landfall at Matagorda Island, TX (979 mb).
- In Table 3, in the Storm Tide column, find the highest recorded storm tide (9.15 ft).

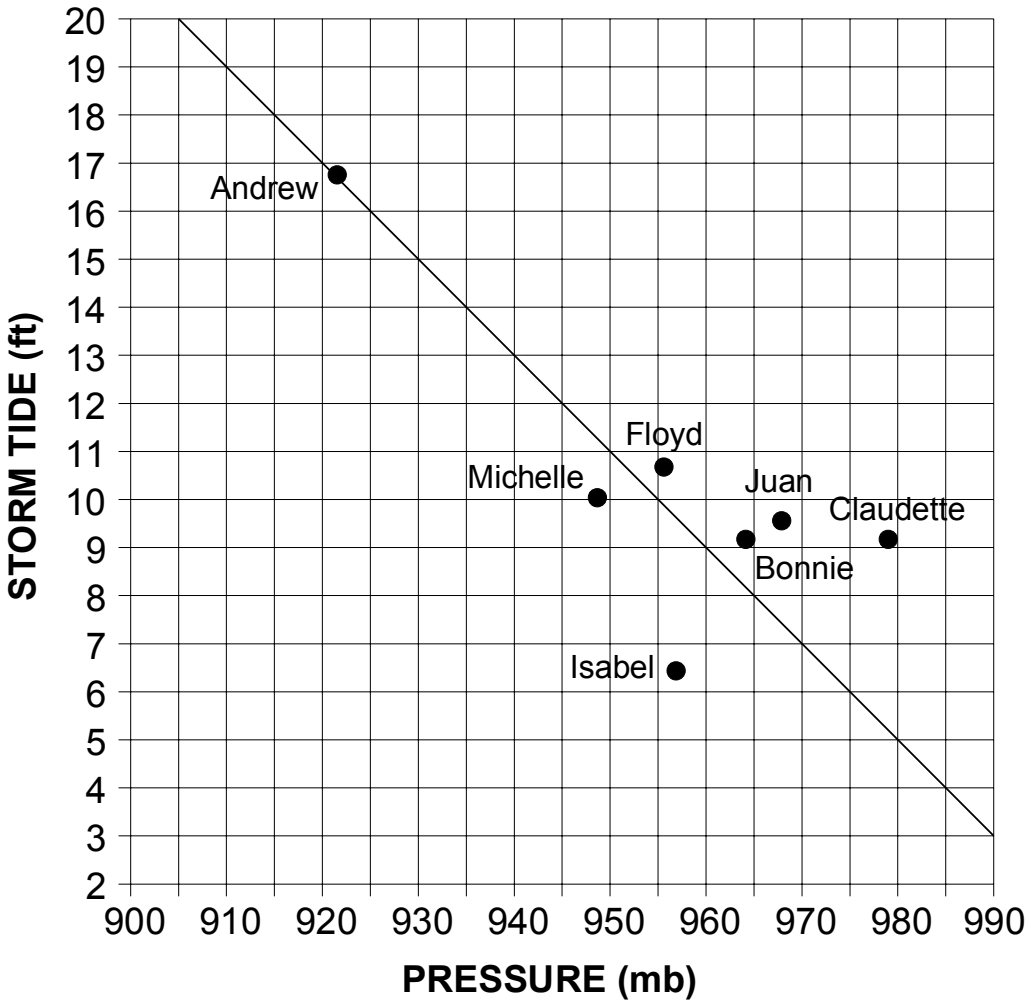


- Mark the place on the following graph where the two numbers meet.

Find and record the same information (pressure at landfall and highest storm tide height) for the following Atlantic hurricanes:

Juan (2003)
Isabel (2003)
Michelle (2001)
Floyd (2001)
Bonnie (1998)
Andrew (1992).

