

2007

## Precipitation Patterns

STORM Project

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**Activity 7**  
**Precipitation Patterns**  
**Level 2**

<http://www.uni.edu/storm/activities/level2/index.shtml>

**Objective:** Students will demonstrate the relationship between precipitation types and surface temperatures. They will use forecast maps to predict where snow or rain will fall over the next several days.

**National Science Education Standards** – As a result of activities in grades 5-8, all students should develop an understanding of structure of the earth system.

**Teacher Notes:** You will need to make three copies of the map (that comes at the end of the student sheet) for each student. The activity website is: <http://www.uni.edu/storm/activities/level2/act7.shtml>

**Engage:**

Ask students questions such as: “What types of precipitation have you seen?” “What is the temperature like when it rains?” “ ... when it snows?” “... when there is freezing rain?”

Listen to their answers to assess the ideas they bring with them.

Review the processes of the Water Cycle. Explain what happens during the precipitation phase. Read the background information at the end of these notes.

1. What are the 4 main types of precipitation?
1. How does each type of precipitation form?
1. How does temperature affect the development of each type of precipitation?

**Explore:**

Access the activity website and click on National Radar. The colored areas show where precipitation is falling around the USA. Now click on the Current Surface Precipitation/Fronts button. Compare this map to the first national radar map. Are they similar? Do you notice if precipitation is falling near fronts, or near Highs or Lows?

Once again, click on the National Radar. Look for a large area of precipitation. Put the cursor over this area and click on it. This will give you a closer look at the radar for that part of the country. Colors of yellow, orange, and red indicate moderate to heavy precipitation. What states are receiving moderate to heavy precipitation? Click back to the activity web page.

**Explain:**

On the activity website, click on the Snow Forecast selection. On one copy of the USA/Southern Canada map, outline the areas forecasted to receive snow for today.

On the activity web page, click on the Current Temperatures. What are the surface temperatures like in the areas in which snow is forecasted? How do these temperatures compare to the freezing temperature of water?

Using your knowledge of the water cycle and what you have seen on the websites, answer the following questions:

1. Most precipitation begins in what form?
2. What factor determines which form of precipitation hits the ground?
3. Which form of precipitation melts and refreezes before it hits the ground?
4. How is hail different from the other forms of precipitation?

### **Extend:**

On the activity website click on the 24-hour precipitation forecast. Use a colored pencil to outline this area on another copy of the USA map.

Click on the 24-hour temperature button. Use this information to predict where snow might fall. Use the weather symbol for snow ( \* )to mark areas on your map where you predict snow will fall in 24 hours.

On the activity website click on 48-hour precipitation forecast. Use a colored pencil to outline this area on another copy of the USA map.

Click on the 48-hour temperature button. Use this information to predict where snow might fall. Use the weather symbol for snow \* to mark areas on you map where you predict snow will fall in 48 hours.

### **Evaluate:**

Correct student maps. Quiz option - Draw a diagram and label correctly how all four forms of precipitation begin and change before the precipitation reaches the ground.

### **For Further Inquiry:**

How do rain and snow patterns move across the United States? Challenge students to design an investigation to answer this or any other question they might have about precipitation patterns.

### **Background Information:**

In order for precipitation to form, particularly over a large area, several ingredients are necessary. First there must be a source of moisture. The primary moisture sources in the U.S. are the Atlantic and Pacific Oceans as well as the Gulf of Mexico. Winds around high and low pressure systems transport this moisture inland.

Once the moisture is in place, clouds still need to form. The most effective way to do this is by lifting the air. This can be accomplished by forcing the air up and over mountains or, more commonly, by forcing air to rise near fronts and low pressure areas.

