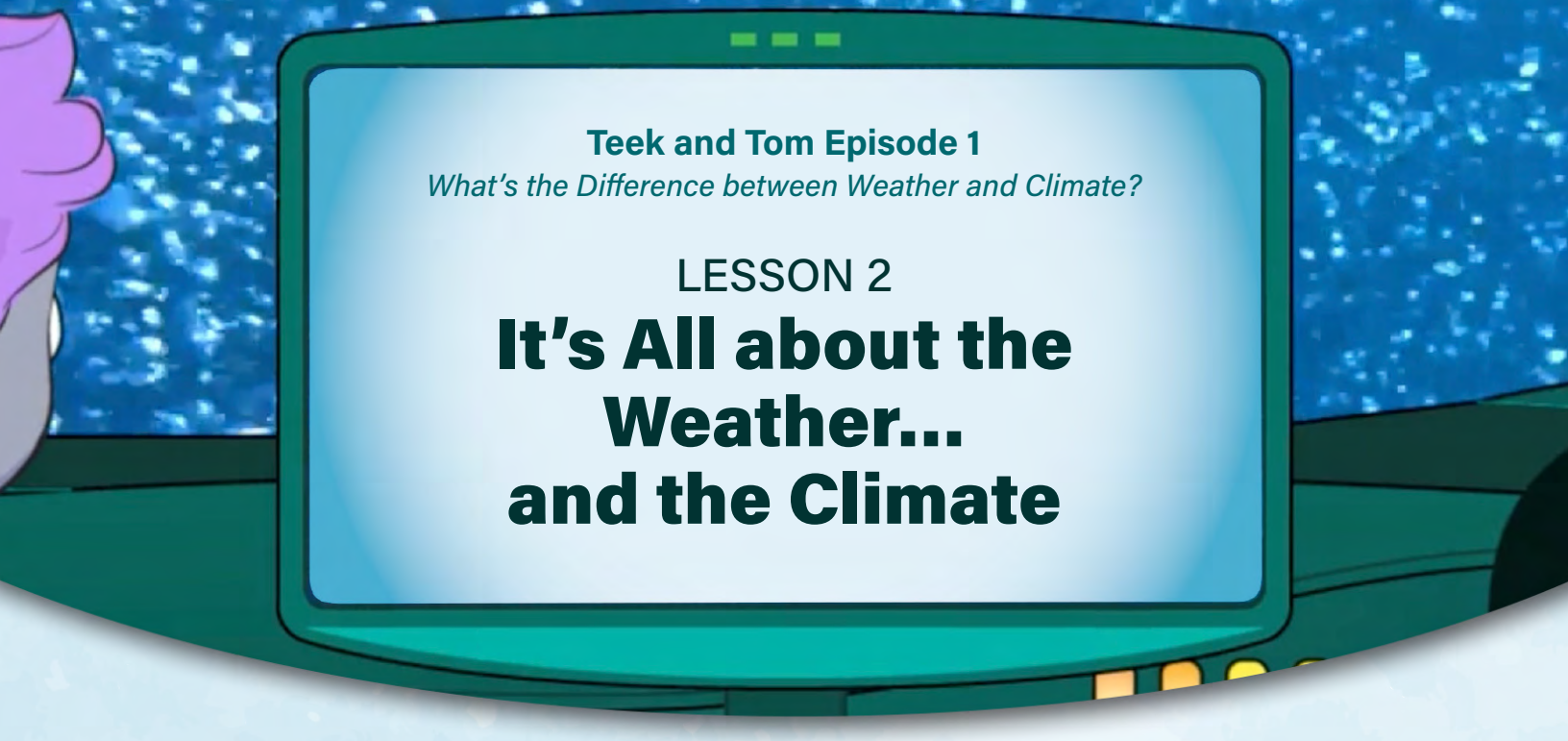


Teek and Tom Episode 1

What's the Difference between Weather and Climate?

