

Flood Learning Module

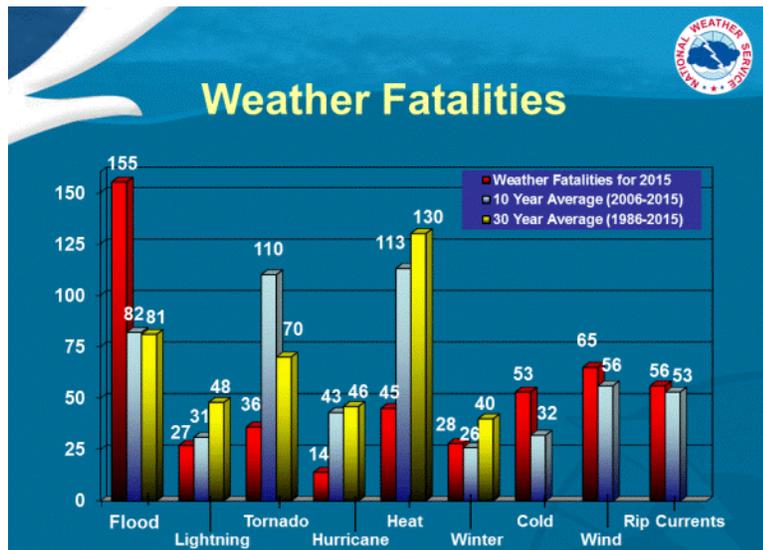


Figure 1. Statistics of weather fatalities in the United States.
[Source](#)

Flooding has had the highest annual average fatality rate of all hazardous weather types in the United States over the last 30 years. In Figure 1, the yellow columns indicate the 30-year average for deaths in the U.S. due to hazardous weather and flooding clearly stands out as the deadliest weather phenomenon in the U.S. Historically, flooding ranks second only to drought as the deadliest natural disaster worldwide and our goal in this learning module is first discover how and why flooding occurs, then learn about the three main types of flooding events and finish with flood safety.

Flooding

There is no place in the U.S. that does not experience flooding. The shaded regions on the map of the U.S. in Figure 2 show how flooding typically occurs in different part of the country. As you examine this map pay close attention to how geography plays a major role in flooding events. For example, if you lived in the Rocky Mountains, spring and summer thunderstorms can drench the rocky slopes of these mountains with several inches of rain. All that water will be pulled by gravity down the rocky slopes, which can quickly produce a flood that has the potential to wash out the valley below [1](#). Back in 1976, a flood like this did occur in Big Thompson Canyon in Colorado. One afternoon a storm dropped 6 inches of rain in a small amount of time over the mountains. As the water drained into the valley below, it produced a 15-foot wall of water that raced out of the canyon killing 144 people in a few minutes. To read more about this flood and others, watch this video:

[Floods in the U.S.](#) (6:18)

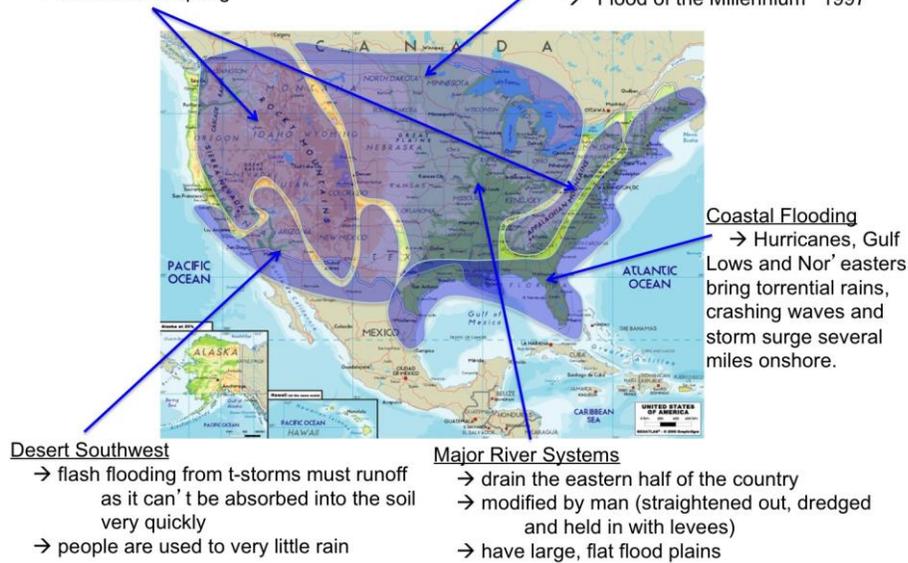
Flood Prone Areas in the US.

Mountainous Regions

- flash flooding that is topography induced
- snow melt in spring

Northern Rivers

- ice jams in spring
- “Flood of the Millennium” 1997



Coastal Flooding

- Hurricanes, Gulf Lows and Nor’ easters bring torrential rains, crashing waves and storm surge several miles onshore.

Desert Southwest

- flash flooding from t-storms must runoff as it can’t be absorbed into the soil very quickly
- people are used to very little rain

Major River Systems

- drain the eastern half of the country
- modified by man (straightened out, dredged and held in with levees)
- have large, flat flood plains

Figure 2. A map of the U.S. showing flood prone regions 1.

