Hurricanes
6–8

Hurricane Science

LESSON PLAN 2

Tracking Hurricanes

Knowing the risk of hurricanes helps young people and their families be prepared.

Key Terms and Concepts

direction
latitude
location
longitude
true compass bearing
24-hour distance
24-hour velocity

Purpose

To guide the students and their families to track the movement of hurricanes

Objectives

The students will—

- Use the *Atlantic Hurricane Tracking Map* to plot and predict the path of a hurricane.
- Plot and compare actual hurricane movement to a predicted path with the handout *Where Is It Going?*
- Research the meteorological history of the 1900 Galveston hurricane; use this information to write a series of weather forecasts for each point listed in *Where Is It Going?* and plotted on the *Atlantic Hurricane Tracking Map*; define Key Terms and Concepts to use in their forecasts. (Linking Across the Curriculum)
- Calculate the velocity of a hurricane based on the points on a graph. (Linking Across the Curriculum)
- Demonstrate wind effects in the path of a hurricane to emphasize the need to be prepared all along the possible path of a hurricane.
- Use *The Galveston Hurricane: Just the Facts* and previous tracking information to create and describe various dramatic scenarios.
- Interview family members to find out ways in which severe weather prediction has changed. (Home Connection)
- Use *Hurricane Problems* to calculate math problems related to hurricanes. (Linking Across the Curriculum)

Activities

"Where Is It Going?"
"Wind Science"

American Red Cross

Visit the American Red Cross Web site at *www.redcross.org/disaster/masters*

Hurricanes 6–8

LESSON PLAN 2

Tracking Hurricanes

Materials

- Transparency of *Atlantic Hurricane Tracking Map*, 1 copy per student or team
- *Atlantic Hurricane Tracking Map*, 1 copy per student or team
- *Where Is It Going?*, 1 copy per student or team
- 2 pens of different colors

American Red Cross

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"Where Is It Going?"

SET UP 15 minutes **CONDUCT** 30 minutes

Social Studies: Mapping; Science: Meteorology

TEACHING NOTE The students may work independently or in pairs.

Follow the steps below to help the students predict and track the hurricane that hit Galveston, Texas, in 1900.

1. Distribute a copy of *Atlantic Hurricane Tracking Map* to each student or team.

2. Write the following coordinates on the board and have the students plot them on their maps:
   - Hurricane Start—Antigua, British West Indies (west longitude 61°40′ and north latitude 17°40′)
   - Hurricane End—Galveston, Texas (west longitude 94°20′ and north latitude 28°40′).

3. Based on the beginning and end points, have the students predict and draw the path the hurricane may have taken. Make sure the students use one color pen for the predicted path and a different color for the actual path.

4. Ask the students to look along their predicted paths and point out areas that might be at risk as the hurricane moves toward Galveston.

5. As a class, share and compare the predicted paths, using the transparency.

6. Distribute a copy of *Where Is It Going?* to each student or team. Have the students plot the hurricane's actual movement on their tracking maps.

7. As they plot the path, tell the students to label the date next to each point and then compare the predicted path with the actual path and write their observations. What does the actual path of the hurricane tell an observer?

Wrap-Up

Use the transparency to discuss students' observations and analyze their comparisons.

Hurricanes 6–8

LESSON PLAN 2

Tracking Hurricanes

Linking Across the Curriculum

Language Arts: Research; Science: Meteorology

There is more to a hurricane than just its path. Today's meteorologists do more than track a hurricane; they also report changes in its wind speed and air pressure. They want to predict not only where the hurricane is going, but the level of damage it is likely to inflict on the people living in its path.

List the following key terms and concepts on the board and give students time to find the meanings of each one.

direction
latitude
location
longitude
true compass bearing
24-hour distance
24-hour velocity

Meanings:

Location: a position on the earth's surface or in geographic space definable by coordinates or some other referencing system

Longitude: the imaginary lines that cross the surface of the earth, running from north to south, measuring the distance east or west of the prime meridian

Latitude: the imaginary lines that cross the surface of the earth parallel to the equator, measuring how far north or south of the equator a place is located

True compass bearing: a bearing taken in reference to true, not magnetic, north

24-hour distance: the distance a storm travels in 24 hours

24-hour velocity: the average speed of a storm's movement in 24 hours. For example, if a storm moved 100 miles (161 kilometers) in 24 hours, then its 24-hour velocity would be 4.2 miles (6.8 kilometers) per hour

Now, instruct students to research online to find as much information about the hurricane moving toward Galveston in 1900 as they can. They will be looking for information about wind speed, air pressure, the forward speed of the hurricane and other pertinent facts. Challenge them to use this information to write a series of possible weather forecasts (television, radio or print media) for each point plotted on the map to keep people informed as the hurricane moved toward them. The students will use the key terms and concepts in their forecasts.