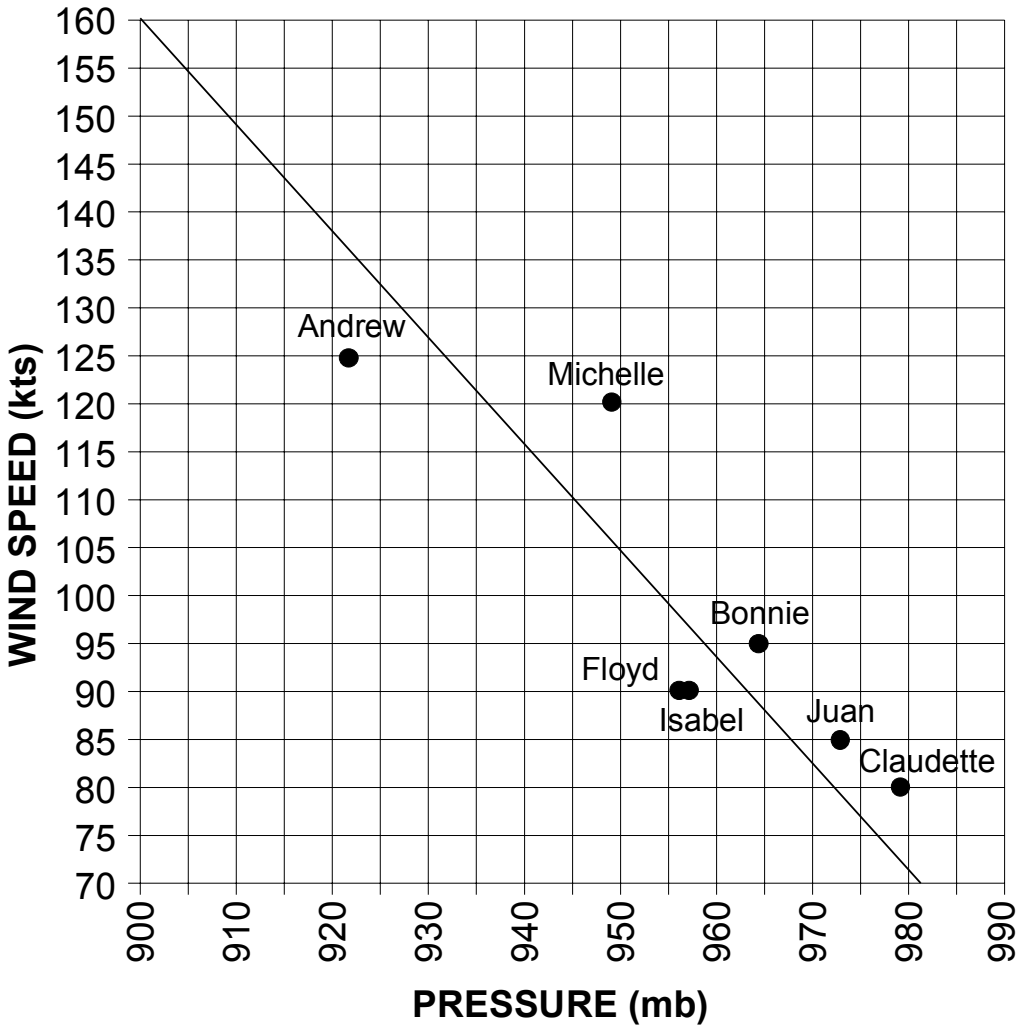
Draw a best-fit line.



B. Graph Pressure vs. Wind Speed

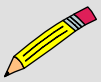
-Following the same directions, find the wind speed (80 kts) and pressure (979 mb) at landfall for Hurricane Claudette from Table 1.

- On the following graph, plot the point where the wind speed intersects with the pressure.
- Do the same for Hurricanes Juan, Isabel, Michelle, Floyd, Bonnie and Andrew.
- Draw a best-fit line.

