

Phase Change, Humidity, and Precipitation

You've observed how heat energy is transferred in the atmosphere by rising air currents, and there are water parcels of different densities in waterbodies. You've learned about global winds and ocean currents as mechanisms for distributing heat on Earth. In this lesson, you will experiment with different phases of water to determine how water vapor or humidity are components of weather. You will also study mountain ranges to determine how they influence weather patterns. As you proceed through the lesson, keep the focusing question in mind.

? How do rising and sinking air masses on either side of the Continental Divide **?**
affect temperatures and precipitation on the Eastern Slope

MATERIALS

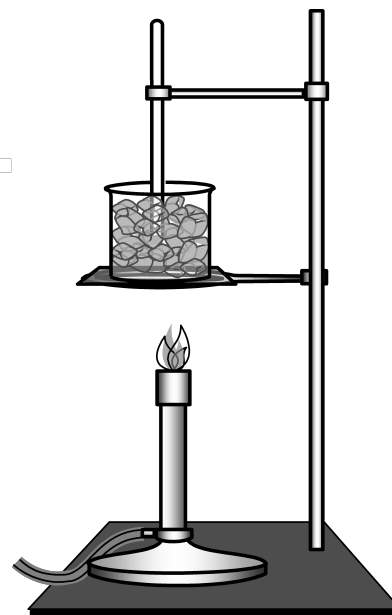
Materials are listed with each section.

Part A: Stored Energy and Phase Change of Water

Materials: 500 mL beaker, Bunsen burner or hot plate, crushed ice, thermometer, ring stand with clamp and wire gauze, safety goggles

PROCEDURE

1. Set up the materials as shown in the diagram. Make sure the thermometer is suspended in the ice and is not touching the bottom of the beaker.
2. You will take a beaker of crushed ice and heat it up until the water boils for at least 5 minutes. You will collect data every minute for the entire time. Predict what you think the graph will look like (sketch a graph in your notebook).
1. Make a data table in your notebook so that you can record the temperature every minute until the water boils. Once the water is boiling, take five more temperature readings.
4. Graph the data and look for patterns.
5. After studying the graph, answer the questions.
 - a. Describe the shape of the graph.
 - b. What was the phase of the substance when the temperature changed the least?

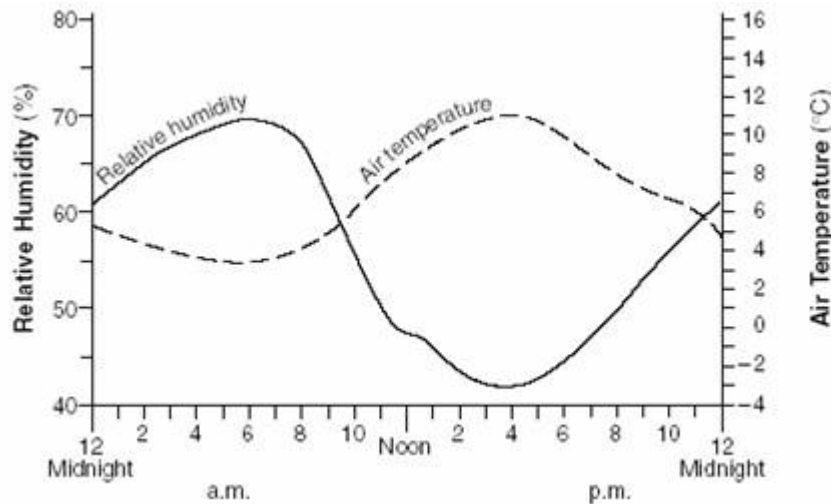


- How can you explain this?
- What was the phase of the substance when the temperature changed the most? How can you explain this?
 - Pick out three different places on the graph and describe what's happening to the energy transfer related to that portion of the graph.
 - On the graph, label where the energy is being stored. Also, label melting and evaporation. [Sparknotes](#) has a good discussion about latent heat and the phase changes.
6. Based on this experiment, explain why you feel cold after stepping out of a hot shower.