LESSON 2

It's All about the Weather... and the Climate

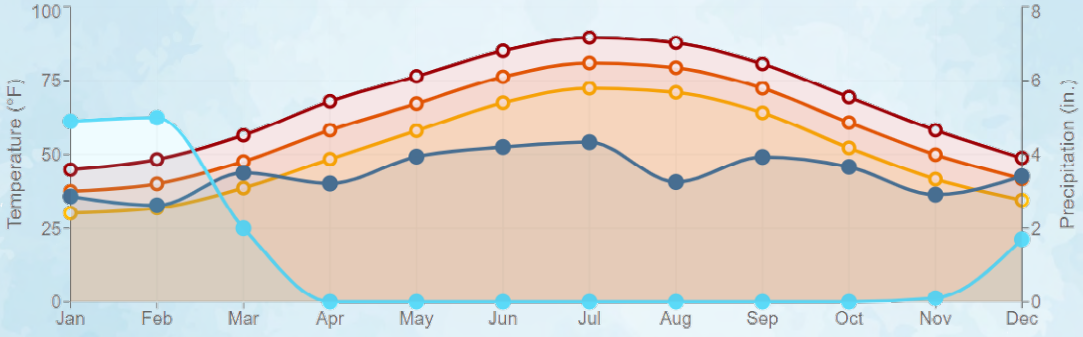
All URLs were reviewed and accurate at the time of this lesson's publication. If you should come across a non-operational link, contact NOAA Ocean Service Education at oceanserviceseducation@noaa.gov. All images are credited to NOAA unless otherwise noted.

Introduction

Weather stations across the United States have provided observations over many decades. The weather measurements collected over the most recent 30 years are averaged to produce "climate normals." Climate normal data can be put into simple graphs of temperature and precipitation to show a location's climate. These are updated every ten years. Weather and climate use measurements of temperature, precipitation, humidity, wind speed, and direction. Weather forecasts use short-term data, while climate predictions use averages of 30 years of data.

The climate normal graph below shows 30 years of averaged data. The average monthly precipitation (rain) at Ronald Reagan Washington National Airport (AP) in Virginia is in dark blue. The average monthly snow is represented in light blue. The average minimum monthly temperatures are in yellow, the average maximum monthly temperatures are in red, and the average of the minimum and maximum monthly temperatures are in orange.

Ronald Reagan Washington National Airport



The latitude of a location on the Earth has a primary influence on its climate. This is due to the tilt of the Earth on its axis and the amount of solar radiation reaching it. Other factors that affect climate in a particular region are nearness to large bodies of water, elevation, the rain shadow effect of mountains, global wind and ocean current patterns, and cloud cover.

In general, we expect cities near water to have more moderate temperatures. They experience a smaller range of temperatures between day and night, and their seasons are milder. Cities near water also have more precipitation depending on the prevailing wind patterns. An island's windward side faces the prevailing winds, whereas the island's leeward side faces away from the wind, sheltered by hills and mountains. As winds blow across the ocean, they pick up and transport moisture pulled directly from the water. (Refer to the graphic in the student record sheets.)

Precipitation is also strongly affected by the nearness of mountains. The side of a mountain range that faces the wind, the windward side, will have higher precipitation. The opposite side of the mountain, or leeward side, will often be in a rain shadow, with very little rain. (Refer to the graphic in the student record sheets.)

Lesson Summary

In lesson one, students were introduced to a basic understanding of the difference between weather and climate. In this activity, they will look at the factors that influence precipitation and temperatures of a location, and then make decisions based on climate information.

Credit: Getty Images

Objectives

- Students will investigate weather and climate through maps and archived data.
- Students will examine data from a location and compare it to other locations to determine the effect of geographic features on temperature and precipitation.

Estimated Time

It is estimated that one to two 45-minute class periods are needed for this lesson. This does not include the time required to view Teek and Tom Episode 1: *"What's the Difference Between Weather and Climate?"*, 16:45 minutes (https://oceantoday.noaa.gov/teekandtom/episode-1.html).

Education Standards

The lessons that accompany the Teek and Tom series were designed for upper elementary and middle school students. The Standards addressed are abbreviated here with a full list in Appendix A (https://oceantoday.noaa.gov/teekandtom/educators-guide/appendix-a.pdf).

Next Generation Science Standards

- **3-ESS2-1: Earth's Systems.** Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.
- **MS-ESS2-5: Earth's Systems.** Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.

Common Core English and Language Arts: Writing Standards Grades 4-5

Common Core Mathematics: Measurement and Data - Represent and interpret data.