Resources:

- NOAA History: Galveston Storm of 1900
  http://www.history.noaa.gov/stories_tales/cline2.html
- The Storm: Galveston Island, Texas
  http://www.1900storm.com/isaaccline/isaacsstorm.lasso
- Issac's Storm
  http://www.randomhouse.com/features/isaacsstorm/

American Red Cross

Visit the American Red Cross Web site at *www.redcross.org/disaster/masters*

Hurricanes 6–8

LESSON PLAN 2

Tracking Hurricanes

Mathematics: Calculation and Graphing

Using *Atlantic Hurricane Tracking Map* and *Where Is It Going?*, have the students plot the points of the Galveston Hurricane's approach on the hurricane grid. When the grid is complete, instruct them to calculate the velocity of the hurricane by dividing miles (or kilometers) by 24 hours (v = d/t). For example:

v = 408 mi/24 hr = 17 mi per hr

Note: In this case, velocity refers to the forward motion of the hurricane, not the speed of its winds.

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Hurricanes 6–8

LESSON PLAN 2

Tracking Hurricanes

Materials

- Several strips of paper, 1 inch (2.5 centimeters) wide by 4.25 inches (10.8 cm)
- Tape
- Pencil
- Cup
- Glass
- *The Galveston Hurricane: Just the Facts*, 1 copy per student
- *Hurricane Problems*, 1 copy per student (Linking Across the Curriculum)

American Red Cross

Visit the American Red Cross Web site at *www.redcross.org/disaster/masters*

"Wind Science"

SET UP 15 minutes **CONDUCT** 40 minutes

Science: Meteorology and Physical Science; Language Arts: Writing

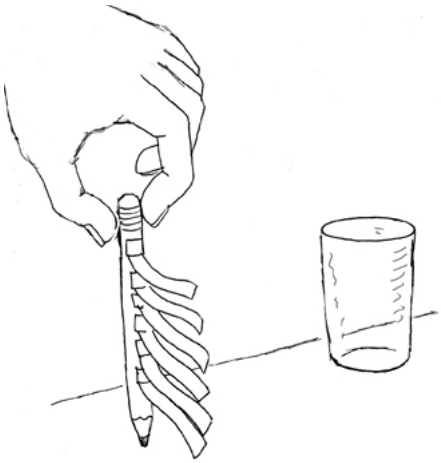
1. Discuss the following concept with the students:
   Winds arriving before the eye of the hurricane and after the eye of the hurricane passes come from different directions, if the eye passes directly over a specific area. If the eye is further from the area, winds continue in the same direction.

Tell the students they are going to observe a demonstration that illustrates this concept.

TEACHING NOTE If appropriate, have a small group conduct the demonstration for the class.

2. Tape the strips of paper (the winds of the hurricane) closely together down the side of a pencil (the eye of the hurricane).

3. Holding the top of the pencil, rotate it counterclockwise, moving toward the cup (the community). As the hurricane approaches the community, which way do the winds blow? After the eye passes over the community, which way do the winds blow? What does this illustrate about the winds in a hurricane?



4. Place the glass (a distant community) slightly away from the cup. Now, rotate and move the hurricane over the community (the cup) once again.
   What happens to the winds over the distant community?
   What does this illustrate about the winds in a hurricane?
   (The winds blow in the same direction because the eye is not over the distant community. The community close to the eye experiences winds in different directions. Farther from the eye, winds blow in only one direction.)

5. How might this demonstration help a community understand the need for better preparation and wind-resistant buildings?

Hurricanes 6–8

LESSON PLAN 2

Tracking Hurricanes

Wrap-Up

Distribute *The Galveston Hurricane: Just the Facts*. Give students time to read about this historic hurricane. Ask: How does the demonstration you just saw relate to this event?