Part B: Saturation and Relative Humidity

PROCEDURE

- Relative humidity** is a ratio of the air's actual water-vapor content compared with the amount of water vapor required for saturation at that temperature and pressure. Study [Table 1](#) and explain the relationship between air temperature and the quantity of water that the air holds at saturation.
- Study figure below and explain what is the relationship between air temperature and relative humidity assuming the moisture content remains the same?



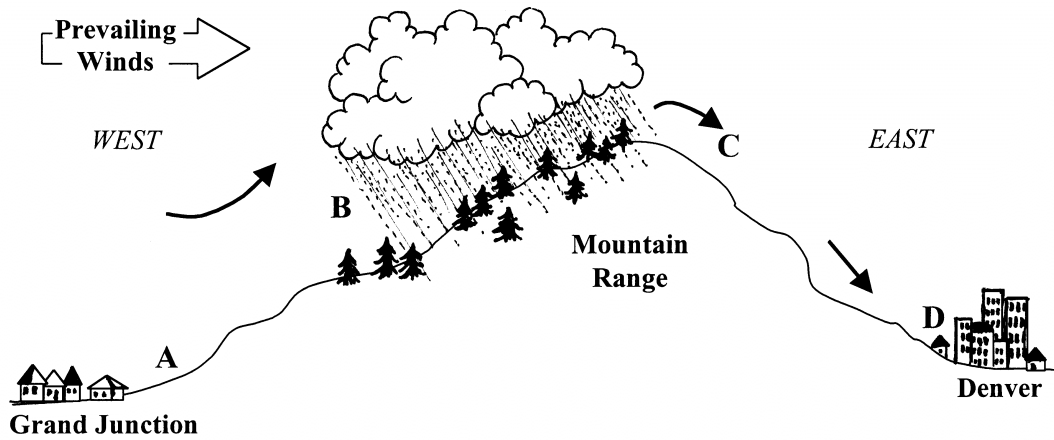
- When visiting Miami or St. Louis in the summer, it feels quite “sticky” and uncomfortable to most people. Using what you know about relative humidity, explain why this is the case.

Part C: How do mountain ranges affect precipitation?

Materials: precipitation data for Winter Park and Denver, Colorado.

Colorado is more than 1,000 miles from the Pacific Ocean. So, what is Colorado’s connection to the ocean? You’ve studied evaporation, humidity, and behavior of different temperature gases. In this part of the lesson, you will pull all of this together to see how the ocean comes to Colorado.

Study the diagram on the next page. It will help you as you proceed with this section.



PROCEDURE

1. Talk to your partner and share your ideas about how you can explain what you observe.
2. In the table below are data for two weather locations in Colorado—Winter Park and Denver. On graph paper, plot the average total precipitation for each location.

Average Total Precipitation (inches)
(Winter Park 1942-2008; Denver 1948-2008)

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total	
2.31	2.05	2.65	3.00	2.65	1.81	2.08	2.23	1.79	1.77	2.22	2.28	26.83	Winter Park
0.51	0.57	1.26	1.75	2.42	1.66	1.94	1.75	1.15	1.00	0.81	0.57	15.40	Denver

3. Study the average snowfall for each month. To compare other cities in Colorado, go to <http://www.wrcc.dri.edu/clmatedata/climsum/>. You can find climate data for cities in other states too.

Average Total Snowfall (inches)
(Winter Park 1942-2008; Denver 1948-2008)

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total	
36.0	31.4	36.1	31.4	11.3	1.4	0.0	0.0	2.5	12.2	30.6	34.5	227.5	Winter Park
7.5	7.1	12.4	8.5	1.6	0.0	0.0	0.0	1.5	4.0	8.6	7.8	59.2	Denver

ANALYSIS QUESTIONS

1. Explain why Winter Park has more precipitation per year than Denver. Be sure to use all of the weather concepts in your explanation.
2. Calculate the percent of total precipitation that comes from snowfall for both Winter Park and Denver during an average year. On average, 12 inches of snow melts to form one inch of precipitation.
3. Explain Colorado’s connection to the Pacific Ocean in terms of weather (use the map entitled US ave precip temp).

CONCLUSION

Use what you learned in this lesson to write a conclusion to the focusing question.