# Blizzard Learning Module

Source

In the United States, there are over 1.4 million car accidents each year that occur due to frozen precipitation. These accidents cause over 600,000 injuries and 7,000 deaths. Frozen precipitation is responsible for about 20% of all weather-related deaths, so it is clear why we must learn how a blizzard forms in wintertime low-pressure systems. In this learning module, we will first uncover the meteorology of a blizzard and then discuss winter storm safety, but first check out this video!

**2010 Blizzard Time Lapse** (0:37)

## Ingredients for a Blizzard

We can see from the criteria above that blizzards are a dangerous combination of wind and snow, but how does a blizzard form? The following are three primary features that cause blizzards to form in the US:

- The Rocky Mountains
- Cold Canadian Air
- A Developing Low-Pressure System

To see why these features are important, watch this video: **Blizzard Formation** (5:18)

The National Weather Service (NWS) will issue a **blizzard warning** if all four of the following conditions are met:

1. Falling or blowing snow.
2. Wind speeds must be at least 35 mph.
3. Visibility must be reduced to ¼ mile or less.
4. These 3 conditions must be forecast to last at least 3 hours.

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## Ingredients for a Blizzard: The Rocky Mountains

One of the most important geographic features for blizzard formation in the U.S. is the Rocky Mountains. The Rocky Mountains stretch from Alaska to Mexico and divide the west from the east (see Figure 1). The Rockies are very tall extending 10,000 to 20,000 feet into the atmosphere. Because they are so tall, they are very effective at controlling the behavior of the wind in the lower atmosphere. When it comes to a making a blizzard, these mountains play two important roles. First, they are very effective at blocking the warm, moist air from the Pacific Ocean. Second, this mountain chain can act like a funnel by guiding very cold air southward from Canada into the U.S. By blocking the warm air from the west and channeling cold air southward from Canada, these mountains set up the battleground for the blizzard.

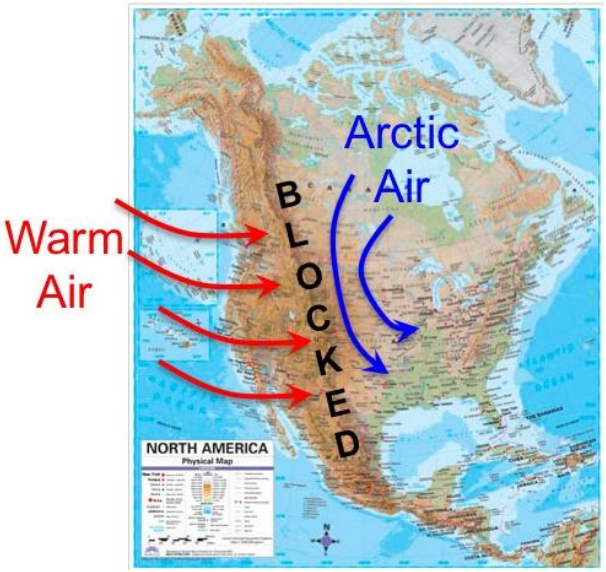


*Figure 1. Topographic map of North America showing how the Rocky Mountains influence the airflow.*
Source

## Ingredients for a Blizzard: Cold Canadian Air

A crucial ingredient for the formation of snow is sufficiently cold air. In the U.S., our cold air comes from the northern latitudes, and specifically Canada. Why is Canada so cold in winter? First, much of the eastern two-thirds of this country are vast open plains, much like the middle part of the U.S. In winter, Canada is so far north, that the Sun is not able to warm the wide-open prairie very effectively. In fact, throughout winter in Canada, more energy is lost from the ground than is supplied by the sun. Since most of Canada is north of 50°N latitude, the sun is ineffective at heating the ground. This is due to two things [1].

1. In winter, the sun angle (the number of degrees of elevation from the horizon to the sun) is very low. As a result, even at noon the sun is not very high in the sky. The lower the sun angle, the more indirectly the sun energy hits the earth. This spreads the energy of the sun out over a large area rather than concentrating it over a smaller area causing it to be cooler. (Figure 2) [1].

2. Daylight hours in Canada in winter are very short. Due to Canada's high latitude, the sun rises late and sets early. Therefore the Sun's path across the sky is very short and does not take much time to complete. As a result, in a typical 24-hour day, some parts of Canada will only see the sun for a few hours. In fact, on the Winter Solstice (December 21) the sun won't even rise for any location north of 66.5°N! Figure 2 on the next page shows a picture of the sun every hour for a full day if you were standing on the South Pole in the middle of summer. This picture explains why even in summer it is cold at high latitudes. Even though the sun is out for 24 hours, the angle is so low in the sky that the energy is spread to thin to warm up the surface [1].

The combination of a low sun angle and short days in winter allows the ground to cool very efficiently. As a result, a very dense and cold air mass forms over the Canadian Prairie. Meteorologists identify this air mass as a high-pressure system. This high-pressure system will be very important in making the snow and winds we need to form a blizzard [2].