Using the data from the demonstration, the eyewitness report on *The Galveston Hurricane: Just the Facts* and the tracking information in *Where Is It Going?*, have student teams choose a subject to describe the drama of the hurricane:

- Newspaper reports
- On-the-scene, eyewitness interviews
- A grandmother telling her grandchild about the storm of 1900
- Daily television weather reports to reenact the storm, its path and its destruction

Home Connection

Have the students interview older friends or family members to discover ways severe weather forecasting has changed since they were young. For example, in the past, Galveston received weather information via telegraph. How have things changed in the way we receive weather reports? (Consider cable, the Internet and the number of television channels.) How has new technology changed the information gathered, analyzed and reported?

Linking Across the Curriculum

Mathematics: Computation and Problem Solving

Distribute *Hurricane Problems* and have the students work in small groups to solve the problems. Have them share and discuss their answers.

Answers to *Hurricane Problems*

1. Mean: 14.2 feet; median: 13 feet; range: 10 feet
2. 32,355 gallons
3. Circumference = 942 miles; area = 70,650 square miles
4. Area around eye: 707 square miles
5. Average rainfall is 2.18 inches

TEACHING NOTE These answers conform to the following rules of rounding numbers:
0–4 round down (truncate)
5–9 round up

For an added challenge, ask the students to convert their answers to the metric system.

American Red Cross

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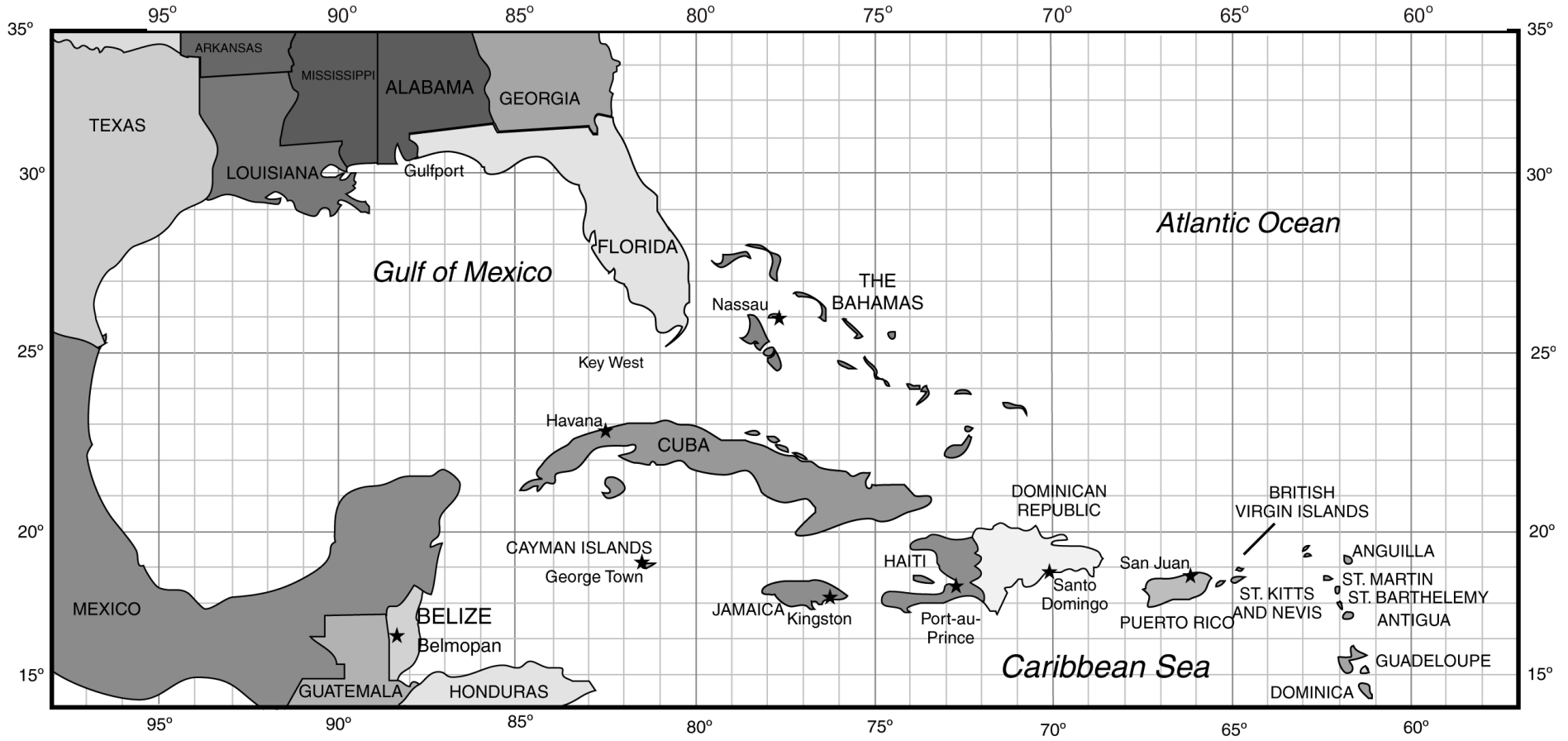
Atlantic Hurricane Tracking Map

