

Name: _____

Skill Sheet 25-A

Temperature Scales



Temperature, a measure of the average kinetic energy of the molecules of a substance, has an important role in our daily lives. Whether we are cooking dinner, dressing for school, or suffering from a cold, we often wish to know something about the temperature of our environment or some body of matter. To report values for temperature, the Fahrenheit and Celsius scales are commonly used by scientists and society. In this exercise, you will examine these scales and practice converting temperature values from one scale to the other.

1. Fahrenheit and Celsius

The Fahrenheit and Celsius temperature scales are the most commonly used scales for reporting temperature values. Scientists use the Celsius scale almost exclusively, as do many countries of the world. Some countries, such as the United States, still rely heavily on the Fahrenheit scale for reporting temperature information. When the meteorologist on television tells you the forecast for the week, the scale he is using for temperature is Fahrenheit. Your oven is calibrated in Fahrenheit values, as is the thermometer your doctor uses to assess your health. In the United States, we are comfortable with the Fahrenheit scale and design our appliances and tools using this system of measurement.

However, if you were in Europe, you would see temperatures given in degrees Celsius. Scientists use the Celsius scale for their experiments and report their results in degrees Celsius. Therefore, it may be necessary at some point in time to convert information reported in degrees Celsius to degrees Fahrenheit or vice versa. To accomplish this, we use conversion formulas.

2. Converting Fahrenheit values into Celsius

If you have been given temperature information in degrees Fahrenheit ($^{\circ}\text{F}$) and need the values to be reported in degrees Celsius ($^{\circ}\text{C}$), you would use the following formula:

$$^{\circ}\text{C} = \frac{5}{9} (^{\circ}\text{F} - 32)$$

Example:

What is the Celsius value for 65° Fahrenheit?

$$^{\circ}\text{C} = \frac{5}{9} (65^{\circ}\text{F} - 32)$$

$$^{\circ}\text{C} = 18.3$$

3. Practice converting Fahrenheit to Celsius values

1. The weatherman tells you that today will reach a high of 45°F . Your friend from Sweden asks what the temperature will be in degrees Celsius. What value would you report to your friend?

2. Your father orders a fancy oven from England. When it arrives, you notice that the temperature dial is calibrated in degrees Celsius. You wish to bake a cake at 350°F . At what temperature will you have to set the dial on this new oven?

3. Your new German automobile's engine temperature gauge reads in Celsius, not Fahrenheit. You know that the engine temperature should not rise above about 225°F . What is the corresponding Celsius temperature on your new car's gauge?

4. Converting Celsius to Fahrenheit values

To convert Celsius temperature values to degrees Fahrenheit, you must again use a conversion formula:

$$^{\circ}\text{F} = \left(\frac{9}{5} \times ^{\circ}\text{C}\right) + 32$$

Example:

200°C is the same temperature as what value on the Fahrenheit scale?

$$^{\circ}\text{F} = \frac{9}{5}(200^{\circ}\text{C}) + 32$$

$$^{\circ}\text{F} = 392$$

5. Practice converting Celsius to Fahrenheit values

1. Your grandmother in Ireland sends you her favorite cookie recipe. Her instructions say to bake the cookies at 190.5°C. To what Fahrenheit temperature would you set the oven to bake the cookies?

 2. A scientist wishes to generate a chemical reaction in his laboratory. The temperature values in his laboratory manual are given in degrees Celsius. However, his lab thermometers are calibrated in degrees Fahrenheit. If he needs to heat his reactants to 232°C, what temperature will he need to monitor on his lab thermometers?

 3. You phone a friend who lives in Denmark and tell him that the temperature today only rose as high as 15°F. He replies that you must have enjoyed the warm weather. Explain his answer using your knowledge of the Fahrenheit and Celsius scales and conversion formulas.
-

6. Extension: the Kelvin temperature scale

For some scientific applications, a third temperature scale is used: the Kelvin scale. The Kelvin scale is calibrated so that raising the temperature one Kelvin raises it by the same amount as one degree Celsius. The difference between the scales is that 0°C is the freezing point of water, while 0 K is much, much colder. On the Kelvin scale, 0 K (degree symbols are not used for Kelvin values) represents **absolute zero**. Absolute zero is the temperature when the average kinetic energy of a perfect gas is zero—the molecules display no energy of motion. Absolute zero is equal to -273°C, or -459°F. When scientists are conducting research, they often obtain or report their temperature values in Celsius, and other scientists must convert these values into Kelvin for their own use, or vice versa. To convert Celsius values to their Kelvin equivalents, you would use the formula:

$$K = ^\circ C + 273$$

Example:

Water boils at a temperature of 100°C. What would be the corresponding temperature for the Kelvin scale?

$$K = ^\circ C + 273$$

$$K = 100^\circ C + 273$$

$$K = 373$$

To convert Kelvin values to Celsius, you would perform the opposite operation; subtract 273 from the Kelvin value to find the Celsius equivalent.