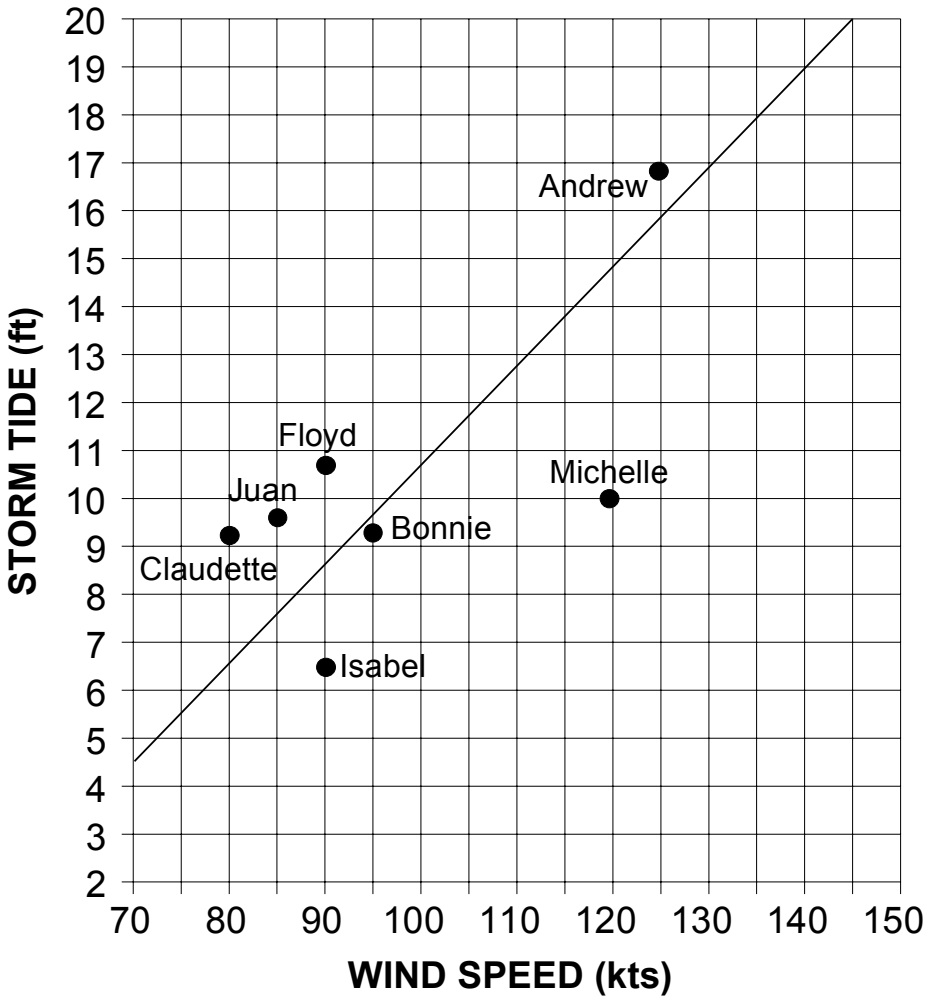


- Click "Back" to return to the Hurricanes "Gather Data.1" web page.
- Click "Forward" at the bottom of the page to go to "Gather Data.2."

C. Graph Tide Height vs. Wind Speed



- Using the Wind Speed and Storm Tide Height numbers from the previous two graphs, plot the point where the values (80 kts and 9.15 ft) intersect on the graph for Hurricane Claudette.
- Do the same for Hurricanes Juan, Isabel, Michelle, Floyd, Bonnie and Andrew.
- Draw a best-fit line.



D. Math Interpretations

- Click on the "Conversion Factors" site.

1. Convert 75 miles per hour to knots. There is 0.864 nautical mile per standard mile. One knot is one nautical mile.

$$\frac{75 \text{ miles}}{\text{hour}} \times \frac{0.864 \text{ nautical mile}}{\text{standard mile}} = \frac{64.8 \text{ nautical miles}}{\text{hour}}$$

2. Convert 120 miles per hour to kilometers per hour.

$$\frac{120 \text{ miles}}{\text{hour}} \times \frac{1.609 \text{ kilometers}}{\text{mile}} = 193 \text{ kilometers per hour}$$

3. Convert 920 millibars to inches of mercury.

$$\frac{920 \text{ millibars}}{1} \times \frac{1 \text{ inch of mercury}}{33.86 \text{ millibars}} = 27.17 \text{ inches of mercury}$$

4. Convert 950 millibars to hPa.

$$\frac{950 \text{ millibars}}{1} \times \frac{33.86 \text{ hectopascals}}{33.86 \text{ millibars}} = 950 \text{ hPa}$$

- Click "Back" to return to the Hurricanes "Gather Data.2" web page.
- Click "Forward" at the bottom of the page to go to the "Gather Data.3" web page.

E. Tracking Hurricanes

- Go to <u>one</u> of the following sites.

a. If you live near the Atlantic Ocean, click on the "Atlantic Hurricane Tracking Data by Year" site.

b. If you live near the Pacific Ocean, click on the "Pacific Hurricane Tracking Data by Year" site.

