Hurricane Floyd Lesson Plan(s)
Grade 4-5

Learning Objectives:
To learn more about tropical cyclones and the history of Hurricane Floyd.

Lesson:
- Tropical Terminology
- Tropical Cyclone Overview
- Tropical Cyclone Threats
- Hurricane Floyd History
- Preparedness/Safety
- Saffir-Simpson Scale

Possible Activities:
- What Would You Do? - Students take the role of mayor for a city. Hurricane Opal is developing and approaching their city. The students must decide whether or not to order a forced evacuation of the city. Students read actual news reports about the storm. They then read "memos" from city staff members, taking various positions on the evacuation. The students review basic information about hurricanes. Finally, students "announce" their evacuation decision by filling out a "press release". http://weathereye.kgan.com/lounge/plans/hurricane.html
- Hurricane Bingo - http://secoora.org/classroom/hurricane/bingo
- Make your own Anemometer- http://secoora.org/classroom/hurricane/anemometer
- Hands on Storm Surge Activity - http://secoora.org/classroom/hurricane/surge
- Make a hurricane. Fill a large bowl or basin with lukewarm water about two-thirds of the way. Stir the water gently counterclockwise and add some vegetable oil or food coloring on top of the spinning water with an eye dropper. Note that the color moves out and forms bands just as clouds do in a hurricane.

Resources:

- http://www.erh.noaa.gov/mhx/Floyd/
- http://www.nhc.noaa.gov
- Link for Hurricane Tracking Sheets-- http://www.nhc.noaa.gov/AT_Track_chart.pdf
- Hurricane Hunter Link-- http://www.hurricanehunters.com/
- Web Weather For Kids: http://eo.ucar.edu/webweather/
- http://www.weatherwizkids.com/hurricane1.htm
- http://www.seacoos.org/Community%20and%20Classroom/hurricane-classroom/

Tropical Meteorology Terminology

Eye: The roughly circular area of comparatively light winds that encompasses the center of a severe tropical cyclone. The eye is either completely or partially surrounded by the eyewall cloud.

Eyewall / Wall Cloud: An organized band or ring of cumulonimbus clouds that surround the eye, or light-wind center of a tropical cyclone. Eyewall and wall cloud are used synonymously.

Hurricane: A tropical cyclone in which the maximum sustained surface wind is 64 kt (74 mph or 119 km/hr) or more. The term hurricane is used for Northern Hemisphere tropical cyclones east of the International Dateline to the Greenwich Meridian.

Hurricane Warning: A warning that sustained winds 64 kt (74 mph or 119 km/hr) or higher associated with a hurricane are expected in a specified coastal area in 24 hours or less. A hurricane warning can remain in effect when dangerously high water or a combination of dangerously high water and exceptionally high waves continue, even though winds may be less than hurricane force.

Hurricane Watch: An announcement for specific coastal areas that hurricane conditions are possible within 36 hours.

Storm Surge: An abnormal rise in sea level accompanying a hurricane or other intense storm, and whose height is the difference between the observed level of the sea surface and the level that would have occurred in the absence of the cyclone. Storm surge is usually estimated by subtracting the normal or astronomic high tide from the observed storm tide.

Tropical Cyclone: A warm-core non-frontal synoptic-scale cyclone, originating over tropical or subtropical waters, with organized deep convection and a closed surface wind circulation about a well-defined center. Once formed, a tropical cyclone is maintained by the extraction of heat energy from the ocean at high temperature and heat export at the low temperatures of the upper troposphere. In this they differ from extratropical cyclones, which derive their energy from horizontal temperature contrasts in the atmosphere (baroclinic effects).

Tropical Depression: A tropical cyclone in which the maximum sustained surface wind speed is 33 kt (38 mph or 62 km/hr) or less.

Tropical Disturbance: A discrete tropical weather system of apparently organized convection -- generally 100 to 300 nmi in diameter -- originating in the tropics or subtropics, having a nonfrontal migratory character, and maintaining its identity for 24 hours or more. It may or may not be associated with a detectable perturbation of the wind field.

Tropical Storm: A tropical cyclone in which the maximum sustained surface wind speed ranges from 34 kt (39 mph or 63 km/hr) to 63 kt (73 mph or 118 km/hr).

Tropical Storm Warning: A warning that sustained winds within the range of 34 to 63 kt (39 to 73 mph or 63 to 118 km/hr) associated with a tropical cyclone are expected in a specified coastal area within 24 hours or less.

Tropical Storm Watch: An announcement for specific coastal areas that tropical storm conditions are possible within 36 hours.