Example:

A substance has a melting point of 625 K. At what Celsius temperature would this substance melt?

$$^{\circ}\text{C} = \text{K} - 273$$

$$^{\circ}\text{C} = 625 \text{ K} - 273$$

$$^{\circ}\text{C} = 352$$

Although we rarely need to convert between Kelvin and Fahrenheit, use the following formulas to do so:

$$^{\circ}\text{F} = \left(\frac{9}{5} \times \text{K}\right) - 460$$

$$\text{K} = \frac{5}{9} (^{\circ}\text{F} + 460)$$

Solving problems

1. A gas has a boiling point of -175°C . At what Kelvin temperature would this gas boil?

2. A chemist notices some silvery liquid on the floor in her lab. She wonders if someone accidentally broke a mercury thermometer, but did not thoroughly clean up the mess. She decides to find out if the silver stuff is really mercury. From her tests with the substance, she finds out that the melting point for the liquid is 275 K. A reference book says that the melting point for mercury is -38.87°C . Is this substance mercury? Explain your answer and show all relevant calculations.

3. You are at a Science Camp in Florida. It's August 1st. Today's activity is an outdoor science quiz. The first question on the quiz involves a thermometer that reports the current temperature as 90° . You need to state the temperature scale in which this thermometer is calibrated: Kelvin, Fahrenheit, or Celsius. Which scale is correct? Defend your answer with your knowledge of the temperature scales.

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Many of our daily activities require the heating or cooling of matter to suit the needs of a specific situation. Cooking, heating or air conditioning a room, and freezing a popsicle all require some application or removal of heat energy from a system. It is easy to calculate the amount of energy that was added to or removed from a system. To do this, you use the heat equation, which relates heat energy to changes in temperature observed in bodies of matter.

1. Specific heat

Suppose you want to know how much energy is needed to see an increase in temperature in an object. You must first know the specific heat of the substance in question. Specific heat is defined as the amount of heat energy needed to raise 1 gram of a substance 1°C in temperature.

The higher the specific heat, the more energy is required to cause a change in temperature. Substances with higher specific heats require more loss of heat energy to experience a lowering of their temperature than do substances with a low specific heat. Some sample specific heat values are presented in the table below:

Substance	Specific Heat (calorie/g °C)
Aluminum	0.22
Copper	0.09
Glass	0.20
Iron	0.11
Fresh water	1.00
Gold	0.03
Carbon	0.17

Water has the highest specific heat of the listed types of matter. This means that water is slower to heat but is also slower to lose heat. This is why the temperature does not fluctuate to extremes in geographic areas where there is a body of water nearby. However, in areas that are far from large bodies of water, such as deserts, the air temperature goes from being very hot during the day to being very cold at night.

1. Which of the substances listed in the table above would heat up fastest if an equal amount of heat energy were applied to all of the substances at the same time? Explain your answer.

2. Which of the substances listed in the table above would you choose as the best insulator (substance that requires a lot of heat energy to experience a change in temperature)? Explain your answer.

2. Calculating changes in heat and temperature

With knowledge of the specific heat value for a substance, we can calculate how much heat energy is required to affect a needed change in temperature or how much change in temperature we would observe with the application of a specific amount of heat energy. To do this, we would use the heat equation:

$$Q = mc\Delta T$$

where Q is the heat energy (calories), m is the mass of the substance (grams), c is the specific heat of the substance (calories/g°C), and ΔT is the change in temperature (°C).

Example 1:

How much energy is required to heat 35 g of gold from 10°C to 50°C?