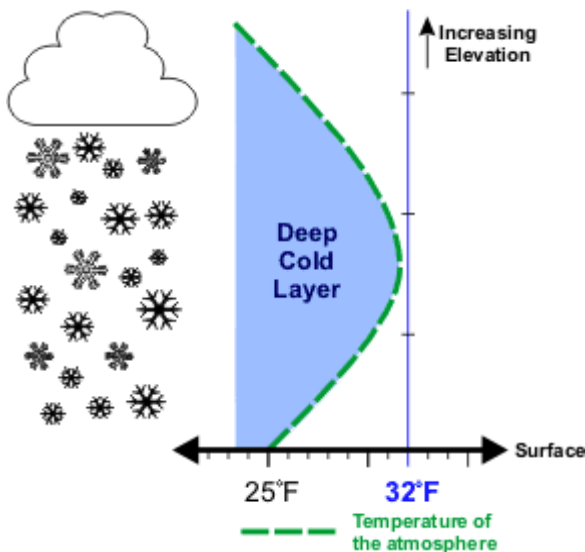
Cloud droplets and/or ice crystals are too small and too light to fall to the ground as precipitation. So there must be a process(es) for the cloud water, or ice, to grow large enough to fall as precipitation. One process is called

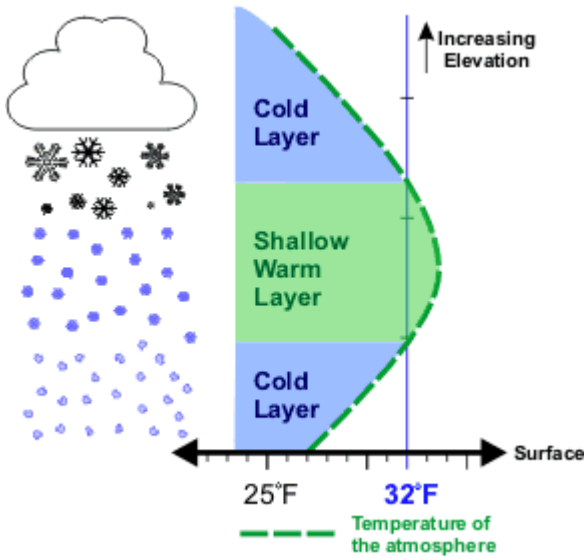
the collision and coalescence or warm rain process, common in tropical regions, and in some cumulonimbus clouds during thunderstorms. In this process, collisions occur between cloud droplets of varying size, with their different fall speeds, sticking together or coalescing, forming larger drops. Finally the drops become too large to be suspended in the air and they fall to the ground as rain. But this is not the main precipitation producing process for most of the United States.

In the middle latitudes (between about 30 degrees and 70 degrees north latitude) another process is primarily responsible for precipitation. The process is called the **ice crystal process**. This occurs in colder clouds when both ice crystals and water droplets are present. In this situation it is "easier" for water vapor to deposit directly onto the ice crystals so the ice crystals grow at the expense of the water droplets. The crystals eventually become heavy enough to fall. If the temperature is close to or below freezing from the cloud to the ground, snowflakes will fall to the ground and the precipitation type is snow. If temperatures warm above freezing above the surface, the snowflakes may melt to rain.

The vertical distribution of temperature determines the type of precipitation (rain vs. snow vs. sleet vs. freezing rain) that occurs at the surface.

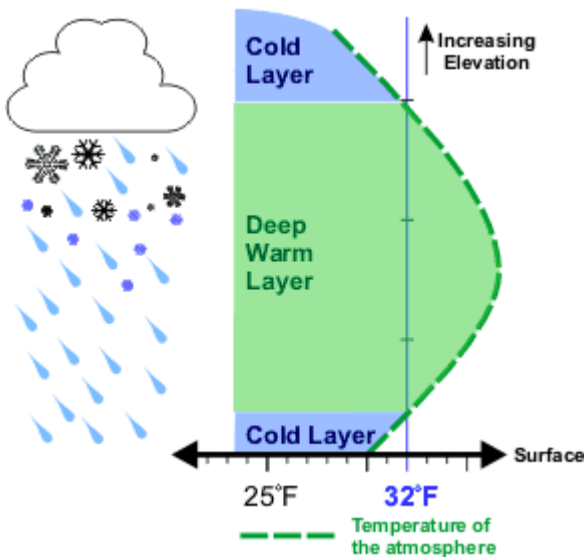
In the image (left) the dashed line is the temperature in respect to elevation. The surface temperature is 25°F (-4°C) and increases with height before decreasing. However, since the temperature remains below freezing any precipitation that falls will remain as snow.