Tropical Cyclone Overview

In order for a Hurricane to form:

- Need a pre-existing disturbance with thunderstorms.
- Warm ocean temperature (at least 80 degrees F) to a depth of about 150 ft.
- Light upper level winds (low wind shear)

Stages of a Tropical Cyclone

1. Tropical Wave
2. Tropical Disturbance
3. Tropical Depression
4. Tropical Storm
5. Hurricane

Before the Hurricane reaches you:

- Satellites take pictures of the storm.
- Hurricane Hunter Airplanes fly into the storm to find out how strong it is.
- As it comes closer to land, weather radars track it. Radio, TV, and NOAA Weather Radio stations warn people about the hurricane.

When the hurricane comes:

- A hurricane is a big doughnut of winds with a calm section at the middle - that's the eye of the hurricane.
- The calm center may last from a few minutes to an hour or more. The sun may come out and you think the storm is over. But it isn't.
- As the hurricane moves, winds will blow just as hard, but from the opposite direction. Don't be tricked by the eye of the hurricane!
- Hurricanes are killer storms. Don't be caught by one. Get out of its way. Go inland if necessary. Follow advice

Important facts to remember:

- Hurricane Season begins June 1 and continues through November 30.
- The peak time for tropical development is September and October.
- Always remember that hurricane size does not determine strength.
- The speed of the winds may be over 150 miles an hour! Trees and houses may be blown down. Windows in buildings are blown out. Heavy rain may cause flooding. If you're not close to shore, you may plan to stay in your house and ride out the storm.

Tropical Cyclones Pose Many Threats

Storm Surge: Winds and surge are stronger in the right front quadrant, the direction a hurricane is moving when it makes landfall plays a large role in the storm surge that will be experienced. If you live near the coast you may need to leave home for higher ground! Evacuate when you are told to do so. The hurricane can cause a great wall of water called storm surge to flow over the beaches. The storm surge may sink boats, knock down piers and wash away houses and buildings.

Wind: The speed of the winds may be over 150 miles an hour. Trees and houses may be blown down. Windows in buildings are blown out. Falling trees and flying debris pose a serious threat. Strong inland winds can cause significant damage. Flying objects act as missiles in strong hurricane winds, so secure your belongings if you are able to do so. Mobile homes are offer little protection during a storm and are extremely dangerous places to be during a hurricane. Nothing can stop the strongest hurricane winds, so evacuate if you can.

Tornadoes: Most tornadoes occur on the northeast quadrant of the hurricane, as squall lines move onshore. Typically a tornado watch will be issued well ahead of a hurricanes actual landfall. Rooms with large expanse roofs are highly susceptible to damage from high winds and tornadoes. Gyms, cafeterias, and other such facilities are dangerous places to take refuge. Twenty-six tornado warnings were issued the day before Floyd made landfall.

Inland Flooding: Inland flooding can be a major threat to communities hundreds of miles from the coast as intense rain falls from with these huge tropical air masses. In a study from 1970 to 1999, freshwater flooding accounted for about 60% of U.S. tropical cyclone deaths, most in inland counties. So just because you don't live near the beach, don't be fooled!

Remember Turn Around, Don't Drown!

Hurricane Floyd History
September 16, 1999

Hurricane Floyd was no ordinary storm. Floyd brought flooding rains, high winds and rough seas along a good portion of the Atlantic seaboard from the 14th through the 18th of September, 1999. The greatest damages were along the eastern Carolinas northeast into New Jersey, and adjacent areas northeastward along the east coast into Maine. Several states had numerous counties declared disaster areas. Flooding caused major problems across the region, with at least 57 deaths reported. Damages are estimated to be $1.6 billion in Pitt County, North Carolina alone, and total storm damages have surpassed the $6 billion caused by Hurricane Fran in 1996.

Floyd was a large and intense Cape Verde hurricane that pounded the Bahama Islands, seriously threatened Florida, struck the coast of North Carolina and moved up the east coast into New England. It neared category five intensity on the Saffir-Simpson Hurricane Scale as it approached the Bahamas, and produced a flooding catastrophe in the eastern United States, particularly in North Carolina.

Floyd triggered the second largest evacuation in US history to date, when 2.6 million coastal residents of five states were ordered from their homes as Hurricane Floyd approached. Evacuees in Charleston had the longest average travel times, almost nine hours. Beaufort (SC) and the two Georgia sites also had average travel times exceeding six hours.

There were 57 deaths that were directly attributable to Floyd, 56 in the United States and 1 in Grand Bahama Island. Most of deaths were due to drowning in freshwater flooding. At that time, Floyd was the deadliest hurricane in the United States since Agnes of 1972. Total damage estimates range from 3 to over 6 billion dollars.