The mass of our substance is 35 g. We see from the table of specific heat values that the specific heat of gold is 0.03 calories/g°C. The change in temperature observed is 40°C (50°C – 10°C = 40°C). Inserting these values into the heat equation:

$$Q = mc\Delta T$$

$$Q = (35 \text{ g})\left(0.030 \frac{\text{calories}}{\text{g} \cdot ^\circ\text{C}}\right)(40^\circ\text{C})$$

$$Q = 42 \text{ calories}$$

To produce the necessary change in temperature, 42 calories of heat energy need to be put into this sample of gold.

Example 2

A 250 g sample of aluminum is provided with 1,200 calories of heat energy. What will be the change in temperature of this sample of aluminum?

The heat energy added to this system is 1,200 calories. The mass of the aluminum is 250 g. From our table, we find that the specific heat of aluminum is 0.22 calories/g°C. Inserting these values into the heat equation:

$$Q = mc\Delta T$$

$$1,200 \text{ calories} = (250 \text{ g})\left(0.220 \frac{\text{calories}}{\text{g} \cdot ^\circ\text{C}}\right)(\Delta T)$$

$$\Delta T = 21.8^\circ\text{C}$$

3. Practice calculating changes in heat and temperature

Using the heat formula and the table of specific heat values, solve the following heat problems.

1. A 500 g piece of iron increases its temperature 7°C when heat energy is added. How much heat energy produced this change in temperature?

2. When 300 calories of energy are lost from a 125 g object, the temperature decreases from 45°C to 40°C . What is the specific heat of this object?

3. 1,200 calories of heat energy are added to a liquid with a specific heat of $0.57 \text{ calories/g}^{\circ}\text{C}$. If the temperature increases from 20°C to 33°C , what is the mass of the liquid?

4. A scientist wants to raise the temperature of a 10 g sample of glass from -45°C to 15°C . How much heat energy is required to produce this change in temperature?

5. Sophie wishes to heat a pot of fresh water from 20°C to 100°C in order to boil water for pasta. She calculates that her pot holds 2,000 g of water and that she would need to apply 160,000 calories of heat energy to produce the desired temperature change. Is she correct in her calculations? Defend your answer and show your work.

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If you look at the nutrition label on a jar of chunky peanut butter, you will see that it has 188 calories per serving (2 tablespoons or 32.0 grams). How did scientists figure out the number of calories per serving? They had to calculate heat energy. In systems where the heat energy is in its potential form (like food or fuel), you need a special process to calculate heat energy. The process is called calorimetry. Calorimetry can also be used to calculate the heat energy of a chemical reaction. In this activity, you will learn how scientists use calorimetry to determine values for stored heat energy in a variety of situations.

1. How does a calorimeter work?

A calorimeter can be made using simple materials. The basic design has a contained, insulated place to burn food, a way to expose water to the heat produced by the burning food, and a thermometer. The diagram to the right shows the type of calorimeter you made and used in the Investigation on calorimetry.

Calorimetry is the process of determining the calories contained in an object or piece of food. To use a calorimeter correctly, a known amount of water is placed in a chamber. It is best if this chamber is insulated. A thermometer is placed in the water. The material to be tested is then burned so that the energy stored in its chemical bonds can be released to heat up the water.

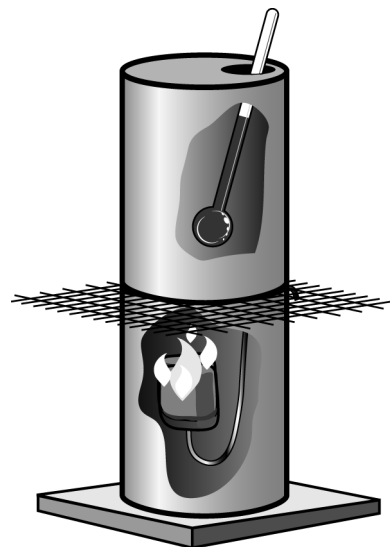
In a closed system, the heat energy lost by the burned object can be gained by the water. The energy is transferred from the burning object (a combustion reaction) causes an increase in the kinetic energy of the water molecules and therefore, an increase in temperature. By measuring the temperature of the water, we have a measurement of the amount of heat gained by the water from the burning of the object.

Since we know the mass of the water in the calorimeter, the change in temperature, and the specific heat of the water, it is simple to calculate how much heat energy (in calories) was needed to produce the temperature change. To do this, we use the heat formula:

$$Q = mc\Delta T$$

where Q is the heat energy (calories), m is the mass of the substance (grams), c is the specific heat of the substance (calories/g°C), and ΔT is the change in temperature (°C).