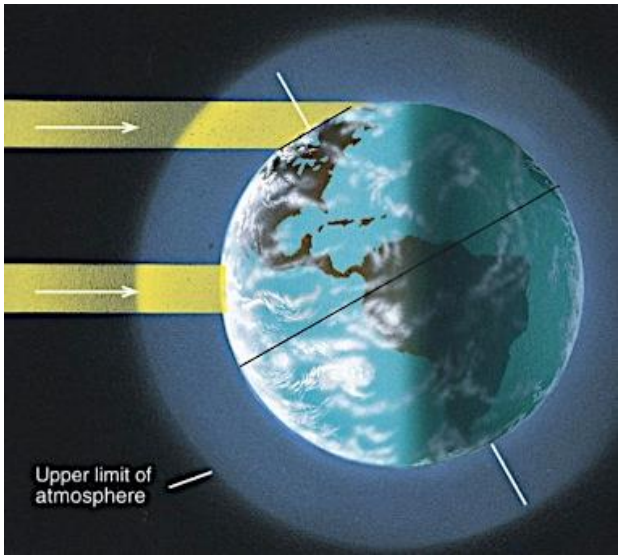


*Figure 2. Top – A schematic showing how the sun's energy flux changes with latitude. Bottom – A picture of the sun every hour for a whole day in the middle of summer taken from the South Pole* [1].

Source

## Ingredients for a Blizzard: Developing Low-Pressure System

We have established that the Rocky Mountains are very effective at channeling the cold air and high air pressure that forms in Canada southward into the U.S. However, to make a blizzard we need a strong low-pressure system to form. Low-pressure systems (Figure 3 and 4) are characterized by having a centrally located region of low air pressure and wind that spirals into this low-pressure center in a counterclockwise direction. These wintertime cyclones produce a variety of precipitation including thunderstorms, heavy rain, freezing rain, sleet, and snow (see Figure 3 on the next page for the distribution of precipitation around a low-pressure system).

The heaviest snow and best blizzard conditions happen to the northwest of the low-pressure system where the cold air from Canada, that was channeled south by the Rocky Mountains, undercuts warm air being transported north from the Gulf of Mexico by the low-pressure system. Meteorologists refer to the region where heavy snow and blizzards form as the "wrap around region" which is depicted in Figure 4. The two most common low-pressure systems that make blizzards in the Midwest are the "Colorado Low" which starts in Colorado and the "Alberta Clipper" which starts in Alberta Canada. As these cyclones traverse the U.S., heavy snow and blizzards form to the northwest of their tracks. This is why North and South Dakota have the most frequent blizzards in the U.S. (see Figure 4) [2, 3].