[Source](#)

Coastal Floods

The boundary between land and ocean is one of the most volatile boundaries on earth. In the United States, the East Coast gently slopes into the Atlantic Ocean and Gulf of Mexico, which makes it far more flood prone than the West Coast with abruptly juts out of the Pacific Ocean 1. As a result, any time a large low-pressure system like a hurricane or winter cyclone passes near the East Coast of the U.S., the topography makes it especially prone to flooding 2. For this lesson, let’s focus on **coastal flooding** that occurs due to a landfalling tropical cyclone like a hurricane.

Coastal Flooding (7:02)

Below is a meteorological summary of a coastal flooding event.

Onset	During landfalling tropical cyclones
Duration	These flooding events can last several days to several weeks (Hurricane Katrina (2005) produced flooding conditions for several months!)
Predictability	Can be predicted 1-7 days in advance. The National Hurricane Center tracks and forecasts tropical cyclones and can predict their landfall location several days in advance.
Coverage	Floodwaters from a hurricane can cover large regions like the size of a large state.
Who/What is affected?	Primarily coastal property, but these floods have often covered several hundreds of miles of land that is far from the shore.
Primary Cause	Slow moving tropical cyclones. The slower a hurricane moves, the more rain that can fall over the same area.
When do they typically occur?	Hurricane Season (June – November)

In 2008, Hurricane Ike set its site on the Houston, TX and began its journey to become the 3rd most costly hurricane in U.S. history (nearly \$40 billion spent on cleaning up after this storm). The left image in Figure 3 shows that the National Hurricane Center accurately projected the path of this hurricane up to 4 days in advance. When Ike made landfall on September 13, 2008, the eye of the hurricane passed over Galveston, TX and caused a lot of damage (see the Doppler radar image in Figure 3). Once the hurricane made landfall, it dropped enormous amounts of rain from the Texas coast all the way to Michigan! The left image in Figure 4 shows how the path of Ike's remnants eventually went straight over Champaign, IL and dumped over 4 inches of rain! The right image shows the Doppler radar estimated rainfall from Ike and it is clear that he produced rainfall totals greater than 4 inches over much of Texas, Missouri, Arkansas, and Illinois. To put this into perspective, the average monthly rainfall for September in central Illinois is about 3 inches of rain. Ike gave us 125% of our monthly rainfall in one day!

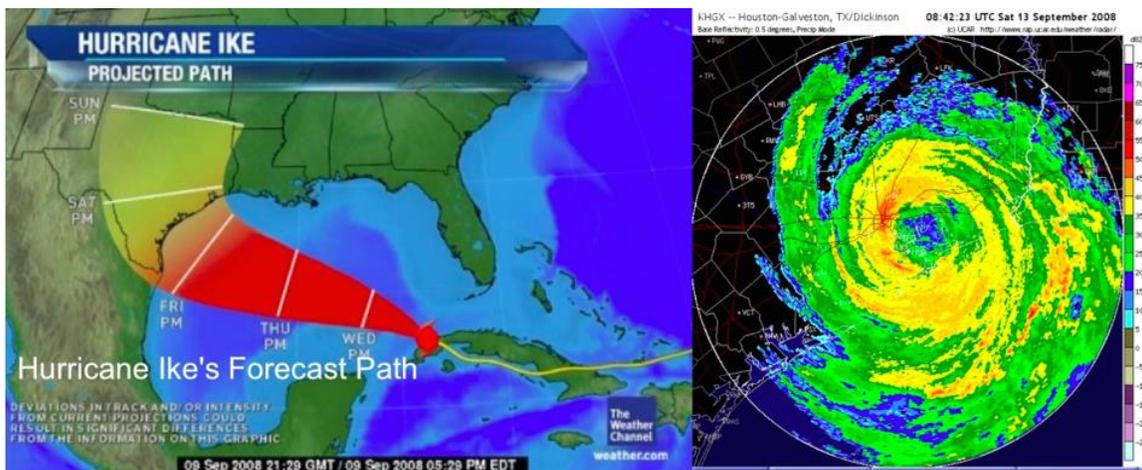


Figure 3. Left – Hurricane Ike's projected path. Right – NWS Doppler radar image of Ike at landfall 4.

[Source](#)



Figure 4. Left – Hurricane Ike's path. Right – Doppler radar estimated precipitation from Hurricane Ike 4.

[Source](#)

Widespread Floods

Of the three types of flooding we will learn about in the module, widespread flooding is the most costly and covers the largest area. **Widespread flooding** is often referred to as the “slow and leisurely disaster” because floods of this magnitude often take weeks or months to develop. Typically, a widespread flood will be associated with a major river system like the Mississippi River and when large river systems flood it is typically due to a variety of factors. Meteorological factors include snowmelt, high thunderstorm frequency, persistent weather patterns, and El Niño/La Niña **3**. Human factors include failed levee systems, broken dams, and poor land management **4**. Regardless of the cause, in this learning module we will focus on the flooding that occurs on the Mississippi River system. This river system is the largest in North America and drains nearly 40% of the land area in the U.S. Millions of people rely on this river, which is why it is so devastating when it floods.

Widespread Flooding (7:05)

Below is a meteorological summary of a widespread flooding event.