College, Career, and Civic Life (C3) Framework for Social Studies: Geographic Representations

Materials

For a class of 30

- Pencils (one per student)
- Scissors
- Tape or glue
- Students will need printouts of student record sheets, graphs, and/or maps to carry out the activities. Student record sheets are located at the end of this lesson.
- If you would like to provide the maps/graphics on a projection system, students will only need the student record sheets. Depending on the configuration of your classroom, we recommend one set per student or group.
- All maps/graphics presented in the activity are available as a slide set to project or present while teaching these activities. (https://oceantoday.noaa.gov/teekandtom/educators-guide/slide-set-2.zip)

Preparation

1. The teacher notes below include information about finding local maps/data.
2. Teacher notes/extensions, etc., below also include ways to explore the topic or activity further. Additional content to explore is available in the extensions section of the lesson.

InvesTeekation Pathway

Part 1. Engage

Review the visuals the students made in the previous activity/lesson 1. Give students the sheet of phrases to cut out so that they can arrange these on the student record sheets. This activity is best done in pairs or small groups to encourage discussion. The answer key is below.

WEATHER	CLIMATE
Tells us what kind of clothes to wear today.	*A picture that comes to mind when you think of a faraway place.*
May affect what activities I do outside today.	*We usually have a snowstorm in December.*
Can change from day to day.	*Heat waves have become more common in my area for the past few years.*
Tells us whether to take an umbrella today.	*Tells us what kind of clothes to buy.*
Tells us whether to put on clothes for snow today.	*Summer is usually very hot.*
What you see when you look out the window today.	*There are four seasons where I live.*

EXPLORE

Part 2. Explore

1. Students will learn how weather data collected over time is used to develop climate normals. Using a hypothetical story about Tom Di Liberto, they will use real data and calculate the mean for minimum temperature, maximum temperature, and precipitation for a period of 10 years. Note: Since the date of each year is in July, the precipitation is rain.

Answers to the 10-year mean data table.

Mean Minimum Temperature	Mean Maximum Temperature	Mean Precipitation
67 °F	*87.1 °F*	*0.014 inches*

Ten years of data is not enough to develop a picture of average climate characteristics. The latest 30-year period (1991-2020) is used to create the graphs for this activity.

2. Have students look at the climate normal graphs for temperature and precipitation for Tom's hypothetical home in Beltsville, Maryland. In this case, temperature and precipitation are shown in separate graphs. Usually, temperature and precipitation are shown together. Students are asked a series of questions about the temperature and precipitation graphs.

Discussion questions

1. In July, the mean minimum temperature (climate normal) was 67.6 °F, and the mean maximum temperature (climate normal) was 87.1 °F. In which years were the maximum temperatures that Tom recorded higher than the climate normals?

   1993, 1994, 1997, 1999, 2000.

2. Do Tom's 10-year mean minimum and maximum temperatures in July fit within the 30-year climate normals? Explain.

   The average minimum temperature in Tom's data was 67 °F, which is very close to the 30-year data of 67.6 °F. His mean maximum temperature of 87.1 °F was the same as the 30-year data.

3. The precipitation climate normals for Beltsville between 1991 and 2020 look like the graph below. The dark blue line represents monthly rain, and the lighter blue line represents monthly snow. The average monthly rainfall (climate normal for 1991-2020) in Beltsville in July over 30 years was 4.51 inches. How did the rainfall that Tom recorded in July over 10 years compare to the climate normal?

   Tom's 0.014 inches of rainfall was much less than the average of 4.51 over 30 years.

4. Compare the accuracy of Tom's 10 years of precipitation data and 30 years of climate data.

   There was not much difference in the temperature data, but there was a big difference in the precipitation data. The 10-year time period might have been a particularly dry stretch of years.

Credit: Shutterstock

Part 3. Explain

1. Students will look at graphs of climate data (climatographs) for U.S. cities. Temperature and precipitation are influenced by factors such as latitude, where the city is located within a landmass, and the presence of ocean currents. Other factors include the city's proximity to mountain ranges or large bodies of water and prevailing winds. As a class, help students find the location of each of the cities discussed in the activity using the map on their student record sheet, the projection slide, or another means that works for you (e.g., Google Maps).
2. The graphs on the student record sheets show climate normals with temperature data for four cities. They should consider which of four factors is the main influencer of that city's temperature range. They will do the same for four cities and four factors that influence yearly precipitation.
3. Emphasize to the students that they should read the graphs carefully. The months are always along the x-axis, and the temperature and precipitation ranges are on the y-axis. For example, ask students to compare the temperature range of Utqiaġvik and Minneapolis. One city reaches 60 °F and the other 100 °F. Also, compare the precipitation range of Tucson and Salt Lake. The graph for Tucson only reaches 2.4 inches, while Salt Lake reaches 16 inches.
4. Discuss the importance of carefully reading the labels on each axis to make accurate comparisons. Each group of four cities will have one primary factor responsible for differences in temperature or precipitation. Emphasize that weather and climate are complicated, and there may be secondary factors present that affect the temperature and/or precipitation.