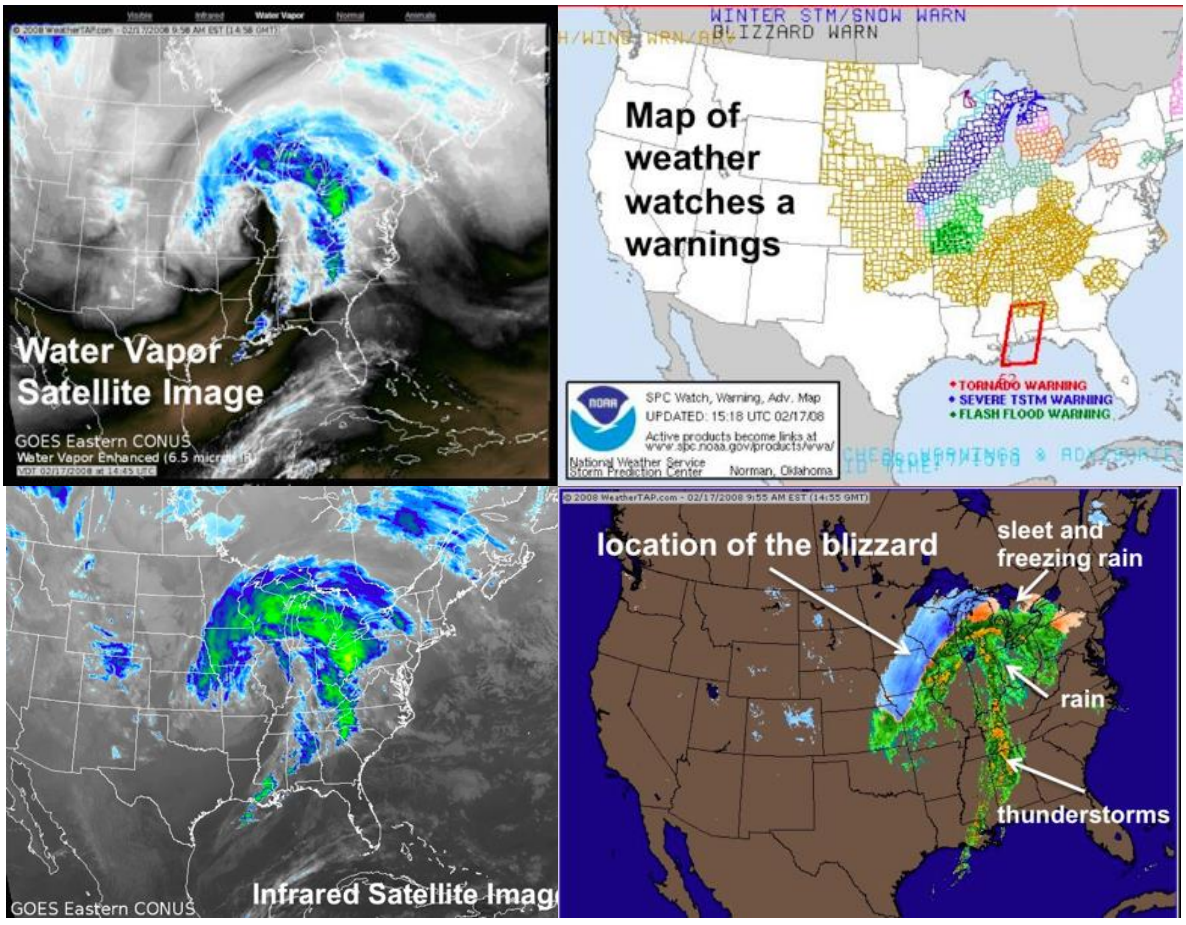


*Figure 3. Top left – An infrared satellite image of a low-pressure system. Bottom left – A water vapor satellite image of a low-pressure system. Top right – A radar image of a low-pressure system with precipitation type color coded and labeled. Bottom right – A map of weather warnings, watches and advisories.*