Name _____



American Red Cross

Visit the American Red Cross Web site
at *www.redcross.org/disaster/masters*

Where Is It Going?

Name _____

Directions: Use the information below to plot the track of the 1900 Galveston hurricane. What can you observe from the data? Compare the actual track with your prediction.

Daily position and bearing data of the storm from August 30 to September 8, 1900:

Date	Location Description	West Longitude	North Latitude
August 30	at Antigua, B.W.I.	61˚40′	17˚40′
August 31	SSE of Ponce, Puerto Rico	65˚00′	16˚00′
September 1	SSW of Mayaguez, Puerto Rico	69˚00′	15˚20′
September 2	ESE of Kingston, Jamaica	74˚10′	17˚00′
September 3	WNW of Kingston, Jamaica	78˚50′	19˚00′
September 4	SE of Havana, Cuba	80˚50′	21˚00′
September 5	E of Havana, Cuba	81˚20′	23˚00′
September 6	W of Miami, Florida	81˚40′	25˚40′
September 7	SE of New Orleans, Louisiana	89˚00′	28˚00′
September 8	SE of Galveston, Texas	94˚20′	28˚40′

The Galveston Hurricane: Just the Facts

Name _____

By 1900, Galveston was the fourth-largest city in Texas with a population of 37,789. Its citizens were not aware of the low-pressure system of a late-summer hurricane as it moved across Cuba to be blocked by high pressure in the eastern United States. Galveston residents were oblivious to the prevailing trade winds that drove the storm west.

As the storm approached the Texas Gulf Coast, a weaker low-pressure system was moving eastward through the central United States. Because the hurricane turned northward to join the second low-pressure system, it crossed Galveston Island.

On September 8, 1900, the hurricane, with winds of 100 miles (161 kilometers) per hour, created a storm surge of 20 feet (6.1 meters), 6 to 9 feet (1.8 to 2.7 meters) higher than any previously recorded Galveston flood. Water was pushed northward over the island from the Gulf of Mexico and southward over the island from Galveston Bay.

The citizens of Galveston frantically tried to save themselves as well as family members and friends. Pieces of roofing slate, used to replace wood shingles for fire safety, became deadly projectiles as they were blown about by the high winds. The railroad causeway and the wagon bridge to the mainland were destroyed. Ships were moved tens of miles inland. Debris, created and swept inland by the storm, piled up like a retaining wall at the downtown area, protecting it from total destruction.

Water swept over the entire island, killing between 6,000 and 8,000 people and destroying 3,500 houses and property worth, at that time, approximately $20 million. The death toll is uncertain because a physical count of bodies was impossible; the number was determined by the difference between an earlier census and the subsequent count of the survivors. To complicate matters, it was tourist season and unknown numbers of out-of-towners were vacationing in Galveston.

After devastating Galveston, the storm continued north and east finally leaving North America through Newfoundland. From Antigua, where the hurricane had originated, the storm had traveled over 4,000 miles (6,436 kilometers) in approximately 14 days.

The Galveston Hurricane: Just the Facts

For residents of Galveston, the hurricane could not have struck at a worst place or time:

- The eye passed west of Galveston Island, placing the area of maximum winds near the city of Galveston.
- The storm struck nearly perpendicular to the coast.
- The shallow continental shelf off the coast added to an already high storm surge created by the winds.
- The storm struck during high tide.
- Removal of the dunes to provide fill eliminated natural protection.
- The geography of Galveston Bay and Galveston Island made the effects of the receding waters even worse.
- Summer tourists increased the population.
- Warning and evacuation procedures were ineffective.