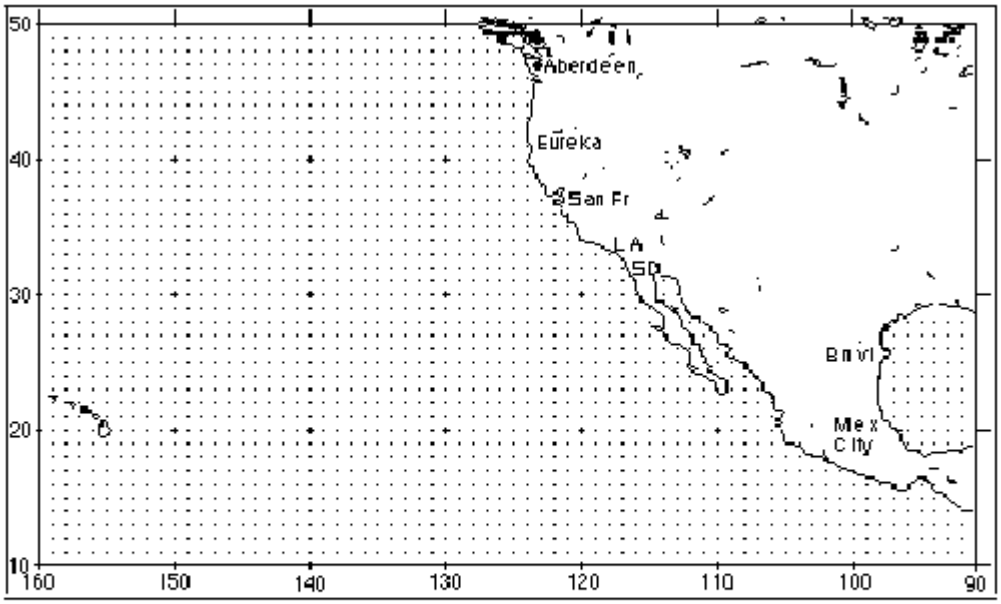
- Click on the year you were born.
- Scroll down the page and look for the worst hurricane that year and click "Details" for the hurricane.

1. Using latitude and longitude numbers, plot the path of the storm when it was classified as a hurricane on the hurricane-tracking chart on the next page.

2. Connect the plotted points to show the path of the hurricane.

3. Compare the track of the hurricane you plotted with the one on the map that shows all hurricanes for that year.

*** Teacher note *** Because of age differences in the class, some students will have different hurricanes to plot. The tracks of all the hurricanes for a given year are overlaid on a single map at the top of that page.


Aberdeen
Eureka
San Fr
LA
SD
Mex City
50
40
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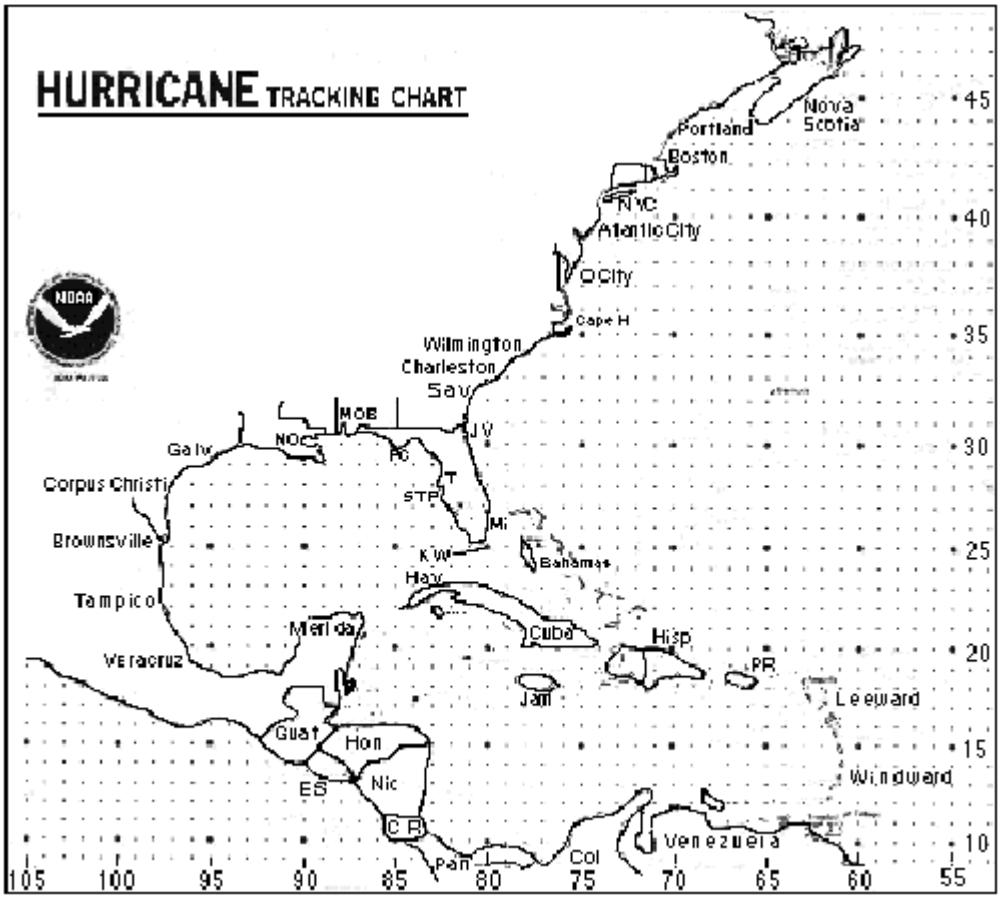
100
90