Source

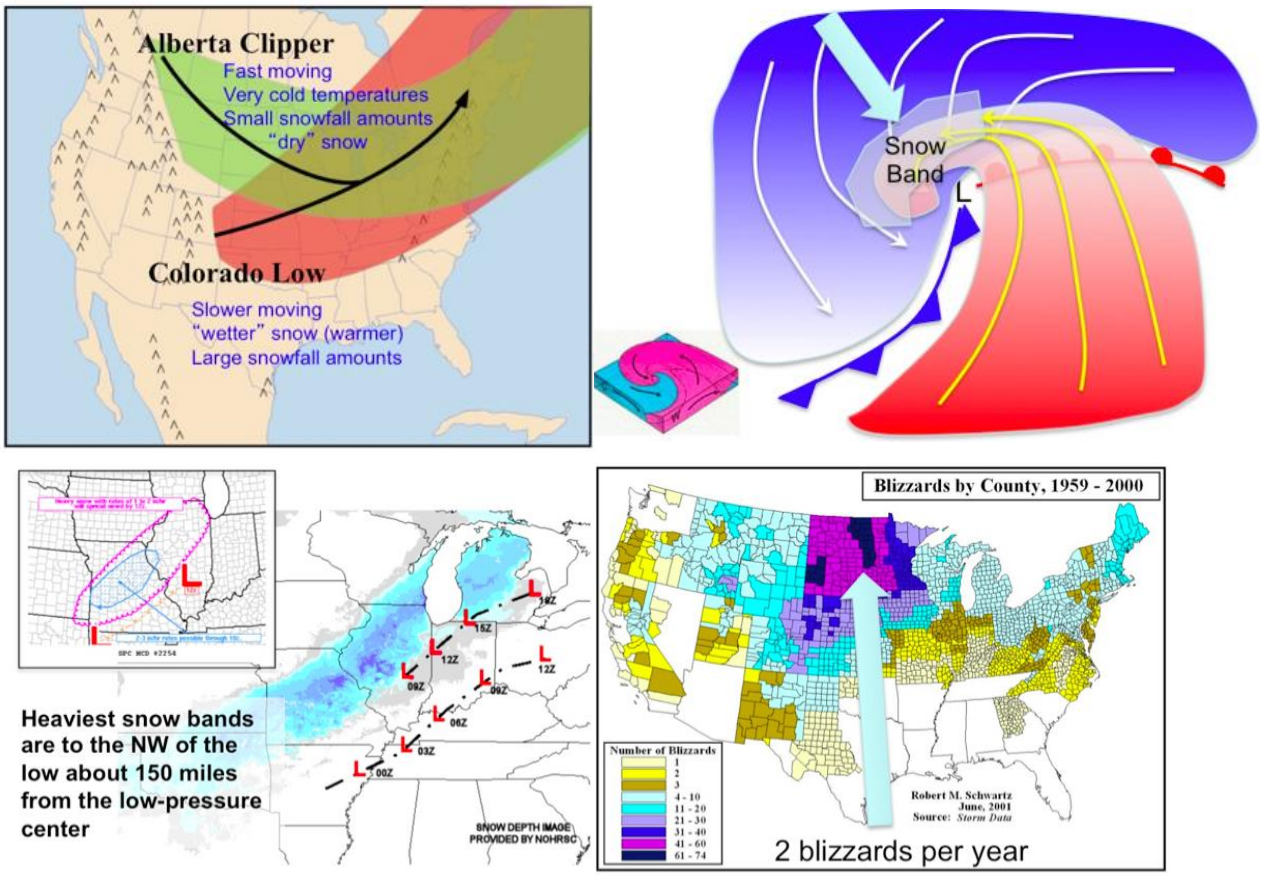


*Figure 4. Top left – A map showing the tracks of the Alberta Clipper and Colorado Low, which are two low-pressure systems. Top right – A schematic of a low-pressure system with cold front, warm front, warm air mass, cold air mass and "wrap around region" labeled. Bottom left – A map showing that the heaviest snowfall in low-pressure system falls to the northwest of the low-pressure center. Bottom right – A map showing blizzard frequency in the US* **2, 3**.

Source

To see how much snow can fall in the "wrap around region" check out this video!

**2010 Snowstorm Time Lapse** (1:13)

## Ground Blizzards

As you read in the first section, the NWS criteria for a blizzard warning require snow. However, there is no requirement on a certain depth of snow, which means you can have a blizzard even if there is only an inch of snow! Another interesting thing about blizzards is that they can form even if it isn't snowing at the time of the blizzard. If there is already snow on the ground and the winds increase to 35 mph and blow that snow around so that it reduces the visibility to a ¼ mile or less for three hours, you will have a **ground blizzard**. Ground blizzards typically only extend about 30 feet above ground but they can be just as bad as a regular blizzard. Figure 5 shows what a ground blizzard looks like. To predict where ground blizzards might form, meteorologists look at satellite imagery to find "snow swaths." The satellite image in Figure 5 has a clearly outlined snow swath, which is a large area where snow covers the ground. If the winds over this snow swath pick up the snow and blow it around, you may get a ground blizzard [5].

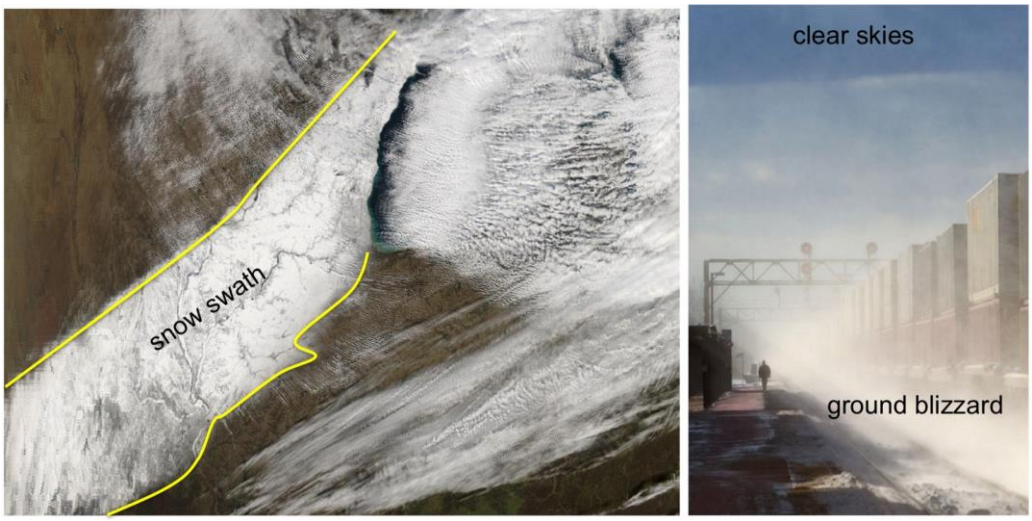


*Figure 5. Left - Visible satellite image of a snow swath. Right - Picture of a ground blizzard.*
Source

## Historical Blizzards

In Chicago, IL in 1967 weather forecasters predicted a typical winter snowstorm. The winds were expected to be light and the snowfall totals were not forecast to exceed 4 inches. However, what Chicago received was anything but typical. Once the storm had passed, Chicago recorded over 20 inches of snow and winds over 40 mph in this storm. Over 50,000 cars were stranded on Chicago streets, over 800 buses were abandoned, and stranded were thousands of students overnight at school because they could not get home. Twenty-six people died and the snowdrifts topped 15 feet in some places. Check out the images in Figure 6 to see what this blizzard looked like [5].