Since the only place the heat energy could have come from is the material being tested, we now have a value for the amount of heat energy contained in the material.



Example:

A piece of food is tested in a calorimeter to determine how much heat energy it contains. If the water in the calorimeter has a mass of 150 g and the temperature of the water increases by 3°C, how much heat energy was released by the burning of the food (energy stored in the food)?

1. Identify the information given to you in the problem:

$$\text{mass of water} = 150 \text{ g}$$

$$\text{change in temperature} = 3^\circ\text{C}$$

$$\text{specific heat of water} = 1 \text{ cal/g}^\circ\text{C}$$

2. Insert the information into the formula:

$$\text{heat gained} = \text{mass} \times \text{change in temperature} \times \text{specific heat}$$

$$\text{heat gained} = 150 \text{ g} \times 3^\circ\text{C} \times 1 \text{ cal/g}^\circ\text{C}$$

3. Solving the problem gives a heat energy value of 450 calories for the food.

Note: If we know the mass of the food, we can calculate the number of calories per gram of that type of food. This, then, enables us to calculate the heat energy of any mass of that type of food.

A note about heat energy calories and food calories. One food calorie is equal to 1,000 heat energy calories or 1 kcal. Food calories are often written as *Calories* (with a capital C) to help you remember that they are larger than heat energy calories. If you consume a potato chip that has, according to the nutritional label, 15 *Calories*, you are actually consuming 15,000 *calories* of potential heat energy.

2. Calculating heat energy

1. A calorimeter contains 350 g of water. When a chemical reaction occurs in reaction chamber, the water experiences a change in temperature of 35°C. How much heat energy was released by the chemical reaction?
-
2. When a sample of material is combusted in the reaction chamber of a calorimeter, the 500 g of water in the device experiences an increase in temperature from 25°C to 28°C. How much heat energy was stored in the material?
-

3. A chemical reaction conducted in a calorimeter releases 9,000 calories of heat energy. If the calorimeter contains 400 g of 20° C water at the start of the reaction, what will be the temperature of the water in the calorimeter at the conclusion of the chemical reaction?

4. A nutritionist wishes to know the energy value for a piece of food. She uses a calorimeter in which she places 200 g of water. The change in temperature in the water after the food has been completely combusted is 15°C. How much heat energy was stored in the food?

5. If the mass of the food in question (4) was 8 grams, how many calories of heat energy were stored per gram in this type of food?

6. There are 9 calories of energy per gram of fat, whereas there are 4 calories in a gram of protein or carbohydrates. If you were going to explore the Antarctic, what kind of food would you pack for your trip and why? To help you answer this question, do some research on the Internet to find out how modern day adventurers are exploring Antarctica.

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Skill Sheet 27-A

Degree Days



Freezing winter weather or sweltering summer heat—in either condition, people use energy to keep their homes, schools, and businesses comfortable. You can use degree day values to help predict how much energy will be needed each month to heat or cool a building. In this activity, you will learn how degree day values are calculated and how to use them to evaluate energy needs.

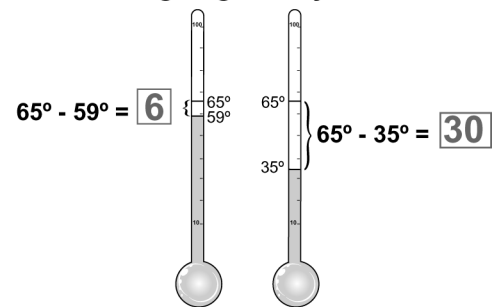
1. Understanding degree days

Degree day values are calculated by comparing a day's average temperature to 65° Fahrenheit. The more extreme the temperature, the higher the degree day value. For example, if the average daily temperature were 72°F, the degree day value would be 72 minus 65, or 7. On a day with an average temperature of 35°F, the degree day value would be 65 minus 35, or 30.

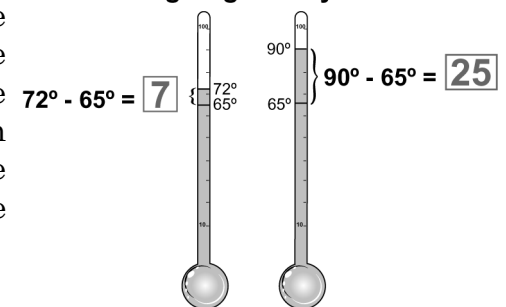
When the average daily temperature is *lower* than 65°F, we use the term **heating degree day value**, because you need to add heat to a building to bring it to a comfortable temperature. When the average daily temperature is *higher* than 65°F, we talk about the **cooling degree day value**.