Onset	These floods develop slowly with a lot of advanced warning
Duration	These flooding events can last several weeks to several months.
Predictability	Very predictable but inevitable. The Hydrological Prediction Center uses a vast network of river gauges that predict when the rivers will reach their crest several days in advance. But, there is nothing that can be done to stop the flood once it starts.
Coverage	Floodwaters can cover very large regions like the size of a many states put together.
Who/What is affected?	Anyone living in the river’s flood plain or watershed. A watershed is the area around the river where any precipitation that falls in that area will eventually drain into the river.
Primary Cause	Persistent weather patterns. Often the weather patterns get “stuck” over some areas and bring a nearly constant supply of rain for several weeks.
When do they typically occur?	Any time of the year. Widespread floods often span multiple seasons.

In 1993, one of the worst floods in U.S. history developed along the Mississippi River. The flood began as the snow in Iowa, Minnesota, Wisconsin, and the Dakotas began to melt and drain into the river. As spring approached, several thunderstorms broke out across a stationary front draped across the Midwest (see Figure 5). After several weeks of rainfall combined with the snowmelt, the Mississippi River began to overrun its banks. During the height of the flood, Iowa had so much excess water that many referred to it as the “Sixth Great Lake”. When it was all said and done, 20 million acres were flooded in 9 states, 50,000 homes were submerged, 75 towns were inundated with water, 48 people had died and the economic losses reached \$20 billion. One of the major concerns during this flood was the health of the river’s levee system (see Figure 6). Ultimately, the failure in this levee system led to much of the devastation along the river. This flood became known as “Great Flood of 1993” and it was what meteorologist called a 500-year flood. A 500-year flood is one that has a 1 in 500 chance of happening in any given year **6**. This was truly a devastating event.

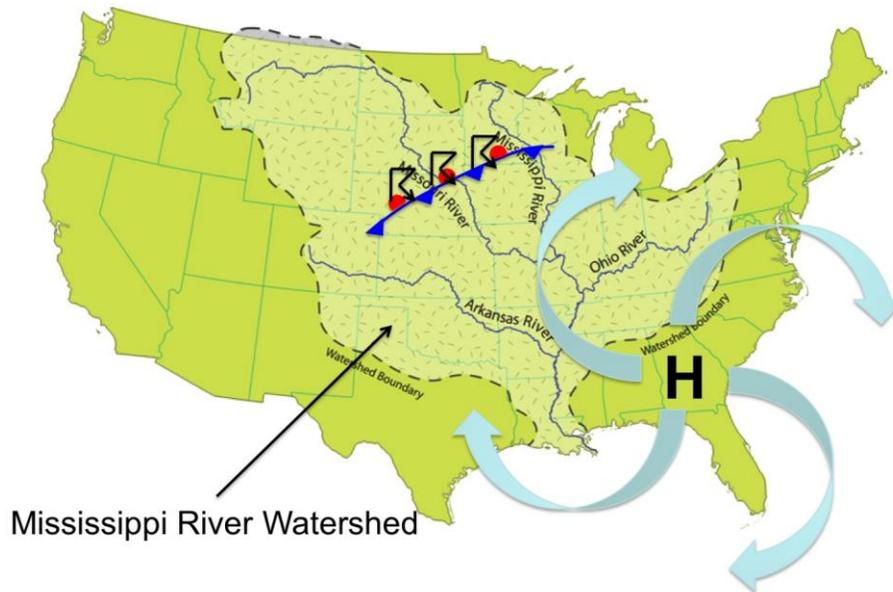


Figure 5. Meteorological factors of the “Great Flood of 1993.” [2](#)
[Source](#)

Great Flood of 1993



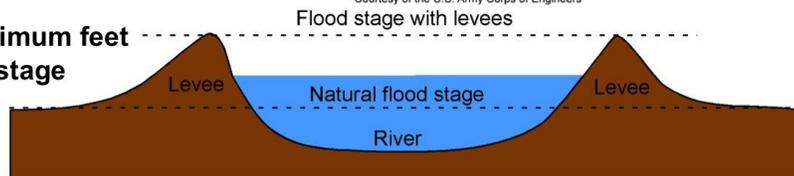
Keep the river from entering its natural flood plain

Flood Probabilities for Any Single Year	
“X”-Year Flood	Probability of Occurrence In a Year
5	20%
10	10%
20	4%
100	1%
500	0.2%



Courtesy of the U.S. Army Corps of Engineers

“crest” = the maximum feet above flood stage



© 2005 Kendall/Hunt Publishing

Figure 6. Top left – Before and after satellite images of the Mississippi River near St. Louis, MO [4](#). Top right – Flood probability chart [6](#). Middle right – A picture of a breached levee along the Mississippi River [5](#). Bottom right – A schematic of a levee system [5](#).

[Source](#)

Flash Floods

Flash floods are by far the deadliest type of flooding in the U.S. Unlike the coastal flooding or widespread flooding, flash floods can happen in an instant and catch you off guard. At the beginning of this lesson, the Big Thompson Canyon Flood of 1976 was discussed and hopefully through that story you are able to grasp the seriousness of a flash flooding event. As was the case in this story, most flash flood events are due to thunderstorms, but flash flooding may also occur due to things like a failing levee or dam break or rapid ice/snow melt. In this module, we will focus on flash flooding that occurs with thunderstorms. The worst-case scenario for thunderstorm flooding is when thunderstorms begin to “train”. Training thunderstorms are those that follow one another like the boxcars on a train. Since each storm is capable of dropping several inches of rain, getting repeatedly hit by thunderstorms can quickly produce flash flood conditions.

Below is a meteorological summary of a flash flooding event.