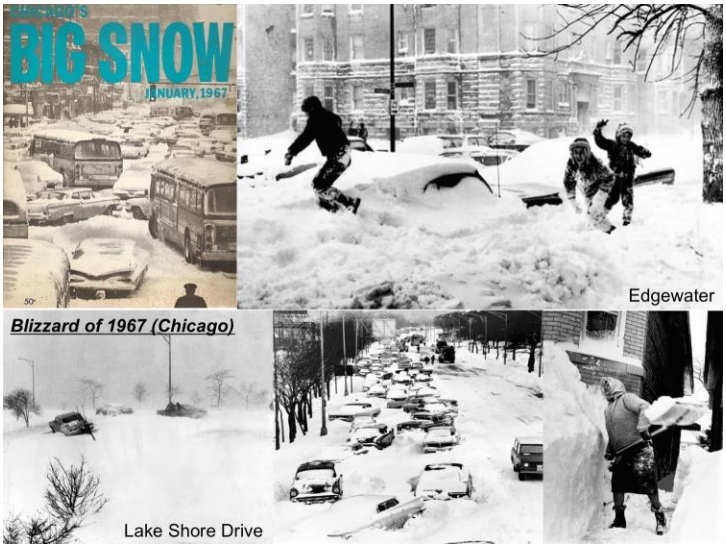


*Figure 6. Images from the Chicago Blizzard of 1967.*
Source

In 1977, one of the worst blizzards to hit the U.S. in recent history formed over the Great Lakes. Buffalo, NY was hardest hit as 80 mph winds and heavy snow covered the city (see Figure 7). This blizzard produced wind chill values as cold as -50°F and shut down the city for a week. To learn more about this blizzard, watch this video!

**1977 Blizzard** (6:59)


*Figure 7. Images from the 1977 Blizzard in Buffalo, NY.*
Source

In January 1888, one of the most tragic blizzards in U.S. history formed over the Dakotas. The weather conditions before the blizzard were unusually warm and many people in the northern U.S. left for work and school without coats, gloves, or hats. Around noon, a very strong cold front blasted through the region with winds over 50 mph and temperatures as cold as -30°F. As the snow fell in this blizzard it was described as being as fine as flour and so heavy that it reduced visibility to just a couple of feet. The combination of wind, snow, and extreme cold killed many people and animals. The most tragic part of the story was that hundreds of school children died in this blizzard as they tried to leave school for home. Many froze in their tracks or got lost in the blinding snow and wind [5].

## Wind Chill

The deadliest part of a blizzard is not the snow – it is the wind. The human body loses heat very efficiently as wind speeds increase and temperatures decrease. Because of this, the NWS formulated the "**wind chill**". Wind chill temperature is how cold it actually feels to a human and is based on the rate of heat loss from exposed skin. The wind chill chart in Figure 8 shows the relationship between wind speed and air temperature. The values on the chart tell us how quickly the body will cool given a certain wind speed and air temperature. For example, if the air temperature is 30°F and the wind speed is 15 mph, your exposed skin will cool as if it is 19°F and calm winds. The color-coding on this image tells you how quickly skin will freeze given the wind speed and air temperature. When skin freezes, it is called **frostbite**. The most susceptible parts of the body are extremities such as fingers, toes, and ears. If you get a chance, Google "Frostbite" to see what it can do to human skin! When your body reaches an abnormally low temperature (below 95ºF), you will experience a condition called **hypothermia**. Hypothermia causes uncontrollable shivering, disorientation, memory loss, slurred speech, and exhaustion. In both cases, immediate medical attention is required [4, 6].

To learn more about wind chill and safety, watch this video!

**Wind Chill** (4:42)

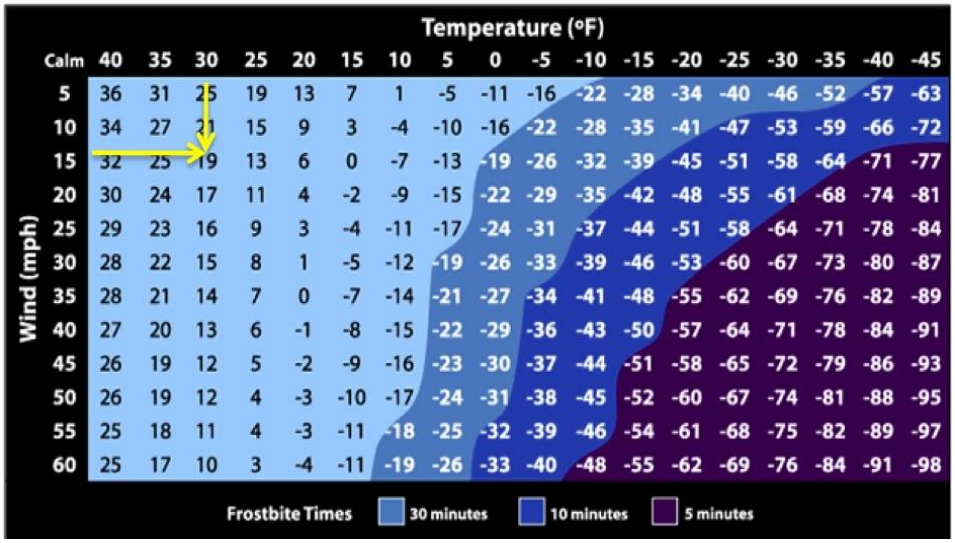


*Figure 8. Wind Chill Chart*
Source

**Pre-Class Activity** [3]

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

1. What is not true about wind chill temperature?
    a. It is colder than the actual temperature read on a thermometer.
    b. It decreases with increasing wind speed.
    c. It is the temperature measured by a thermometer in winter.
    d. It tells us how cold it feels on exposed skin.