We compare the daily average temperature to 65°F because 65°F is a temperature at which most people are comfortable without needed heating or air conditioning. If the average temperature is close to 65°F, you won't need to spend much money heating or cooling your home that day. However, if the average temperature is well above or below 65°F, you'll be spending a lot more money on electricity or fuel.

Heating Degree Day Values



Cooling Degree Day Values



1. On July 22, 2002, the average daily temperature in St. Louis, Missouri, was 88°F. Calculate the cooling degree day value.

2. On January 22, 2003, the average daily temperature in St. Louis was 14°F. Calculate the cooling degree day value.

3. On which day—July 22, 2002 or January 22, 2003—was the heating degree day value zero? On which day was the cooling degree day value zero?

2. Using temperature data to calculate degree day values

The table below shows temperature data recorded by the National Weather Service in May 2003.

Table 1: Temperature data for St. Louis, May 1-14, 2003

Day	High temp (°F)	Low temp (°F)	Average temp (high +low)÷2	Heating degree day value	Cooling degree day value
1	73	61	$(73+61)÷2 = 67$	0	2
2	63	52			
3	70	44			
4	65	52			
5	83	58			
6	79	59			
7	74	60			
8	71	53			
9	90	70			
10	82	62			
11	65	52			
12	71	52			
13	74	56			
14	75	60			
Two week totals:					

1. Calculate the average temperature, the heating degree day value, and the cooling degree day value for each day. Record your answers in the Table 1. The first one is done for you.
 2. During the first two weeks of May, on how many days were St. Louis residents more likely to use their heating systems? On how many days were they more likely to cool their homes?
-

3. Calculating monthly totals for degree day values

1. Find the sum of the numbers in the fifth column of Table 1. This will give you the *total heating degree day value* for May 1-14, 2003. Record your answer in the table's last row.
 2. Find the *total cooling degree day value* for same time period by finding the sum of the sixth column of Table 1. Record your answer in the table's last row.
 3. The total heating degree day value for May 15-31, 2003 was 31. The total cooling degree day value was 32. Find the *monthly* total heating and cooling degree day values.
-
4. In St. Louis, the average total heating degree day value for May is 79. The average total cooling degree day value for May is 114. How was May 2003 different from the average? Do you think residents used more energy than usual to keep their homes comfortable, or less?
-

4. Using average monthly degree day values

The National Weather Service provides average monthly degree day values to help citizens better evaluate their energy needs.

Average monthly heating degree day (HDD) and cooling degree day (CDD) values for St. Louis

January		February		March		April		May		June	
HDD	CDD	HDD	CDD	HDD	CDD	HDD	CDD	HDD	CDD	HDD	CDD
1097	0	844	0	613	7	294	32	79	114	6	316

Average monthly heating degree day (HDD) and cooling degree day (CDD) values for St. Louis

July		August		September		October		November		December	
HDD	CDD	HDD	CDD	HDD	CDD	HDD	CDD	HDD	CDD	HDD	CDD
0	461	1	396	46	196	246	36	583	3	949	0

1. On a separate piece of paper, make a bar graph showing the average monthly heating and cooling degree day values for St. Louis. Place months on the x -axis and monthly average degree day values on the y -axis. Use red bars for the heating degree day values and blue bars for the cooling degree day values. Use your graph to answer the following questions:
 2. In which month should a St. Louis resident budget the most money for heating costs?

 3. In which month should a St. Louis resident budget the most money for cooling costs?

 4.
 - a In which month do you think a St. Louis resident will spend the least amount of money to keep their home at a comfortable temperature? Explain.

 - b Challenge! What additional information would you need to calculate the actual monthly heating and cooling costs for a particular building?

All climate data courtesy of the National Weather Service St. Louis Weather Station.

Name:

Skill Sheet 27-B

Using a Weather Map



You have read about how Earth and its atmosphere are affected by heating and cooling. You have learned how the sun heats the Earth and how the heating of land is different than the heating of water. Based on your readings, you are going to analyze the national weather forecast and make deductions as to what causes differences in weather across the nation.