Onset	These floods develop rapidly and occur with little warning.
Duration	These flooding events typically last just a few hours or as long as a couple of days.
Predictability	Extremely difficult to predict in advance since they are due to focused and repeating thunderstorm activity.
Coverage	Very localized coverage like the size of a county.
Who/What is affected?	Anyone living near small rivers and streams, urban areas, flat open fields, mountain valleys and desert regions. Just about EVERYWHERE!
Primary Cause	Slow moving and/or training thunderstorms.
When do they typically occur?	March – September (Thunderstorm season in the U.S.)

To understand the power and diversity of the flash flood let’s look at a few different scenarios. We have already learned about the mountain-valley flash flood situation in Big Thompson Canyon, so let’s investigate a flood that occurred due to repeated thunderstorm training. In the video below, you will watch a flood in Australia. When the video starts, you would be led to think that there is always water flowing through the creek in the video, but in reality, this raging river is normally just a ditch. Upstream, training thunderstorms repeatedly dropped rain over the area this ditch drains and after a few minutes, what was once a grassy depression near a parking lot has turned into a deadly flash flood [5](#).

[Toowoomba Floods in Australia](#) (5:55)

The next video shows what happens when training thunderstorms hit a man-made lake in Wisconsin [5](#). As the water levels began to rise in Lake Delton, the dam holding them back burst! As the water rushed out of the lake many houses were carried along with it.

[Lake Delton Flood](#) (3:25)

Urban areas are also prone to flash floods. Large cities are made of materials like concrete, metal, and asphalt, which water cannot soak into 5. If a thunderstorm rolls through that produces several inches of rain, a city’s storm sewer system may not be able to keep up! In the next video, you will see how the landscape of a city makes it extremely vulnerable to flash floods.

[Melbourne Flood](#) (2:18)

Finally, the most important thing to remember during a flooding event is to **NEVER** drive through floodwaters. The motto you should always obey is “turn around, don’t drown.” To demonstrate why this is important, watch this last video! It only takes 6 inches of water for an adult to get knocked off their feet, and only 2 feet of water to wash away most vehicles!

[Road Washout](#) (3:15)



[Source](#)

Pre-Class Activity 11

Instructions: Before teaching about floods, have the students answer the questions below, followed by a scenario question for in-class discussion between you and your students.

1. How many inches of water does it take to wash a car/truck away?
 - a. 6 inches
 - b. 8 inches
 - c. 12 inches
 - d. 24 inches
 - e. 50 inches

2. How many inches of water does it take to wash you away?
 - a. 6 inches
 - b. 8 inches
 - c. 12 inches
 - d. 20 inches
 - e. 50 inches

3. Which of the following is not a type of flooding?
 - a. Coastal flooding
 - b. Agricultural flooding
 - c. Widespread flooding
 - d. Flash flooding

Discussion Question: A hurricane is approaching and is forecasted to have rainfall rates of 1 inch per hour, and even worse, it is expected to stall over your area! Within 24 hours, you notice water levels rising and turn on the news to see what's happening. You see live footage of flooding of a nearby river and cars being washed away by the powerful waters. What types of preparation should you take in your home?

In-Class Activity

Severe Weather Situation: Floods

Instructions: In this project, your group will forecast and prepare for a flooding event in the U.S. Each group member will choose one of the following roles and complete the tasks written at the end of each section.

1. Meteorologist
2. City Mayor
3. Homeowner (Citizen)
4. School Principal

Real World Application: Meteorologist 4, 7

Task #1

Doppler radar is one of the best tools meteorologists have to estimate the intensity and amount of precipitation. Doppler radar images use color-coded maps, like those below, to show the coverage and intensity of precipitation. The color bar assigned to each Doppler radar image can indicate how heavy it is raining, but it can also be used to estimate how much rain will fall over a one-hour time span. Your task is to estimate the amount of precipitation falling in each of the three radar images below, using the chart in Figure 1.