Discussion questions

Factors that influence temperature

1. *Latitude – Utqiaġvik*
2. *Landmass – Minneapolis/St. Paul*
3. *Ocean currents – San Diego*
4. *Large bodies of water – Jacksonville*

Factors that influence precipitation

1. *Latitude – Tucson*
2. *Landmass – Salt Lake City*
3. *Large bodies of water – Buffalo*
4. *Mountains – Hilo*

Part 4. Elaborate

During episode 1, Teek and Tom visit a farm, and Tom introduces the idea of climate outlooks while Teek gets to drive a tractor. In this activity, students are introduced to a new type of map that represents a climate outlook. The map gives probabilities in percentages of how likely precipitation will be above, below, or near average compared to the climate averaged over 30 years. These are shown by colors that represent the following categories: below normal, normal, or above normal.

Discussion questions

1. When was this climate outlook map issued?

   July 20, 2023

2. What time period does this climate outlook map cover?

   Dec-Jan-Feb 2023-2024

3. Describe what areas of the country will see "likely above normal" precipitation.

   The far southeast part of the U.S., especially South Carolina, Georgia and Florida.

   Do you think that the precipitation will be rain or snow in those areas?

   It is a warm part of the U.S. in winter, so the precipitation will be rain.

4. Describe what areas will see "leaning below normal" precipitation.

   The far north of the central U.S. and areas around the Great Lakes.

   Do you think that precipitation in those areas during that time period will be rain or snow?

   Precipitation in winter will be as snow.

5. How would this climate outlook map help you if you were responsible for preparing a city for flooding events?

   People in the southeast should prepare for heavy rain and potential flash floods. Since the outlook was released in July, there is time to prepare.

6. How would this climate outlook map help you if you were responsible for preparing a city for snowstorm events?

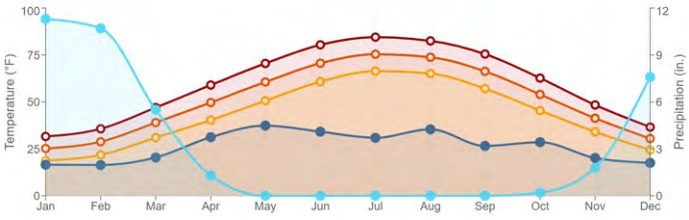
   Cities in the area of leaning below in precipitation, especially snow, might not have to have so many snow plows or salt reservoirs ready.