1. Analyzing temperature

Your teacher has provided you with a national weather forecast from a daily newspaper. Locate the list of the temperature and sky cover in cities around the country. Also, locate the weather map showing sunny regions, the temperature, high- and low-pressure regions, and fronts.

Begin the Investigation by recording the high and low temperatures for cities in the table below. Then find the difference between the two temperature readings. You will fill in the rest of the table later.

City	High	Low	Temp difference	Sky cover	Pressure
Seattle					
Los Angeles					
Las Vegas					
Phoenix					
Atlanta					
Tampa					
San Francisco					
Oklahoma City					
New Orleans					
Kansas City					
Tucson					
Denver					
Dallas					
Houston					
Minneapolis					
Memphis					
Chicago					
Miami					
New York					
Baltimore					

2. What causes the wide variety of temperature conditions across the map?

Use the table in part 1 to respond to the following.

1. Give examples of differences in the cities' high temperatures due to latitude. Explain why these differences exist.

2. Give examples of differences in the cities' high temperatures due to geographical features such as the Pacific Ocean, the Rocky Mountains, the Great Lakes, or the Atlantic Ocean. Explain why geography influences temperatures.

3. Give examples of differences in the cities' temperature *ranges* due to the biomes in which they are located. Explain why different biomes have different temperature characteristics.

4. Fill in the table for the sky cover for each city. How does the sky cover affect the temperatures of cities near the same latitude? Why do you think this is?

3. What does atmospheric pressure tell us about the weather?

1. On your weather map, over which states are areas of high pressure centered? Over which states are low-pressure areas centered?

2. In the sixth column of the table (the heading is **Pressure**) in part 1, record whether you think each city is in a region of high pressure, low pressure, or in-between.

3. What kind of cloud cover or weather is associated with high-pressure regions? Look at the sky cover for the cities in the high-pressure regions. What do you think the humidity is like in these regions?

4. What kind of cloud cover or weather is associated with low-pressure regions? Look at the sky cover for the cities in the low-pressure regions. What do you think the humidity is like in these regions?

5. Locate the fronts shown on the weather map. The flags on the fronts tell us the direction of the wind. The cold fronts are symbolized by triangular flags, the warm fronts by semicircular flags. Are fronts associated with high- or low-pressure regions?

6. What type of weather is associated with a warm front? What type of weather is associated with a cold front?

7. Based on what you have read about low- and high-pressure regions, let's investigate what effect they have on the wind. High-pressure regions tend to push air toward low-pressure regions. Do you think the air in a low-pressure region tends to sink or rise? Does the air in a high-pressure region sink or rise?

8. Based on those conclusions, how do you think low-pressure regions contribute to the formation of rainstorms?

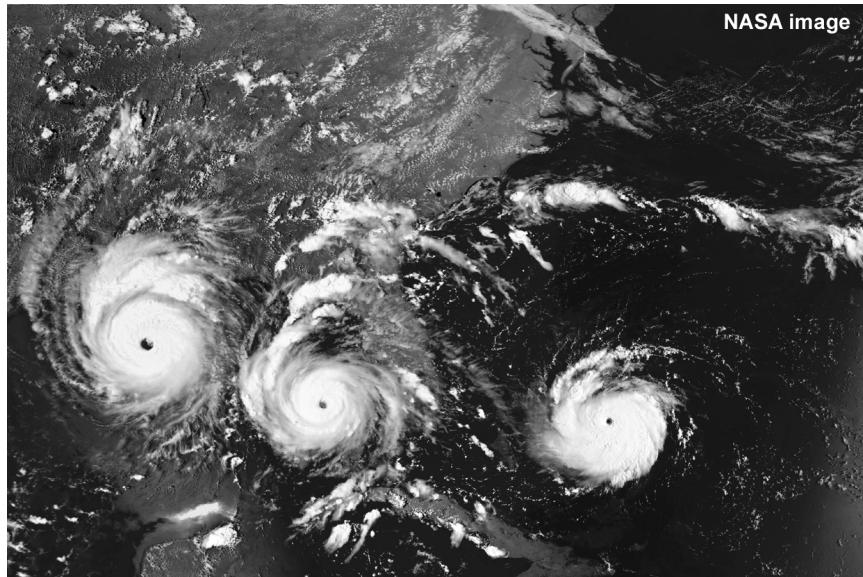
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Skill Sheet 27-C

Tracking Hurricanes



Hurricane Andrew (August 1992) was one of the most devastating storms of the twentieth century. Originally labelled a Category 4 storm, it was recently upgraded to a Category 5, the most severe type of hurricane. Scientists use satellite data and weather instruments dropped by aircraft to measure the storm's intensity. As research techniques improve, weather experts can more accurately analyze data collected by these instruments. NOAA scientists have now determined that Andrew's sustained winds reached at least 165 miles per hour. In this activity, you will track Hurricane Andrew's treacherous journey.