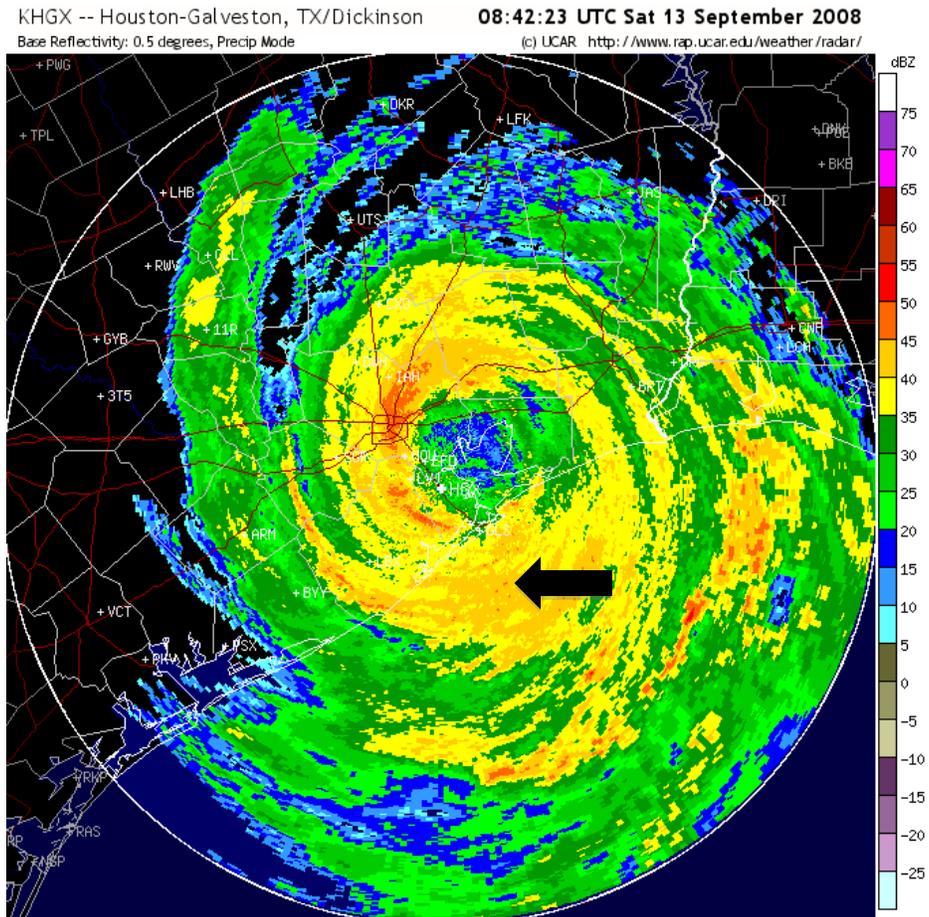
Approximate conversion of radar reflectivity to rainfall rate

Radar Reflectivity (dBZ)	Rainfall Rate (inches/hr)
65	16+
60	8.0
55	4.0
52	2.5
47	1.3
41	0.5
36	0.3
30	0.1
20	trace



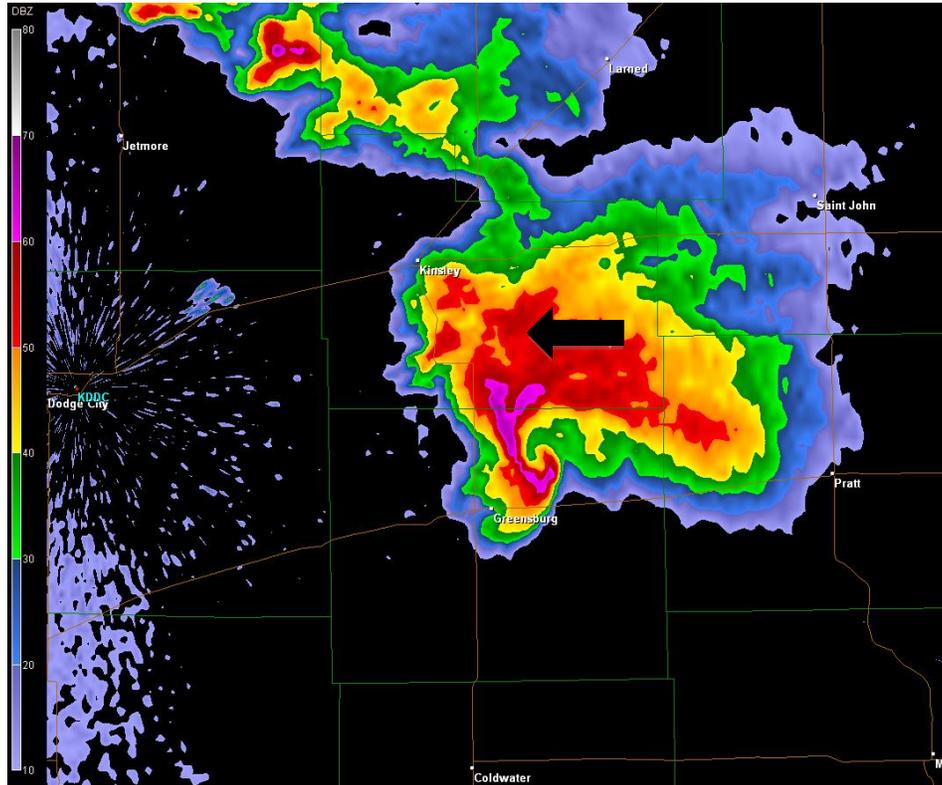
Figure 1. A chart that relates the intensity of the rainfall (measured in dBZ) to a rainfall rate (measured in inches/hour)

Case #1: The image below is of Hurricane Ike at landfall. Use the chart above, along with the color bar on this radar image to estimate how much rain will fall in 3 hours over the location indicated with a black arrow.