2. What weather feature are blizzards associated with?
    a. High-pressure systems
    b. Low-pressure systems
    c. Cold fronts
    d. Warm fronts
    e. Tropical cyclones

3. Which of the following is not necessary to issue a blizzard warning?
    a. Ice accumulation of ¼ inch
    b. Falling or blowing snow
    c. Visibility < ¼ mile
    d. Winds > 35 mph

**Discussion Question**: On a nice spring day, you decide to take a camping trip to the Great Smoky Mountains of western North Carolina. When you reach your campsite, the weather is sunny with temperatures in the 60s; knowing this, you only brought a light jacket and sleeping bag with you. At about 4:00 a.m., you wake up and notice that the temperature has dropped significantly, and that something is weighing down your tent. Heavy snow is falling, limiting visibility to only a few hundred feet. You turn on your radio and hear that a late-season winter storm is occurring, Winter Storm Warnings are in effect, and conditions are only expected to worsen over the next 24 hours. Being so far from civilization, none of your cell phones have a signal. Discuss the dangers of being outside during a possible blizzard and what your next steps to safety should be.

**In-Class Activity**

## Weather Situation: Blizzard

**Instructions**: In this project, your group will forecast and prepare for a blizzard 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. Citizen
3. Mayor
4. Business Owner

## Real World Application: Meteorologist 3, 4, 6

### Task #1

In mid-December, a low-pressure system developed in southern Indiana and produced a major blizzard across central Illinois. Your first task as meteorologist is to draw a weather map that shows the position of the cold front, warm front and "wrap around region". On the blank map of the U.S. below, draw in the position of the low-pressure center, warm front and cold front, as they would need to appear for a blizzard to develop over central Illinois. Once you have these fronts in place, shade in the area where a band of heavy snow will fall.

## Task #2

For the list of cities below, use the air temperature and wind speed to calculate the wind chill temperature and the time to frostbite. (Hint: If the time to frostbite is greater then 30 minutes, write "> 30 min".)

| City | Temperature (°F) | Wind speed (mph) | Wind Chill Temp (°F) | Time to Frostbite (min) |
|---|---|---|---|---|
| Bismarck, ND | 5 | 10 | | |
| Denver, CO | 15 | 15 | | |
| Des Moines, IA | 10 | 10 | | |
| Montreal, QE | 22 | 25 | | |
| Pittsburgh, PA | 19 | 20 | | |
| Boise, ID | 0 | 10 | | |
| Chicago, IL | 6 | 15 | | |
| Columbus, OH | 17 | 25 | | |
| Green Bay, WI | -1 | 5 | | |
| Grand Rapids, MI | 1 | 5 | | |

City with lowest wind chill temperature: _____

## 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 how a blizzard forms. 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 blizzards in the U.S. (fatalities, car crashes, etc.)
2. Discuss the 4 criteria needed to issue a blizzard warning.
3. Thoroughly explain the 3 main blizzard ingredients and how they play a role in the blizzard formation.
4. Explain where blizzards form in a low-pressure system.
5. Define the wind chill temperature and provide an example of how to use it.

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 blizzards so make sure to use your teacher as a resource as well as the Internet. Be sure both informative and entertaining!

## Real World Application: Citizen

## Discussion Questions

1. You are sitting in your living room watching TV, and a blizzard warning has just been announced on the news. During the next couple days, what resources should you gather to prepare yourself and your home for the storm?

2. Suppose that you are driving down Lake Shore Drive in Chicago, IL and it is snowing. While you are driving, conditions get worse, to the point where you cannot see even a few feet in front of you. Do you decide to keep driving and risk an accident? If not, do you decide to remain in your car or abandon it and what factors go into making this decision?

3. Put yourself in the shoes of a single mother with three kids. A blizzard warning is issued at nighttime for the next day. Usually, you drive the kids to school and drive yourself to work. You must decide whether your kids should go to school the next day and if you should go to work. You don't want the kids to miss anything and you can't afford to miss work. Is it worth putting your and their safety at risk in order not to miss school/work? Weigh the consequences (depending on the severity of the blizzard) and if you were to decide either you or your kids will not stay home, explain the means of transportation you and/or your kids are going to use, and what kind of clothes you all should wear to be prepared.

## Task

Based on your ideas from the above discussion questions, create a survival plan for your home in order to prepare beforehand, appropriate actions to take during the blizzard, and deal with the aftermath. Things to consider:

- You may not be able to leave your house during the storm or immediately afterwards
- The resources you will need while you are stuck in your home
- The potential for a power outage, frozen pipes, etc.
- Possible damage caused by the storm, such as the roof caving in
- Clean-up and snow removal

Source

## Real World Application: Mayor

## Discussion Questions

1. You are the mayor of Champaign, IL and the National Weather Service has just informed you of an upcoming blizzard in your area. What guidelines and suggestions should you give to your citizens, and how are you going to communicate this information?