Time-lapse satellite image of Hurricane Andrew's path

1. The storm's beginning

Hurricane Andrew was born as a result of a tropical wave which moved off the west coast of Africa and passed south of the Cape Verde Islands. On August 17, 1992, it became a tropical storm. That means it had sustained winds of 39-73 miles per hour.

1. At 1200 Greenwich Mean Time (GMT) on August 17, Tropical Storm Andrew was located at 12.3°N latitude and 42.0°W longitude. The wind speed was 40 miles per hour. Plot the storm's location on your map (see last page of this skill sheet).
2. For the next four days, Tropical Storm Andrew moved uneventfully west-northwest across the Atlantic. Plot the storm's path as it traveled toward the Caribbean Islands.

Table I: Tropical Storm Andrew's path

Date	Time (GMT)	Latitude (°N)	Longitude (°W)	Wind speed (mph)
8/18/1992	1200	14.6	49.9	52
8/19/1992	1200	18.0	56.9	52
8/20/1992	1200	21.7	60.7	46
8/21/1992	1200	24.4	64.2	58

2. The storm intensifies

Late on August 21, a deep high pressure center developed over the southeastern United States and extended eastward to an area just north of Tropical Storm Andrew. In response to this more favorable environment, the storm strengthened rapidly and turned westward. At 1200 GMT on August 22, the storm reached hurricane status, meaning it had sustained winds of at least 74 miles per hour.

1. Plot Hurricane Andrew's path over the next two days.

Table 2: Hurricane Andrew's path

Date	Time (GMT)	Latitude (°N)	Longitude (°W)	Wind speed (mph)
8/22/1992	1200	25.8	68.3	81
8/23/1992	1200	25.4	74.2	138

2. Hurricane watches are issued when hurricane conditions are *possible* in the area, usually within 36 hours. Hurricane warnings are issued when hurricane conditions are *expected* in the area within 24 hours. Look at the distance the hurricane travelled in the last 24 hours and use that information to predict where it might be in 24 hours, and in 36 hours. Name one area that you would declare under a hurricane watch, and an area that you would declare under a hurricane warning.
-
-

3. Landfall

On the evening of August 23, Hurricane Andrew first made landfall. Landfall is defined as when the center of the hurricane's eye is over land.

1. Plot the point of Hurricane Andrew's first landfall.

Table 3: Hurricane Andrew's first landfall

Date	Time (GMT)	Latitude (°N)	Longitude (°W)	Wind speed (mph)
8/23/1992	2100	25.4	76.6	150

2. Where did this first landfall occur?
-
-

4. Hurricane Andrew crosses the Gulf Stream and strikes the United States

During the night of August 23, Hurricane Andrew briefly weakened as it moved over land. However, once the storm moved back over open waters, it rapidly regained strength. The warm water of the Gulf Stream increased the intensity of the hurricane's convection cycle. At 0905 GMT on August 24, Hurricane Andrew made landfall again.

1. Plot the point of Hurricane Andrew's next landfall.

Table 4: Hurricane Andrew's next landfall

Date	Time (GMT)	Latitude (°N)	Longitude (°W)	Wind speed (mph)
8/24/1992	0905	25.5	80.3	144

2. Where did this landfall occur?
-
-

5. The final landfall

After making its first landfall in the United States (where it caused an estimated \$25 billion in damage), Hurricane Andrew moved northwest across the Gulf of Mexico. On the morning of August 26, 1992 Hurricane Andrew made its final landfall. Afterward, Andrew weakened rapidly to tropical storm strength in about 10 hours, and then began to dissipate.