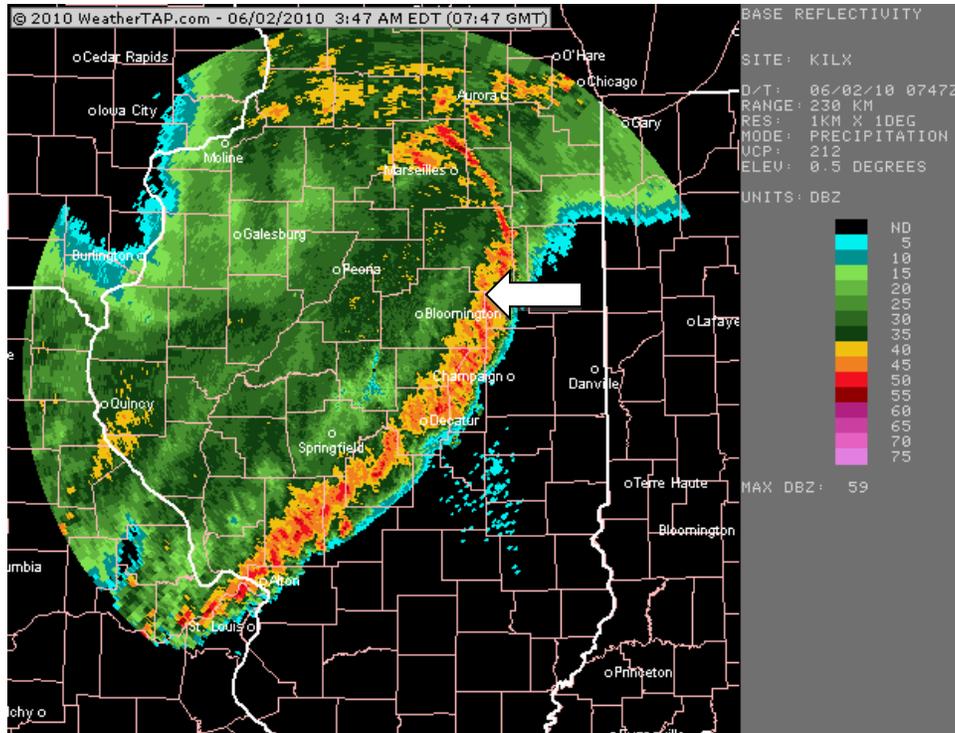
3-hr Rainfall Total _____

Case #2: The image below is of a supercell thunderstorm in Kansas. How much rain will fall in 1 hour at the location indicated by a black arrow?



1-hr Rainfall Total _____

Case #3: Below is a radar image from a line of storms that passed quickly through Champaign, IL. If these storms were only over Champaign for 30 minutes, how much rain would have fallen at the location indicated by a white arrow?



30-min Rainfall Total _____

Task #2

One of the best tools for monitoring widespread flooding events is the national river gauge network. Your task is to first navigate to <http://water.weather.gov/ahps/> and then indicate on the blank map below regions that are experiencing “minor”, “moderate” and “major” flooding. To do this, simply place a small square on your map for any location experiencing “minor” flooding according the website. Place a small triangle on the map for those rivers experiencing “moderate” flooding and a circle for those locations experiencing “major” flooding. Finally, pick one river site on the webpage that is experiencing major flooding and click on the purple box to reveal the river gauge data. Read the river gauge data carefully and write down the date, time, and current depth of the river.



Task #3

As a meteorologist, it is important that you learn to properly convey weather information to the general public. Your task is to create a 5-minute weather broadcast, like you might see on the Weather Channel, describing the three types of flooding. Remember that your classmates will not know much about what you have just learned so be sure to address the following topics in your broadcast:

1. Convey statistics about flooding in the U.S. (fatalities, etc.)
2. Discuss the three main types of flooding in detail.
3. Show some of the videos that are linked above.
4. Explain how Doppler radar is used to monitor a flood.
5. Explain how no place in the US is safe from floods.
6. Show the students the river gauge network and explain how to use the website.
7. Tell a story about a flood.

Build this weather broadcast using presentation software (like PowerPoint) and be sure to supplement everything you discuss with images and videos. Your teacher has access to several videos and pictures of floods so make sure to use your teacher as a resource as well as the Internet. Be sure both informative and entertaining!

Real World Application: Mayor

Before:

You are the mayor of the town Grafton, IL in Jersey County, which is located along the Mississippi River. The river has floodwalls and levees to prevent slight flooding. Early in the morning, you receive a call from the local weather station that a flash flood is about to occur.

1. If you knew that Grafton floods easily, how would you educate the public on flood prevention, procedures, and evacuation plans?
2. How would you communicate to your city about this upcoming flood?
3. Since Grafton has levees and floodwalls, do you think that they should be reinforced with any types of materials (like sandbags)?
 - If so, who do you think would be the best for completing this job? Businesses or community members?
4. What businesses would you contact to have on hand in order to prevent the following from happening: low food supplies, road flooding and blockage, unsanitary water supply, and public harm?

During:

By afternoon, the Mississippi River has now risen 5 feet and the levees have broken. Some streets are flooding but most only have a couple inches of rain. The storm has knocked out power lines, and citizens of your town are starting to panic.

5. How would you control the chaos that has erupted throughout the town?
6. How would you communicate now since the power is out?
7. With roads closing and power outages, how would you get emergency help throughout the town?
 - What buildings would you give most attention and priority to during the flood?
8. Once most roads are blocked and about 6 inches of water has flooded the others, how would your evacuation plan change in order to get the public to safety?
9. What signs would lead you to involve the National Guard or FEMA (Federal Emergency Management Agency) in order to maintain the safety of the public?

After:

Days have passed and the floodwaters have gone down to a manageable level. Many of the houses were destroyed from water damage. Roads are filthy and debris covers your town.

10. Before citizens return, what kinds of services would be needed to clean up the city?
 - Would you hire companies or request that citizens help in this process?
11. Since many of the houses are damaged and are inhabitable, in what ways would you provide your citizens' basic needs? Food, water, shelter?
12. Who would you need to hire to regain electricity and power?
13. Would you keep the government involved in the clean up process and request federal funding for this project?
14. What would you do to prepare for a future flood event?