HURRICANE TRACKING CHART
Nova Scotia
Portland
Boston
NYC
Atlantic City
DCity
Cape H
Wilmington
Charleston
Sav
MOB
NOC
Galv
Corpus Christi
Brownsville
Tampico
Veracruz
Merida
STP
T
JV
Mi
KW
Bahamas
Hav
Cuba
Hisp
PR
Jam
Leeward
Windward
Venezuela
Col
Pan
CR
ES
Nic
Hon
Guat
45
40
35
30
25
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105
100
95
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75
70
65
60
55

- Click "Back" to return to the NOAA Research "Hurricanes" main page, or choose "Hurricanes" from your Bookmarks or Favorites.
- Click "Application."

IV. Application

A. Applying Graphs

- Click on "The Most Intense Hurricanes in the US 1900-1996" site.

1. Using the graphs you made in Gather Data, determine the approximate maximum sustained wind speed of the following hurricanes. Give you answer in miles per hour, not knots.

*** Note: Answers will vary ***

a. Camille (#2) = 173 miles per hour
b. Donna (#6) = 146 miles per hour
c. Opal (#16) = 133 miles per hour
d. Allen (#18) = 127 miles per hour
e. Connie (#59) = 113 miles per hour

2. Using the graphs you made in Gather Data, determine the approximate storm tide of the following hurricanes.

*** Note: Answers will vary ***

a. Camille (#2) = 19.2 feet
b. Donna (#6) = 15 feet
c. Opal (#16) = 12.8 feet
d. Allen (#18) = 12 feet
e. Connie (#59) = 8.9 feet

3. What difference does the timing of the tide make on the damage done by a hurricane?

If the tide is out when the hurricane hits land, the storm surge will be lower than if the tide is in when the hurricane hits.

4. Describe the types of damage that would happen if a hurricane with an intensity of 3 on the Saffir-Simpson Scale hit where you live.

Answers will vary, but should include damage to buildings, power lines, vehicles.

- Click "Back" to return to the NOAA Research "Hurricanes" main page, or choose "Hurricanes" from your Bookmarks or Favorites.
- Click "Enrichment."

V. Enrichment Activities

A. Hurricane-Induced Building Considerations

1. Research the change in construction regulations in Florida due to the effects of Hurricane Andrew in 1992.

2. Brainstorm about the type of housing that would best weather a hurricane.

B. El Nino Effects on Hurricanes

- You can do this section only if you have completed the El Nino Activity.
- Read the following two questions before going to the sites so you know what to look for.

1. Explain the effect El Nino has on the Atlantic and Pacific hurricane seasons.

2. What effect on the number of hurricanes should El Nino have had in 1997 – 1998?

   - Click on the "1997 storm tracks for the eastern Pacific" site (a severe El Nino year.)
   - Click on the "1995 storm tracks for the eastern Pacific" (a non-El Nino year.)

- Click "Back" to return to the NOAA Research "Hurricanes" main web page, or choose "Hurricanes" from your Bookmarks or Favorites.

C. Extra Credit

1. Research the meaning of "Willie-Willie" in Australia.
2. Find out how hurricanes are named.

D. Related Web Sites

1. National Hurricane Center
   http://www.nhc.noaa.gov

2. Hurricane and Natural Disasters Brochures
   http://www.aoml.noaa.gov/general/lib/hurricbro.html

3. National Weather Service Hurricane page
   http://www.nws.noaa.gov/om/hurricane/index.shtml

4. National Weather Service Hurricane Preparedness page
   http://www.nhc.noaa.gov/HAW2/english/intro.shtml

5. Hurricane Research Division, Atlantic Oceanographic and Meteorological Laboratory
   http://www.aoml.noaa.gov/hrd/

6. Hurricanes, Unleashing Nature's Fury
   http://www.nws.noaa.gov/om/brochures/hurrbro.htm

7. NOAA's Hurricane Site
   http://hurricanes.noaa.gov/index.html

8. Aircraft Operations Center
   http://www.aoc.noaa.gov

9. Tropical Cyclones Introduction
   http://www.srh.weather.gov/jetstream/tropics/tc.htm

10. National Climatic Data Center Hurricanes page
    http://lwf.ncdc.noaa.gov/oa/climate/severeweather/hurricanes.html