Following are excerpts from an eyewitness account of the Galveston Hurricane. To read more about this amazing hurricane, visit some of the following resources:

Resources:
The Storm: Galveston Island, Texas *http://www.1900storm.com/isaaccline/isaacsstorm.lasso*
Issac's Storm *http://www.randomhouse.com/features/isaacsstorm/*

The Galveston Hurricane: Just the Facts

Eyewitness Account

On September 8, 1900, the greatest natural disaster to ever strike the United States occurred at Galveston, Texas. In the early evening hours of September 8, a hurricane came ashore at Galveston bringing with it a great storm surge that inundated most of Galveston Island and the city of Galveston. As a result, much of the city was destroyed and at least 6,000 people were killed in a few hours' time.

The following is the account of Isaac M. Cline, the senior Weather Bureau employee present at Galveston, of the events leading up to the storm, his personal experiences in the storm, and the aftermath. The horror of Galveston is only partly described in this work. He was probably somewhat still in shock when he wrote this report as he lost his wife and virtually all of his possessions when his house collapsed during the storm. In a later biographical work, he referred to the shooting of hundreds of looters by vigilantes in the aftermath of the storm and the cremation of hundreds of unknown storm victims who otherwise would have decomposed where they lay. This particular report is excerpted from the *Monthly Weather Review* for September 1900.

SPECIAL REPORT ON THE GALVESTON HURRICANE OF SEPTEMBER 8, 1900

By Isaac M. Cline, Local Forecast Official and Section Director

The hurricane which visited Galveston Island on Saturday, September 8, 1900, was no doubt one of the most important meteorological events in the world's history. The ruin which it wrought beggars description, and conservative estimates place the loss of life at the appalling figure, 6,000.

A brief description of Galveston Island will not be out of place as introductory to the details of this disaster. It is a sand island about thirty miles in length and one and one-half to three miles in width....

The usual signs which herald the approach of hurricanes were not present in this case. The brick-dust sky was not in evidence to the smallest degree. This feature, which has been distinctly observed in other storms that have occurred in this section, was carefully watched for, both on the evening of the 7th and the morning of the 8th. There were cirrus clouds moving from the southeast during the forenoon of the 7th, but by noon only alto-stratus from the northeast were observed. About the middle of the afternoon the clouds were divided between cirrus, alto-stratus,

The Galveston Hurricane: Just the Facts

and cumulus, moving from the northeast. A heavy swell from the southeast made its appearance in the Gulf of Mexico during the afternoon of the 7th. The swell continued during the night without diminishing, and the tide rose to an unusual height when it is considered that the wind was from the north and northwest. About 5 a.m. of the 8th Mr. J. L. Cline, Observer, called me and stated that the tide was well up in the low parts of the city, and that we might be able to telegraph important information to Washington. He, having been on duty until nearly midnight, was told to retire and I would look into conditions. I drove to the Gulf, where I timed the swells, and then proceeded to the office and found that the barometer was only one-tenth of an inch lower than it was at the 8 p.m. observation of the 7th. I then returned to the Gulf, made more detailed observations of the tide and swells, and filed the following telegram addressed to the Central Office in Washington:

> Unusually heavy swells from the southeast, intervals of one to five minutes, overflowing low places south portion of city three to four blocks from beach. Such high water with opposing winds never observed previously.

Broken stratus and strato-cumulus clouds predominated during the early forenoon of the 8th, with the blue sky visible here and there. Showery weather commenced at 8:45 a.m., but dense clouds and heavy rain were not in evidence until about noon, after which dense clouds with rain prevailed.

...

A storm velocity [of the wind] was not attained until about 1 p.m. after which the wind increased steadily and reached a hurricane velocity about 5 p.m. The greatest velocity for five minutes was 84 miles per hour at 6:15 p.m. With two minutes at the rate of 100 miles per hour. The anemometer blew away at this time, and it is estimated that prior to 8 p.m. the wind attained a velocity of at least 120 miles per hour. For a short time, about 8 p.m., just before the wind shifted to the east, there was a distinct lull, but when it came out from the east and southeast it appeared to come with greater fury than before. After shifting to the south at about 11 p.m. the wind steadily diminished in
velocity, and at 8 a.m. on the morning of the 9th was blowing at the rate of 20 miles per hour from the south.

...

On account of the rapid fall in pressure, Mr. John D. Blagden, Observer, took readings of the mercurial barometer as a check on the barograph.… [The] readings confirm the low pressure shown by barograph and indicate the great intensity of the hurricane.