Task

Your task is to record an interview of your plans and safety procedures from the questions listed above. You will need a partner to act as the new reporter, while you act as the mayor on a live news broadcast. Be creative with your responses and remember to ensure your town's safety at all times.

Real World Application: Citizen

Before:

You are married, have two kids, and a dog. You live in a two-story house with a belowground, finished basement. During storms, your basement floods frequently. While watching TV, a Flood Watch appeared on the screen and Jersey County was included.

1. Knowing that your basement floods, how would you prepare and protect the valuables in your basement?
2. Since electricity and water is a harmful combination, what would you turn off in your basement to prevent danger?
3. If you were to prepare a flood kit, what essential items would you include?
4. If your basement does flood, what is your plan of action to contain floodwaters?

During:

By afternoon, floodwaters are beginning to rise in your basement. You have been trying to bucket it out, but it keeps advancing faster than you can maintain. The roads are filling with water, and it is becoming time to decide whether or not to evacuate your home until it passes.

5. Do you think it is safe to wait it out? Or do you think evacuation is necessary?
6. What are some reasons that compel you to evacuate?
 - What would be your possible evacuation plan be taking into account your family situation?
7. If you were to evacuate, what are some important items that you need to bring with you?

After:

You decided to evacuate and are now returning home. Once there, you see that your basement is destroyed and that it is not safe for living. Water reached most of your belongings and your necessary resources are depleted.

8. Think of 3 hidden dangers your property may contain after the flood.
 - Who would you contact to alleviate these problems?

9. Do to your house being inhabitable, where do you plan to stay?
 - What are steps that you need to take to restore your house back to its livable condition?
10. What are you going to do in order to replace valuables lost in the flood?
11. What are some things that your family will need in your temporary shelter in order to live comfortably?

Task

Your task is to create a one page Home Survival and Evacuation Plan for your family, using the conditions from the “**During**” section. You will be presenting this to your class.

Make sure to include the following in your plan:

1. Valuables
 - a. Personal belongings
 - b. Important documents
 - c. Your family’s essential needs
2. Modes of transportation
3. Destination
4. Different routes you will take due to flooding
5. Preparing your home to be left unattended
6. Which exits of your home to use due to possible damage

Real World Application: School Principal

Before:

You are the principal of Grafton Elementary School. It is Monday morning and school is in session. You have just received a phone call that a flood watch is in effect for Jersey County until about 5 pm.

1. How would you prepare your faculty in order to be knowledgeable about flood safety and procedures?
2. What activities do you have to restrict from the students that would happen in a normal school day?
3. What are some main safety hazards that you would make your students aware of?
4. How are you going to communicate with your faculty and students in order to maintain safety?
5. How would you ensure parents that their child is safe and that you are prepared for a flood?

During:

The storm has intensified, and the levees have been broken. Water is starting to come into the exit doors and it is not safe for classroom activities to occur on that level. It is time to begin a plan of action.

6. Where are you going to direct all the children to go?
 - If your school were one story, where would be the safest place to go?
 - If two stories?
7. How would you keep the students occupied and calm while the storm is developing?
8. How much information would you disclose to the students about the situation? Keep in mind that you do not want to scare them.
 - Would you treat each grade differently due to maturity levels?
9. Would you allow the kids to bring any items with them?
10. What valuable items would you, as the principal, need to have with you at all times?
11. At the end of the day, how would you evacuate students safely home while maintaining chaos levels?

After:

The storm has passed and you have had to close down the school for a couple days. When it is safe to return, you see that much of the first floor is slightly damaged. Most supplies are no longer useful.

12. What would you need to clean up the school in order for instruction to begin?
 - a. Floodwaters have filled the drainage system. What do you need to do in order for bathrooms and sinks to be back in working order?
 - b. Your food supplies have spoiled and you did not take into account this disaster into your budget. How are you going to provide food for your students?
 - c. If some of the daily materials were destroyed, how would you ration what school supplies you have left for teachers and students to use before you can afford to restock?
 - d. Your custodial staff is too small to tackle this project on their own, who would you call to help repair the school?
13. How do you convince parents that your school will be ready for instruction to begin soon?
14. How would you plan your calendar year for the missed days due to the flood?

Task

Your task is to create a one-page statistics and survival guide to be displayed and posted on the school website and bulletin board for your school. Make sure it clearly shows the safety plan to communicate to faculty and students where to go and what to do in this event. Be creative and thorough by including pictures and graphs!

Take Home Assignment

Part 1. U.S. River System 4, 6, 8

Instructions: Click the link below and scroll through the activity slides to learn more about the U.S. River System and watersheds. Draw and label the location of the Mississippi River on the U.S. map and answer the following questions.

[U.S. River System \(National Geographic\)](#)



Questions

1. How many watersheds are there in the United States?

2. What is the name of the watershed in which you live?

3. What type(s) of flooding do you expect to typically occur in your watershed?
Explain your reasoning.

4. A 500-year flood has a 0.2% chance of occurring on any given year. Using the probability of occurrence example for a 500-year flood below, what is the probability that a 25-year flood will occur next year?

Example: Probability of Occurrence = $1/500 \times 100\% = 0.2\%$

Probability of 25-year flood: _____

5. Which has a greater chance of happening: a 25-year or a 50-year flood? Briefly explain your reasoning.

6. Which is more severe: a 25-year or a 50-year flood?

Part 2. Matching 11

Instructions: Fill in the blank with the type of flooding (Coastal, Flash, Widespread).