1. Plot Andrew's course across the Gulf of Mexico and its final landfall.

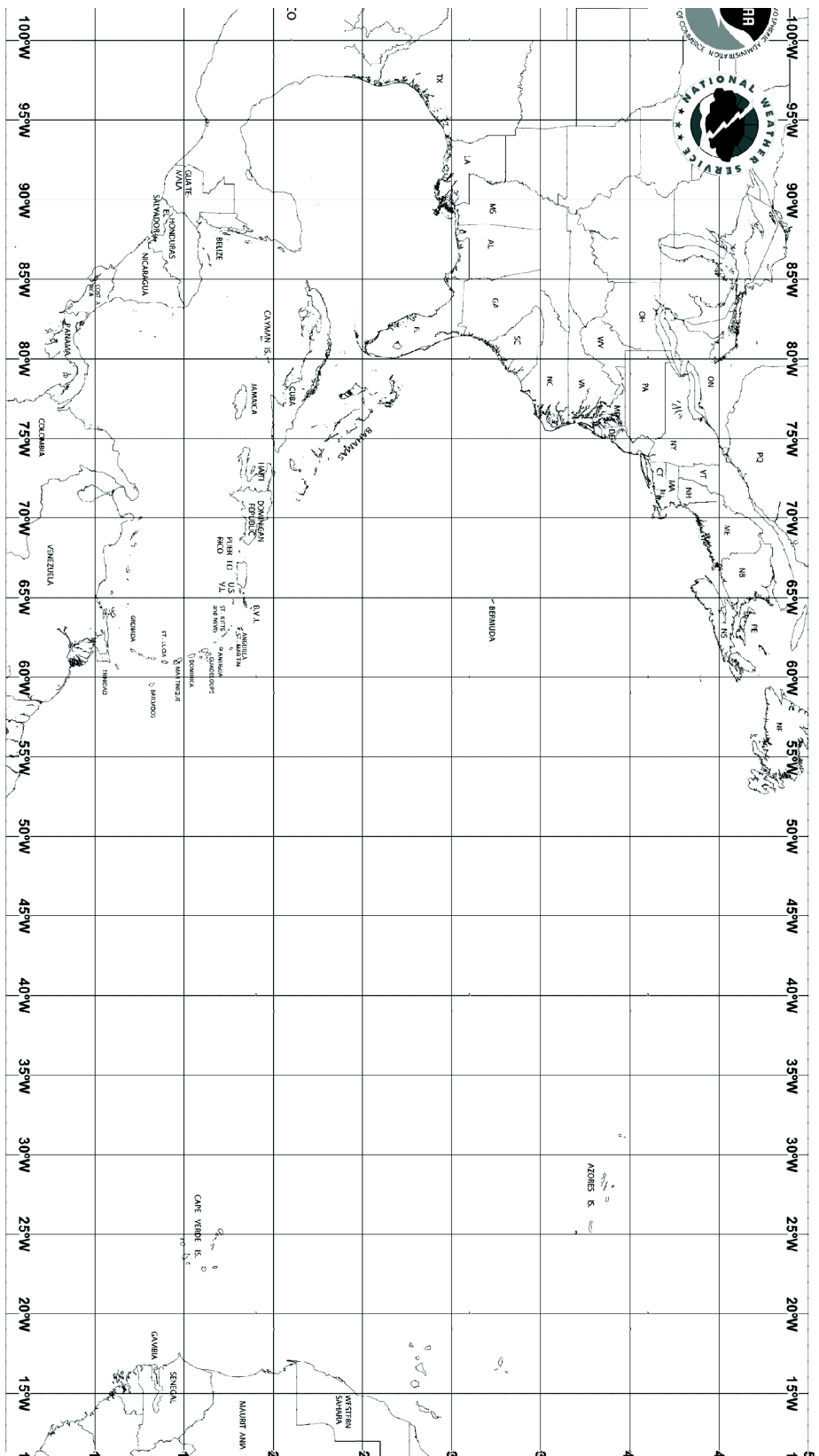
Table 5: Hurricane Andrew's next landfall

Date	Time (GMT)	Latitude (°N)	Longitude (°W)	Wind speed (mph)
8/24/1992	1800	25.8	83.1	133
8/25/1992	1800	27.8	89.6	138
8/26/1992	0830	29.6	91.5	121

2. In which state did Hurricane Andrew's final landfall occur?
-
-

Hurricane information provided by National Oceanographic and Atmospheric Administration's National Hurricane Center.

Atlantic Basin Hurricane Tracking Chart National Hurricane Center, Miami, Florida



This is a reduced version of the chart used to track hurricanes at the National Hurricane Center