Mr. Blagden looked after the instruments during the hurricane in a heroic and commendable manner. He kept the wires of the self-registering

The Galveston Hurricane: Just the Facts

apparatus intact as long as it was possible for him to reach the roof. The rain gauge blew away about 6 p.m. and the thermometer shelter soon followed. All the instruments in the thermometer shelter were broken, except the thermograph which was found damaged, but has been put in working order.

Storm warnings were timely and received a wide distribution not only in Galveston but throughout the coast region. Warning messages were received from the Central Office at Washington on September 4, 5, 6, 7, and 8. The high tide on the morning of the 8th, with storm warning flying, made it necessary to keep one man constantly at the telephone giving out information. Hundreds of people who could not reach us by telephone came to the Weather Bureau office seeking advice. I went down on Strand Street and advised some wholesale commission merchants who had perishable goods on their floors to place them 3 feet above the floor. One gentleman has informed me that he carried out my instructions, but the wind blew his goods down. The public was warned, over the telephone and verbally, that the wind would go by the east to the south and that the worst was yet to come. People were advised to seek secure places for the night. As a result thousands of people who lived near the beach or in small houses moved their families into the center of the city and were thus saved. Those who lived in large strong buildings, a few blocks from the beach, one of whom was the writer of this report, thought that they could weather the wind and tide. Soon after 3 p.m. conditions became so threatening that it was deemed essential that a special report be sent at once to Washington. Mr. J. L. Cline, Observer, took the instrumental readings while I drove first to the bay and then to the Gulf, and finding that half the streets of the city were under water added the following to the special observation at 3:30 p.m.: "Gulf rising, water covers streets of about half of city." Having been on duty since 5 a.m., after giving this message to the observer, I went home to lunch. Mr. J. L. Cline went to the telegraph offices through water from two to four feet deep, and found that the telegraph wires had all gone down; he then returned to the office, and by inquiry learned that the long distance telephone had one wire still working to Houston, over which he gave the message to the Western Union telegraph office at Houston to be forwarded to the Central Office at Washington.

I reached home and found the water around my residence waist deep. I at once went to work assisting people, who were not securely located, into my residence, until forty or fifty persons were housed therein. About 6:30 p.m. Mr. J. L. Cline, who had left Mr. Blagden at the office to look after the instruments, reached my residence, where he found the water neck deep. He informed me that the barometer had fallen below 29.00 inches; that no further messages could be gotten off on account of all wires being down, and that he had advised everyone he could see to go to the center of the city; also, that he thought we had better make an attempt in that direction. At this time, however, the roofs of houses and

The Galveston Hurricane: Just the Facts

timbers were flying through the streets as though they were paper, and it appeared suicidal to attempt a journey through the flying timbers. Many people were killed by flying timbers about this time while endeavoring to escape to town. The water rose at a steady rate from 3 p.m. until about 7:30 p.m., when there was a sudden rise of about four feet in as many seconds. I was standing at my front door, which was partly open, watching the water, which was flowing with great rapidity from east to west. The water at this time was about eight inches deep in my residence, and the sudden rise of 4 feet brought it above my waist before I could change my position. The water had now reached a stage 10 feet above the ground at Rosenberg Avenue (Twenty-fifth street) and Q street, where my residence stood. The ground was 5.2 feet elevation, which made the tide 15.2 feet. The tide rose the next hour, between 7:30 and 8:30 p.m., nearly five feet additional, making a total tide in that locality of about twenty feet. These observations were carefully taken and represent to within a few tenths of a foot the true conditions. Other personal observations in my vicinity confirm these estimates. The tide, however, on the bay or north side of the city did not obtain a height of more than 15 feet. It is possible that there was 5 feet of backwater on the Gulf side as a result of debris accumulating four to six blocks inland. The debris is piled eight to fifteen feet in height. By 8 p.m. a number of houses had drifted up and lodged to the east and southeast of my residence, and these with the force of the waves acted as a battering ram against which it was impossible for any building to stand for any length of time, and at 8:30 p.m. my residence went down with about fifty persons who had sought it for safety, and all but eighteen were hurled into eternity. Among the lost was my wife, who never rose above the water after the wreck of the building. I was nearly drowned and became unconscious, but recovered through being crushed by timbers and found myself clinging to my youngest child, who had gone down with myself and wife. Mr. J. L. Cline joined me five minutes later with my other two children, and with them and a woman and child we picked up from the raging waters, we drifted for three hours, landing 300 yards from where we started. There were two hours that we did not see a house nor any person, and from the swell we inferred that we were drifting to sea, which, in view of the northeast wind then blowing, was more than probable. During the last hour that we were drifting, which was with southeast and south winds, the wreckage on which we were floating knocked several residences to pieces. When we landed about 11:30 p.m., by climbing over floating debris to a residence on Twenty-eighth street and Avenue P, the water had fallen about 4 feet. It continued falling, and on the following morning the Gulf was nearly normal. While we were drifting we had to protect ourselves from the flying timbers by holding planks between us and the wind, and with this protection we were frequently knocked great distances. Many persons were killed on top of the drifting debris by flying timbers after they had escaped from their wrecked homes. In order to keep on the top of the floating masses of wrecked buildings one had to be constantly on the lookout and continually climbing from drift to