1. This type of flooding is usually associated with a major river system and can take weeks to months to develop. These events are very predictable, but inevitable. This type of flooding can occur any time of the year and is a result of a number of meteorological and human factors. It is the most costly and covers the largest area.

2. This type of flooding is a result of slow moving hurricanes and/or large wintertime cyclones. These flooding events can last several days to weeks. This type of flooding can be predicted days in advance to the event.

3. This is the deadliest type of flooding. These floods occur very quickly and with little warning. They are associated most often with thunderstorms and can be very difficult to predict in advance.

Part 3. Short Answer 1, 5, 6

1. Name three flood prone regions in the United States.

1. _____

2. _____

3. _____

2. Briefly explain how flooding can occur even in the desert.

3. Using the 30-year average, how does flooding rank in terms of deadliest weather in the United States? What aspect of flooding causes the most fatalities?

4. What is the famous motto when it comes to flood safety?

5. What are some human factors that may contribute to flooding? List three.

1. _____
2. _____
3. _____

6. What is a 500-year flood?

Student Evaluation 1, 4, 6, 9, 11

Instructions: After completing the lesson on flooding, please have the students answer the following questions below.

1. Flooding occurs in every state across the U.S. T F

2. Flooding is one of the most deadly weather phenomena. T F

3. It takes 5 feet of water to wash away a full size vehicle. T F

4. Which of the following regions is most prone to coastal flooding?
 - a. Topeka, KS
 - b. New Orleans, LA
 - c. Phoenix, AZ
 - d. St. Louis, MO

5. Which of the following regions is most prone to widespread flooding?
 - a. Topeka, KS
 - b. New Orleans, LA
 - c. Phoenix, AZ
 - d. St. Louis, MO

6. Which of the following regions is most prone to flash flooding?
 - a. Topeka, KS
 - b. New Orleans, LA
 - c. Phoenix, AZ
 - d. St. Louis, MO

7. What instrument helps meteorologists measure precipitation intensity and 1-hour rainfall totals?
 - a. Satellite
 - b. Rain gauge
 - c. River height gauge
 - d. Doppler radar

8. What is a training thunderstorm?
 - a. Several storms that line up and repeatedly produce immense amounts of precipitation in one area
 - b. A single storm that moves very quick like a train
 - c. A storm that precedes the official start of thunderstorm season
 - d. Any thunderstorm that causes widespread flooding across state borders

9. Name three types of weather events that lead to flooding and the type of flooding that they are associated with.

Weather Event _____

Type of Flooding _____

Weather Event _____

Type of Flooding _____

Weather Event _____

Type of Flooding _____

10. What is the probability of occurrence of a 125-year flood during any given year?

- a. 0.008%
- b. 0.08%
- c. 0.8%
- d. 8%

Common Core State Standards (CCSS) Initiative

To learn more, visit <http://www.corestandards.org>

Next Generation Science Standards (NGSS)

To learn more, visit <http://www.nextgenscience.org>

The following academic standards are met in this learning module:

1. [NGSS.MS-ESS2-4](#)

MS-ESS2-4. Earth's Systems
Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
Lecture: Flooding & Coastal Flooding; Take Home Assignment: Part 3; Student Evaluation

2. [NGSS.MS-ESS2.5](#)

MS-ESS2-5. Weather and Climate
Provide evidence for air pressure systems and resulting weather conditions.
Lecture: Coastal Flooding, Widespread Floods

3. [NGSS.MS-ESS2-1](#)

MS-ESS2-1. Earth's Systems
Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
Lecture: Widespread Floods

4. [NGSS.MS-ESS3-2](#)

MS-ESS3-2. Human Impacts
Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
Lecture: Coastal Floods, Widespread Floods; In-Class Activity: Severe Weather Scenario; Meteorologist; Take Home Assignment: Part 1; Student Evaluation

[**5. NGSS.MS-ESS3-3**](#)

MS-ESS3-3. Human Impacts
Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.
Lecture: Widespread Floods, Flash Floods; Take Home Assignment: Part 3

[**6. CCSS.MATH.CONTENT.7.SP.C.5**](#)

Grade 7: Statistics and Probability
Investigate chance processes and develop, use, and evaluate probability models.
Lecture: Widespread Floods; Take Home Assignment: Part 1 & 3; Student Evaluation

[**7. CCSS.MATH.CONTENT.7.RP.A.1**](#)

Grade 7: Ratios and Proportional
Analyze proportional relationships and use them to solve real-world and mathematical problems
In-Class Activity: Severe Weather Scenario: Meteorologist

[**8. CCSS.ELA-LITERACY.RST.6-8.3**](#)

Grade 6-8: Science and Technical Subjects
Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
Take Home Activity: Part 1

[**9. CCSS.ELA-LITERACY.RST.6-8.8**](#)

Grade 8: Science and Technical Subjects
Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
Student Evaluation

10. CCSS.ELA-LITERACY.RST.6-8.7

Grade 6-8: Science and Technical Subjects
Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
Video lectures

11. CCSS.ELA-LITERACY.RST.6-8.4

Grade 6-8: Science and Technical Subjects
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific science or technical context relevant to grades 6-8 texts and topics.
Lectures: Bolded text ; Pre-Class Activity; Take Home Assignment: Part 2; Student Evaluation