In this image the surface temperature is higher, 27°F (-3°C). Also as elevation increases, the temperature increases to a point where some of the atmosphere is above freezing before the temperature lowers again below freezing.

As snow falls into the layer of air where the temperature is above freezing, the snowflakes partially melt. As the precipitation reenters the air that is below freezing, the precipitation will re-freeze into ice pellets that bounce off the ground, commonly called sleet. The most likely place for freezing rain and sleet is to the north of warm fronts. The cause of the wintertime mess is a layer of air above freezing aloft.



Freezing rain will occur if the warm layer in the atmosphere is deep with only a shallow layer of below freezing air at the surface. The precipitation can begin as either rain and/or snow but becomes all rain in the warm layer. The rain falls back into the air that is below freezing but since the depth is shallow, the rain does not have time to freeze into sleet.

Upon hitting the ground or objects such as bridges and vehicles, the rain freezes on contact. Some of the most disastrous winter weather storms are due primarily to freezing rain.

## Precipitation Patterns

### Student sheet

#### Engage:

Answer the following questions.

1. What types of precipitation have you seen? \_\_\_\_\_
2. What is the temperature like when it rains? \_\_\_\_\_
3. When it snows? \_\_\_\_\_
4. When there is freezing rain? \_\_\_\_\_

Review the processes of the Water Cycle. Explain what happens during the precipitation phase.

1. What are the 4 main types of precipitation?  
\_\_\_\_\_
2. How does each of these types of precipitation form?  
\_\_\_\_\_  
\_\_\_\_\_
3. How does temperature affect the development of each type of precipitation?  
\_\_\_\_\_  
\_\_\_\_\_

#### Explore:

Access the activity website at <http://www.uni.edu/storm/activities/level2/act7.shtml>, and click on National Radar. The colored areas show where precipitation is falling around the USA. Now click on the Current Surface Precipitation/Fronts button.

1. Compare this map to the first national radar map.
  - a. Are they similar? \_\_\_\_\_
  - b. Do you notice if precipitation is falling near fronts, or near a High or a Low?  
\_\_\_\_\_

Once again, click on the National Radar. Look for a large area of precipitation. Put the cursor over this area and click on it. This will give you a closer look at the radar at that part of the country. Colors of yellow, orange, and red indicate moderate to heavy precipitation.

What states are receiving moderate to heavy precipitation?  
\_\_\_\_\_

Click back to the activity web page.

#### Explain:

On the activity website click, on the Snow Forecast button. On one of your USA/Southern Canada maps, outline the areas forecasted to receive snow for today.

Using the activity web page, click on the Current Temperatures. What are the surface temperatures like in the areas in which snow is forecasted?  
\_\_\_\_\_

How do these temperatures compare to the freezing temperature of water?

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Using your knowledge of the water cycle and what you have seen on the websites, answer the following questions:

1. Most precipitation begins in what form? \_\_\_\_\_
2. What factor determines which form of precipitation hits the ground?  
\_\_\_\_\_
3. Which form of precipitation melts and refreezes before it hits the ground? \_\_\_\_\_
4. How is hail different from the other forms of precipitation?  
\_\_\_\_\_

**Extend:**

1. On the activity website click on 24-hour precipitation forecast. Use a colored pencil to outline this area on your second copy of the USA/southern Canada map.
2. Click on the 24-hour temperature button. Use this information to predict where snow might fall. Use the weather symbol for snow (\*) to mark areas on your map where you predict snow will fall in 24 hours.
3. On the activity website click on 48-hour precipitation forecast. Use a colored pencil to outline this area on your third copy of the USA/southern Canada map.
4. Click on the 48-hour temperature button. Use this information to predict where snow might fall. Use the weather symbol for snow (\*) to mark areas on you map where you predict snow will fall in 48 hours.