2. Emergency services such as hospitals, fire stations, and police officers will need to be available to the citizens during and after the blizzard. How will you make sure that these services will be kept up and running, in spite of limited people and resources?

3. Consider now that the blizzard has passed, and you have survived! However, many frustrated citizens have contacted you about various problems, such limited accessibility to roadways. Many city employees have been working overtime to maintain the city as well. Given the situation, what can you do to please the citizens and properly compensate city employees?

## Task

You have been asked to be interviewed by a local news station. Prepare a skit that you will present to your class. Brainstorm creative ideas as group, and then select two students to act out the skit. One student will act as the interviewer and ask the mayor questions, and another student will act as the mayor and respond to the questions. Things to consider:

- How the mayor kept citizens informed
- Snow removal on roadways
- Damage to the city's infrastructure
- Monitoring city resources such as electricity

Source

## Real World Application: Business Owner

## Discussion Questions

1. You are the owner of a local car towing company, and there is a high demand for service due to cars that have been stranded on the side of the road during the blizzard. How will ensure that you have enough employees, and that you keep them both safe and satisfied?

2. The blizzard has subsided, and your employees are prepared to tow stranded cars. However, you do not have the resources to tow every part of the city at once. How will you prioritize *when* and *where* to dispatch your employees, and why?

3. Under what circumstances might your business close during or after the blizzard? What actions will you take to ensure your business's recovery?

## Task

As the local business owner of a towing company, your employees have to be out on the road during and after the blizzard. Create a blizzard car survival plan to ensure your employees' safety. Things to consider:

- Hypothermia
- Hunger
- Dehydration
- Not being able to see in the dark
- Potential car problems

Source

## Take Home Assignment

### Part 1. Snowfall Measurements 5, 7, 8, 9

As we learned in the 'Water on Earth' module, liquid water is more dense than ice/snow. The amount of air snowflakes contain directly affects their density and their volume (the amount of space it takes up, or how fluffy the snow is). When snow melts, the trapped air is released and thus, the volume of snow is greater than the volume of the liquid water it forms when it is melted. So, how does the volume of snow compare to the volume of liquid water that the melted snow forms?

**Instructions**: After the Chicago 1967 blizzard, the National Weather Service confirmed the snowfall accumulation to be 20 inches. For several reasons, the amount of snowfall can be very difficult to figure out how much snow actually fell. *A rule of thumb is that every 10 inches of snow is equivalent to approximately 1 inch of liquid water, but this can vary greatly*.

1. If all of the snow that fell during the Chicago 1967 blizzard melted, how much many inches of liquid water would you expect there to be? (Remember the rule of thumb).

Liquid Water = _____ inches

2. Using your answer from #1, calculate the total volume of liquid water over the city of Chicago. You may assume the area of the city is 234 miles$^2$. Assume the volume of a cube for this calculation.

Step 1: Convert the area of the city from mi$^2$ to in$^2$ (1 mile = 63,360 inches).

$A_{city}$ = _____ in$^2$

Step 2: Calculate the volume in inches$^3$.
*Hint: Multiply the liquid water (in) by the area of the city.*

$V_{water}$ = _____ in$^3$

Step 3: Convert the volume from $in^3$ to $ft^3$

$V_{total}$ = _____ $ft^3$

3. From your calculation, what potential impacts would this have for the city of Chicago?

4. Using an online search engine, determine how the National Weather Service measures snowfall. Make a list of steps that they use to ensure accuracy.

5. What are some uncertainties associated with this method? Think about the environmental factors and what the snow does when it piles up on the ground.

6. Explain one major factor that might affect the 10:1 ratio of snow to liquid water?

## **Part 2. True/False (Circle one)** 3

1. The Rocky Mountains are an important feature for blizzard formation. T F

2. Blizzards are associated with high pressure systems. T F

3. A blizzard can occur even if it is not snowing. T F

4. Cold air from Canada is essential for blizzard formation. T F

5. The deadliest part of a blizzard is the immense amounts of snow. T F

6. An Alberta Clipper is a low pressure that forms in Alberta, Canada. T F

7. Blizzards most frequently occur in Colorado. T F

8. The wrap around region of the low pressure system is where blizzards occur. T F

9. Frozen precipitation causes about 20% of all weather-related deaths. T F

10. The wind chill chart can be used to estimate time until frostbite occurs. T F

**Student Evaluation** 3, 4, 5, 6

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

1. Which of the following is not a condition necessary for the issuing of a blizzard warning?
    a. Visibility ≤ ¼ mile
    b. Wind speeds ≥ 35 mph
    c. Wind chill temperatures ≤ 32°F
    d. Falling or blowing snow
    e. Blizzard conditions lasting at least 3 consecutive hours

2. Why are the Rocky Mountains important for blizzard formation?
    a. The high elevation of the Rockies provides the cold air necessary for snow.
    b. The Rockies help to guide cold air southward from Canada.
    c. The Rockies allow air to rise to get sufficient cloud formation.
    d. The Rockies cause warm, moist air from the Pacific Ocean to rise over the mountain range and form clouds.