EVALUATE

Part 5. Evaluate

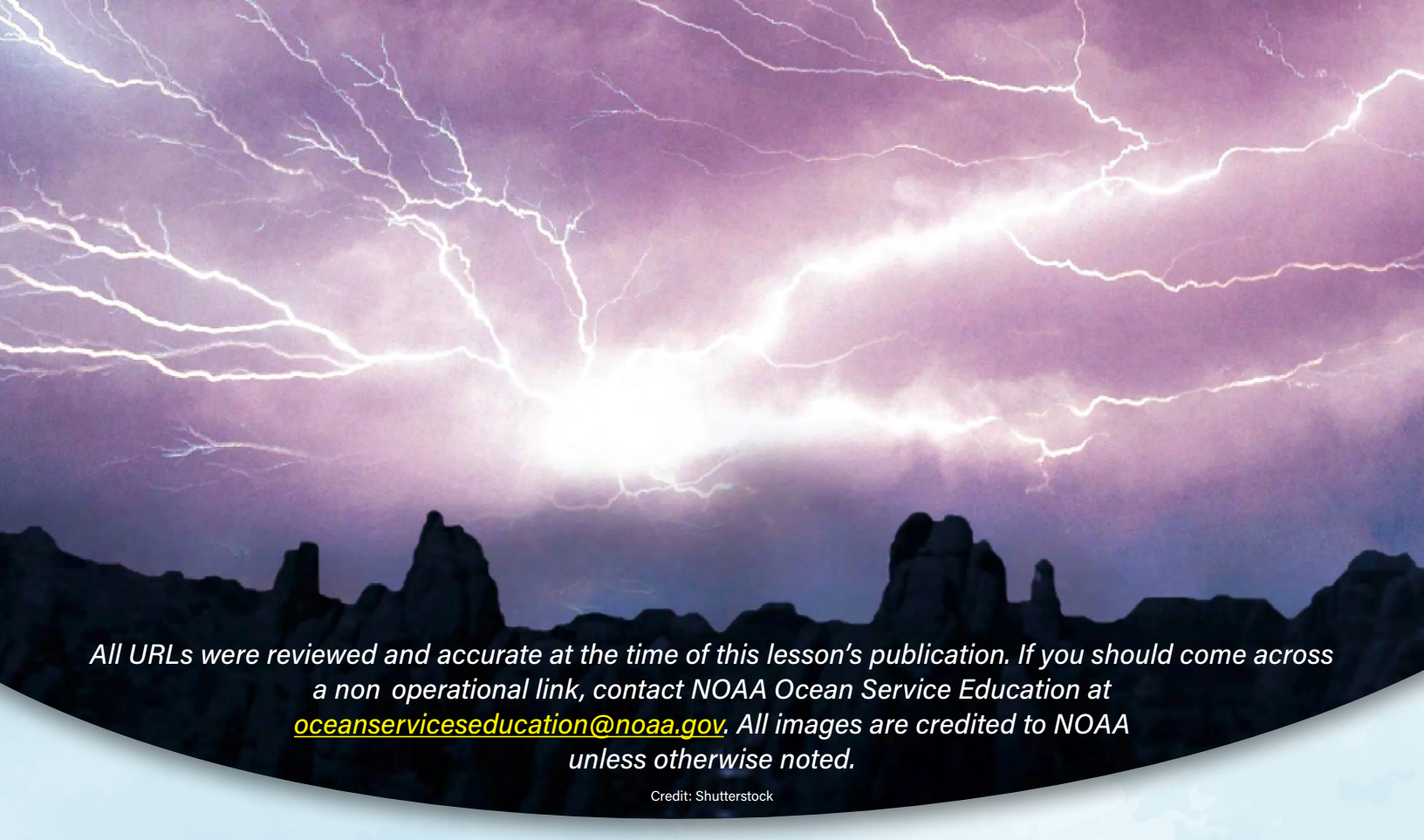
1. Students will apply what they've learned about the effects of geographic features on temperatures and precipitation. They will make up data and use it to create their own climate graph of temperature and precipitation for an imaginary location. They will describe their imaginary location's climate based on the factors that they have learned about.

2. The students should be able to explain how local geographic features affect both the temperature and the precipitation of their city. For example, in the climate normal graph below (Chicago, Illinois), the monthly precipitation (rain) at Chicago O'Hare International Airport is dark blue. The light blue line is monthly snow. The minimum monthly temperature is yellow, the maximum monthly temperature is red, and the average monthly temperature is orange. Chicago is influenced by its closeness to the Great Lakes and its location in the center of the continental United States.



Chicago O'Hare International Airport

If your students are advanced enough, you can provide them with blank graph paper with no labels to construct the climograph.



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Credit: Shutterstock

Extension

Additional information on weather and climate can be found at:

- What's the Difference Between Weather and Climate? NOAA National Centers for Environmental Information (https://www.ncei.noaa.gov/news/weather-vs-climate)
- What is the difference between weather and climate? National Ocean Service (https://oceanservice.noaa.gov/facts/weather_climate.html)

If you want to find temperature or precipitation data for your city, go to NOAA's National Centers for Environmental Information U.S. Climate Normals Quick Access webpage (https://www.ncei.noaa.gov/access/us-climate-normals/#dataset=normals-monthly&timeframe=30&location).

Data is available for climate outlooks of short to longer time periods, as well as archived data. You can find more climate outlook maps on NOAA's National Weather Service Climate Prediction Center webpage (https://www.cpc.ncep.noaa.gov/products/predictions/90day/).

These resources from NOAA's video collections will be helpful for student understanding during discussions regarding their ideas about the influence of temperature and precipitation on climate. The videos show instances of how NOAA provides information about seasonal climate outlooks.