The Galveston Hurricane: Just the Facts

drift. Hundreds of people had similar experiences.

Sunday, September 9, 1900, revealed one of the most horrible sights that ever a civilized people looked upon. About three thousand homes, nearly half the residence portion of Galveston, had been completely swept out of existence, and probably more than six thousand persons had passed from life to death during that dreadful night. The correct number of those who perished will probably never be known, for many entire families are missing. Where 20,000 people lived on the 8th not a house remained on the 9th, and who occupied the houses may, in many instances, never be known. On account of the pleasant Gulf breezes many strangers were residing temporarily near the beach, and the number of these that were lost can not yet be estimated.… The insurance inspector for Galveston states that there were 2,636 residences located prior to the hurricane in the area of total destruction, and he estimates 1,000 houses totally destroyed in other portions of the city, making a total of 3,636 houses totally destroyed. The value of these buildings alone is estimated at $5,500,000.

...

From the officers of the U. S. Engineer tug *Anna*, I learn that the wind at the mouth of the Brazos River went from north to southwest by way of west. This shows that the center of the hurricane was near Galveston, probably not more than 30 miles to the westward. The following towns have suffered great damage, both in the loss of life and property: Texas City, Dickinson, Lamarque, Hitchcock, Arcadia, Alvin, Manvel, Brazoria, Columbia, and Wharton. Other towns further inland have suffered, but not so seriously. The exact damage at these places can not be ascertained.

A list of those lost in Galveston, whose names have been ascertained up to the present time, contains 3,536 names.

UNITED STATES WEATHER BUREAU OFFICE,

GALVESTON, TEX., September 23, 1900.

Source:
NOAA History: Galveston Storm of 1900 *http://www.history.noaa.gov/stories_tales/cline2.html.* Accessed May 31, 2007

American Red Cross

Visit the American Red Cross Web site at *www.redcross.org/disaster/masters*

Hurricane Problems

Name _____

Directions: Hurricanes are defined by numbers: air pressure, wind speed, size and intensity. Work with the numbers to solve the problems below. Discuss your answers and your method.

1. If a hurricane's storm tides were expected to be 20 feet (6.1 meters) at Bulls Bay, 16 feet (4.9 meters) at McClellanville, 13 feet (4 meters) at Myrtle Beach, 12 feet (3.7 meters) at Folly Beach, and 10 feet (3 meters) at Charleston, what would be the mean, median, and range of these measurements?

2. There are 2,157 homes in Long Beach and Ocean Isle Beach. The towns were told to store water in preparation for a hurricane. If each home had to store 15 gallons (57 liters) of water, how many gallons of water would the towns have to store?

3. The diameter of a hurricane is 300 miles (483 kilometers). What is the circumference? What is the area?

4. The diameter of a hurricane is 270 miles (434 kilometers). The eye of the hurricane has a diameter of 30 miles (48 kilometers). Find the area of the hurricane around the eye of the hurricane.

5. The rainfalls from hurricane "x" in North Carolina were as follows: Boone 6.91 inches (17.6 centimeters), Charlotte 3.16 inches (8.0 centimeters), Asheville 1.93 inches (4.9 centimeters), Greensboro 1.43 inches (3.6 centimeters), Wilmington 0.79 inches (2.0 centimeters), Cape Hatteras 0.60 inches (1.5 centimeters), and Raleigh 0.45 inches (1.1 centimeters). What was the average rainfall?