3. Which of the following is not true about Canadian air masses?
    a. Canadian air masses are very cold because the ground cools very efficiently.
    b. Canadian air masses are very cold because of the snow cover in place year-round in Canada.
    c. Canadian air masses are very cold in winter because of the low sun angle.
    d. Canadian air masses are very cold because the short daylight hours
    e. Canadian air masses are very cold because of Canada's high latitude.

4. Wind chill is defined as
    a. the temperature when the wind speed exceeds 35 mph.
    b. how cold it feels to a human when the temperature and winds work together to cool your body more efficiently.
    c. the temperature at which frostbite occurs within 30 minutes.
    d. the change in temperature when a blizzard occurs.

5. Which of the following is not true about low-pressure systems?
    a. Winds spiral inward and in a clockwise direction around a low-pressure system.
    b. Low-pressure systems contain a wrap around region.
    c. The coldest air is found northwest of the center of the low-pressure system.
    d. Wintertime low-pressure systems only produce snow, sleet, and freezing rain.

6. Where is the wrap around region located relative to the center of a low-pressure system?
    a. Southwest of the low
    b. South of the low
    c. East of the low
    d. Northwest of the low

7. What is the deadliest part of a blizzard?
    a. Heavy snowfall
    b. Power outages
    c. Frostbite due to extreme wind chill temperatures
    d. Flooding after a blizzard

8. Where is the U.S. are blizzards most frequent?
    a. The Midwest
    b. Colorado, specifically in the Rocky Mountains
    c. North and South Dakota
    d. New England
    e. The Great Plains
    f. Illinois

9. As we have learned, the human body loses heat more efficiently as wind speed increases and temperature decreases. This can often cause frostbite or hypothermia to occur. What is the difference between frostbite and hypothermia?

10. The current temperature is $10^{o}F$ and the wind speed is 25 mph at sunset. Overnight, the temperature drops by $10^{o}F$, but the wind speed remains constant. How much did the wind chill temperature change from sunset to sunrise?

    $WC_{sunset}$ = _____ $^{o}F$ $WC_{sunrise}$ = _____ $^{o}F$

    $\Delta WC$ = _____ $^{o}F$

    a. $\Delta WC = 4\ ^{o}F$
    b. $\Delta WC = 20\ ^{o}F$
    c. $\Delta WC = 13\ ^{o}F$
    d. $\Delta WC = 35\ ^{o}F$

**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 standards are met in this learning module:

1. **NGSS.MS-ESS1-1**

| **MS-ESS1B. Earth and the Solar System** (Disciplinary Core Idea from MS-ESS1-1) |
|---|
| Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. |
| Lecture: Ingredients for a Blizzard |

2. **NGSS.MS-ESS2-6**

| **MS-ESS2.D. Weather and Climate** (Disciplinary Core Idea from MS-ESS2-6) |
|---|
| Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. |
| Lecture: Ingredients for a Blizzard |

3. **NGSS.MS-ESS2.5**

| **MS-ESS2-5. Weather and Climate** |
|---|
| Provide evidence for air pressure systems and resulting weather conditions. |
| Lecture: Ingredients for a Blizzard; Pre-Class Activity; In-Class Activity: The Meteorologist; Take Home Assignment: Part 2; Student Evaluation |

4. **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). |
| Lecture: Wind Chill; In-Class Activity: The Meteorologist; Student Evaluation |

5. **NGSS.MS-ESS2-4**

| **MS-ESS2-4. Earth's Systems** (DCI ESS2.C) |
|---|
| Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation, crystallization, and precipitation, as well as downhill flows on land. |
| Lecture: Ground Blizzards, Historical Blizzards; Take Home Assignment: Part 1; Student Evaluation |

6. **NGSS.MS-PS1-4**

| **MS-PS1-4. Structure and Properties of Matter** (DCI PS3.A) |
|---|
| In science, heat refers to the energy transferred due to the temperature difference between two objects. |
| Lecture: Wind Chill; In-Class Activity: The Meteorologist; Student Evaluation |

7. **NGSS.MS-PS3-4**

| **MS-PS3-4. Energy** |
|---|
| Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles measured by the temperature of the sample. |
| Take Home Assignment: Part 1 |

8. **CCSS.MATH.CONTENT.7.G.B.6**

| **Grade 7: Geometry** |
|---|
| Solve real-world and mathematical problems involving area, volume, and surface area of two and three-dimensional objects composed of triangles, quadrilaterals, polygons, *cubes*, and right prisms. |
| Take Home Assignment: Part 1 |

9. **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 |

10. **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. |
| Video Lectures |

11. **CCSS.ELA-LITERACY.RST.6-8.9**

| **Grade 6-8: Science and Technical Subjects** |
| --- |
| Compare and contrast the information gained from experiments, simulations, video or multimedia sources that gained from reading a text on the same topic. |
| Video lectures |