Residents who were unable to evacuate before the storm hit huddled for hours on rooftops or clung to trees, waiting for rescue after their homes were filled with water. Over 1,500 people were rescued in the 24 hours following the hurricane, and over 3,500 had been rescued by September 18, two days after Floyd made landfall. Many of these rescues were made by helicopter. So many rescue helicopters were crossing the skies searching for stranded storm survivors that the Coast Guard had to fly one chopper above the others to control the air traffic.

Along with the loss of homes, Hurricane Floyd created an agricultural nightmare. Unimaginable numbers of livestock from across Eastern North Carolina drowned in the flood - an estimated 30,000 hogs, 700,000 turkeys, and 2.4 million chickens. Officials were faced with the grim task of collecting the animal bodies and incinerating them 24 hours a day in 3 counties to avoid a threat to public health. Thousands of farms were affected when the flood waters erased years of careful landscaping and planning of fields in a matter of a few short days.

Tobacco crop losses are estimated at $98 million; livestock losses $8.5 million; total crop losses $432 million and total agricultural losses of $634 million for 44 of the 66 counties included in the North Carolina disaster declaration.

Hurricane and Flood Preparedness from the Red Cross

The Red Cross recommends the following safety steps and tips to prepare for a hurricane:

Assemble a Disaster Supplies Kit

- Gather emergency supplies including: emergency medications, nonperishable foods, a non-electric can opener, bottled water (at least three gallons per day per person), a battery-powered radio, flashlight, extra batteries, extra clothes, important documents, cash and credit cards, a first aid kit and other items for infants, elderly or disabled family members and pets. Store supplies in a waterproof, easy-to-carry container, such as plastic tub with handles.

Prepare a Personal Evacuation Plan

- Identify an evacuation route ahead of time; discuss with family members
- If advised to evacuate, do so immediately
- In case of evacuation to an American Red Cross shelter, be sure to bring the disaster supplies kit, medications, extra clothing, pillows and blankets and other hygiene and comfort supplies
- Make advance preparations for pets so you can bring them with you when you leave, but remember, due to health department regulations, pets aren't allowed in public shelters

Prepare for High Winds

- Measure windows and obtain shutters or cut plywood to cover each one
- Remove diseased and damaged tree limbs well before a storm strikes
- Strengthen garage doors with vertical support beams made from 2x4's and "L" brackets

Preparing for Flooding

Know What to Expect

- Know your area's flood risk--if unsure, call your local Red Cross chapter, emergency management office, or planning and zoning department.
- If it has been raining hard for several hours, or steadily raining for several days, be alert to the possibility of a flood.
- Listen to local radio or TV stations for flood information.
- Reduce Potential Flood Damage By . . .
- Raising your furnace, water heater, and electric panel if they are in areas of your home that may be flooded.
- Consult with a professional for further information if this and other damage reduction measures can be taken.

Floods Can Take Several Hours to Days to Develop

- A flood WATCH means a flood is possible in your area.
- A flood WARNING means flooding is already occurring or will occur soon in your area.

Flash Floods Can Take Only a Few Minutes to a Few Hours to Develop

- A flash flood WATCH means flash flooding is possible in your area.
- A flash flood WARNING means a flash flood is occurring or will occur very soon.

Prepare a Family Disaster Plan

- Check to see if you have insurance that covers flooding. If not, find out how to get flood insurance.
- Keep insurance policies, documents, and other valuables in a safe-deposit box.

When a Flood WATCH Is Issued . . .

- Move your furniture and valuables to higher floors of your home.
- Fill your car's gas tank, in case an evacuation notice is issued.

When a Flood WARNING Is Issued . . .

- Listen to local radio and TV stations for information and advice. If told to evacuate, do so as soon as possible.

When a Flash Flood WATCH Is Issued . . .

- Be alert to signs of flash flooding and be ready to evacuate on a moment's notice.

When a Flash Flood WARNING Is Issued . . .

- Or if you think it has already started, evacuate immediately. You may have only seconds to escape. Act quickly!
- Move to higher ground away from rivers, streams, creeks, and storm drains. Do not drive around barricades . . . they are there for your safety.
- If your car stalls in rapidly rising waters, abandon it immediately and climb to higher ground.

Saffir-Simpson Scale

The Saffir-Simpson Hurricane Scale is a 1-5 rating based on the hurricane's present intensity. This is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale, as storm surge values are highly dependent on the slope of the continental shelf and the shape of the coastline, in the landfall region. Note that all winds are using the U.S. 1-minute average.

