

Bomb Cyclones and Flash Flooding

Background Information

Bomb cyclones, also known as explosive cyclogenesis, are intense weather systems over a vast area characterized by a rapid drop in atmospheric pressure. These storms can bring severe weather conditions, including heavy rainfall, heavy snowfall, hurricane force winds, and flash flooding. On average, about 10 bomb cyclones occur each year in the Northern Hemisphere. Flash floods are particularly hazardous because they occur quickly and with little warning, making them difficult to predict and prepare for.

Vocabulary

- **Bomb Cyclone:** A rapidly intensifying storm that drops at least 24 millibars of atmospheric pressure in 24 hours.
- **Flash Flooding:** Sudden floods are usually caused by heavy rainfall that can occur within minutes or hours.
- **Runoff:** Water that flows over the ground surface rather than being absorbed into the ground.
- **Atmospheric Pressure:** The force exerted by the weight of the air above us.
- **Precipitation:** Any form of water - liquid or solid - falling from the sky, including rain, sleet, snow, and hail.
- **Meteorology:** The science dealing with the atmosphere and its phenomena, including weather and climate.
- **Hydrology:** The science concerned with the properties of the earth's water, especially its movement in relation to land.

Guiding Questions

- What are the main characteristics of a bomb cyclone?
- How does a bomb cyclone lead to flash flooding?
- What are the safety measures people should take during a flash flood?
- How do meteorologists predict and track bomb cyclones?
- What environmental factors contribute to the severity of flash flooding during a bomb cyclone?

Objectives: To understand how urban planning and infrastructure affect the impact of flash flooding during a bomb cyclone and explore the interaction between these powerful storms and the environment, focusing on the causes and effects of flash flooding

Part 1: Investigation Chart: Complete the chart by conducting research to learn more about bomb cyclones

Aspect	Observation	Analysis
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Weather Patterns	<i>Identify changes in pressure and wind that occur with bomb cyclones</i>	<i>Determine the likelihood of a storm- what has to happen in order for a storm to occur?</i>
Location of Bomb Cyclones	<i>Where do bomb cyclones mostly occur in the US?</i>	<i>List as many as you can find in the US</i>
Time of Year of Bomb Cyclones	<i>When do bomb cyclones most occur in the US?</i>	<i>Why do you think it happens this time of the year?</i>
Impact	<i>What was the impact of the bomb cyclones? Give a generalization of damage and impact.</i>	<i>Pick one bomb cyclone and go in depth about the destruction</i>

Part 2: Investigation: Bomb Cyclones and Flash Flooding

Objective: Understand how urban planning and infrastructure affect the impact of flash flooding during a bomb cyclone

Materials:

- Cardboard or foam board for base
- Small boxes or blocks to represent buildings
- Aluminum foil or plastic wrap for roads and surfaces
- Sponges or cotton balls for natural areas
- Watering can or spray bottle for simulating rain and flood
- Markers and labels

Procedures:

1. Design the Town/City Layout:

- a. Use cardboard or foam board as the base.
- b. Arrange boxes or blocks to create buildings, placing them strategically.
- c. Lay aluminum foil or plastic wrap to represent roads and paved surfaces.
- d. Use sponges or cotton balls to represent parks, gardens, and other natural areas.

2. Simulate a Bomb Cyclone:

- a. Slowly pour water over the model using a watering can or spray bottle to simulate heavy rainfall.
- b. Observe how water flows through the town, noting areas of pooling, flooding, and runoff.

3. Modify the Model:

- a. Adjust the placement of buildings, roads, and natural areas to see how different layouts affect water flow and flooding.

Observation Ideas:

Record which areas of the model flood first.

Note how quickly water drains from different parts of the model.

Observe the impact of changing infrastructure on water flow.

Observation Area	Initial Flooding	Water Drainage Speed	Changes After Modification
Residential Zone			
Commercial Zone			
Parks and Gardens			
Roads and Highways			

Conclusion Questions:

1. What areas of your town or city were most affected by flooding? Why do you think this happened?
2. How did changing the layout of buildings and roads affect the flow of water?
3. What strategies can urban planners use to mitigate the effects of flash floods in real cities?
4. How do natural areas, such as parks and gardens, impact water drainage during heavy rainfall?
5. What additional factors might influence the severity of flash flooding in a real-world scenario?

Career Connections

- Meteorologist: Specializes in weather prediction and climate analysis.
- Hydrologist: Studies the movement, distribution, and quality of water in the Earth.
- Emergency Management Specialist: Plans and coordinates emergency response strategies.
- Environmental Scientist: Analyzes environmental problems and develops solutions.

Next Generation Science Standards (NGSS)

MS-ESS2-4: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.

This investigation is designed to engage students in critical thinking and problem-solving while exploring the fascinating and complex interactions between severe weather phenomena and environmental impacts.