Category One Hurricane:

Winds 74-95 mph (64-82 kt or 119-153 km/hr). No significant damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Some damage to poorly constructed signs. Also, some coastal road flooding and minor pier damage.

Category Two Hurricane:

Winds 96-110 mph (83-95 kt or 154-177 km/hr). Some roofing material, door, and window damage of buildings. Considerable damage to shrubbery and trees with some trees blown down. Considerable damage to mobile homes, poorly constructed signs, and piers. Coastal and low-lying escape routes flood 2-4 hours before arrival of the hurricane center. Small craft in unprotected anchorages break moorings. Hurricane Frances of 2004 made landfall over the southern end of Hutchinson Island, Florida as a Category Two hurricane. Hurricane Isabel of 2003 made landfall near Drum Inlet on the Outer Banks of North Carolina as a Category 2 hurricane.

Category Three Hurricane:

Winds 111-130 mph (96-113 kt or 178-209 km/hr). Some structural damage to small residences and utility buildings with a minor amount of curtainwall failures. Damage to shrubbery and trees with foliage blown off trees and large trees blown down. Mobile homes and poorly constructed signs are destroyed. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the center of the hurricane. Flooding near the coast destroys smaller structures with larger structures damaged by battering from floating debris. Terrain continuously lower than 5 ft above mean sea level may be flooded inland 8 miles (13 km) or more. Evacuation of low-lying residences with several blocks of the shoreline may be required. Hurricanes Jeanne and Ivan of 2004 were Category Three hurricanes when they made landfall in Florida and in Alabama, respectively.

Category Four Hurricane:

Winds 131-155 mph (114-135 kt or 210-249 km/hr). More extensive curtainwall failures with some complete roof structure failures on small residences. Shrubs, trees, and all signs are blown down. Complete destruction of mobile homes. Extensive damage to doors and windows. Low-lying escape routes may be cut by rising water 3-5 hours before arrival of the center of the hurricane. Major damage to lower floors of structures near the shore. Terrain lower than 10 ft above sea level may be flooded requiring massive evacuation of residential areas as far inland as 6 miles (10 km).

Category Five Hurricane:

Winds greater than 155 mph (135 kt or 249 km/hr). Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. All shrubs, trees, and signs blown down. Complete destruction of mobile homes. Severe and extensive window and door damage. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the center of the hurricane. Major damage to lower floors of all structures located less than 15 ft above sea level and within 500 yards of the shoreline. Massive evacuation of residential areas on low ground within 5-10 miles (8-16 km) of the shoreline may be required. Only 3 Category Five Hurricanes have made landfall in the United States since records began: The Labor Day Hurricane of 1935, Hurricane Camille (1969), and Hurricane Andrew in August, 1992. The 1935 Labor Day Hurricane struck the Florida Keys with a minimum pressure of 892 mb--the lowest pressure ever observed in the United States. Hurricane Camille struck the Mississippi Gulf Coast causing a 25-foot storm surge, which inundated Pass Christian. Hurricane Katrina (pdf), a category 5 storm over the Gulf of Mexico, was still responsible for at least 81 billion dollars of property damage when it struck the U.S. Gulf Coast as a category 3. It is by far the costliest hurricane to ever strike the United States. In addition, Hurricane Wilma (pdf) of 2005 was a Category Five hurricane at peak intensity and is the strongest Atlantic tropical cyclone on record with a minimum pressure of 882 mb.

2009 Atlantic Names

Ana
Bill
Claudette
Danny
Erika
Fred
Grace
Henri
Ida
Joaquin
Kate
Larry
Mindy
Nicholas
Odette
Peter
Rose
Sam
Teresa
Victor
Wanda

Press Release

Mayor of the city of _____

Hurricane Opal is rapidly approaching our area. I have been reviewing the situation and have come to a decision regarding forced vs. voluntary evacuations.

- **My decision is:**

- **The "Storm Surge" is a major worry for us. In case you do not know, here is what a storm surge is.**

- **Finally, here are a few facts you may find useful:**

1. **The center of a hurricane is called the _____.**
2. **Before becoming a hurricane, a system must first become a _____ storm.**
3. **Hurricane Opal crossed what a chain of islands, known as _____.**
4. **A hurricane causes most of it's death and destruction with _____.**
5. **Opal gained strength as it crossed the _____.**
6. **The winds at the very center of a hurricane are _____.**

This has been a difficult choice. I wish everyone the best of luck, and we can only hope that the storm spares our city.

Mayor _____.