- NOAA Climate YouTube (https://www.youtube.com/user/noaaclimate)
- Videos at Climate.gov (https://www.climate.gov/news-features/videos)

Student Record Sheets

PART 1. In a small group, cut out the phrases below and determine which of them describe climate or weather. Place each phrase in the correct column.

Share your ideas with the class.

WEATHER	CLIMATE

Tells us what kind of clothes to wear today.

A picture that comes to mind when you think of a faraway place.

Tells us what kind of clothes to buy.

We usually have a snowstorm in December.

Can change from day to day.

Tells us whether to take an umbrella today.

Heat waves have become more common in my area for the past few years.

May affect what activities I do outside today.

Tells us whether to put on clothes for snow today.

What you see when you look out the window today.

Summer is usually very hot.

There are four seasons where I live.

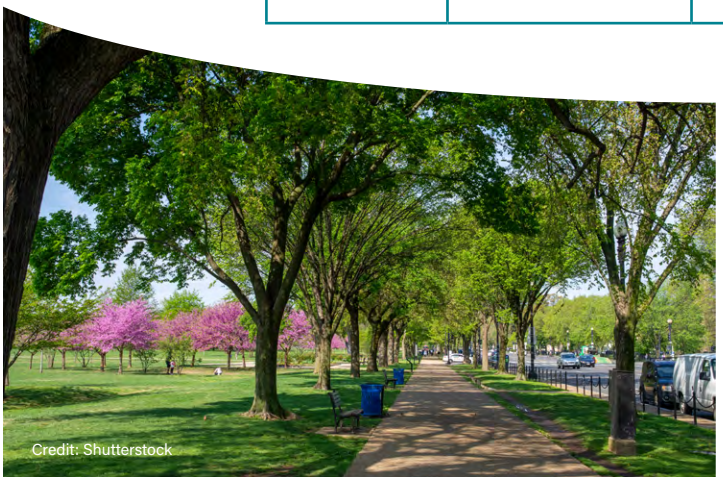
PART 2. STORYTIME!

Tom Di Liberto has always been interested in weather. When he was young, he kept a journal about the weather in Maryland, where he lived. He found weather information in many places, including newspapers, online, or on TV. They always reported the high and low temperatures and the amounts of rain or snow. Weather forecasters use the term precipitation for rain or snow. He started recording that information every day. Over time, he decided to record the weather information on just one day each year: July 4.

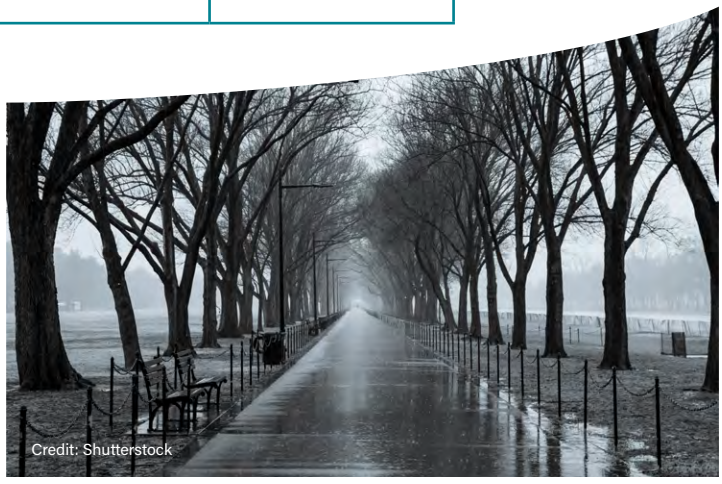
Tom recorded his information for many years until he started working for NOAA as a climate scientist. By that time, his logbook had 10 years of data. Tom wanted to compare his data to NOAA weather records. He found that he needed to find the average (mean) of his data to compare it with NOAA's data.

Calculate the mean for minimum temperature, maximum temperature, and precipitation of Tom's data.

Year	Minimum Temperature (°F)	Maximum Temperature (°F)	Precipitation - Rain (Inches)
1991	70	87	0
1992	66	72	0.12
1993	70	92	0.41
1994	67	90	0.57
1995	66	83	0
1996	58	80	0
1997	65	94	0
1998	63	89	Trace
1999	74	94	0
2000	71	90	0.33
Mean			



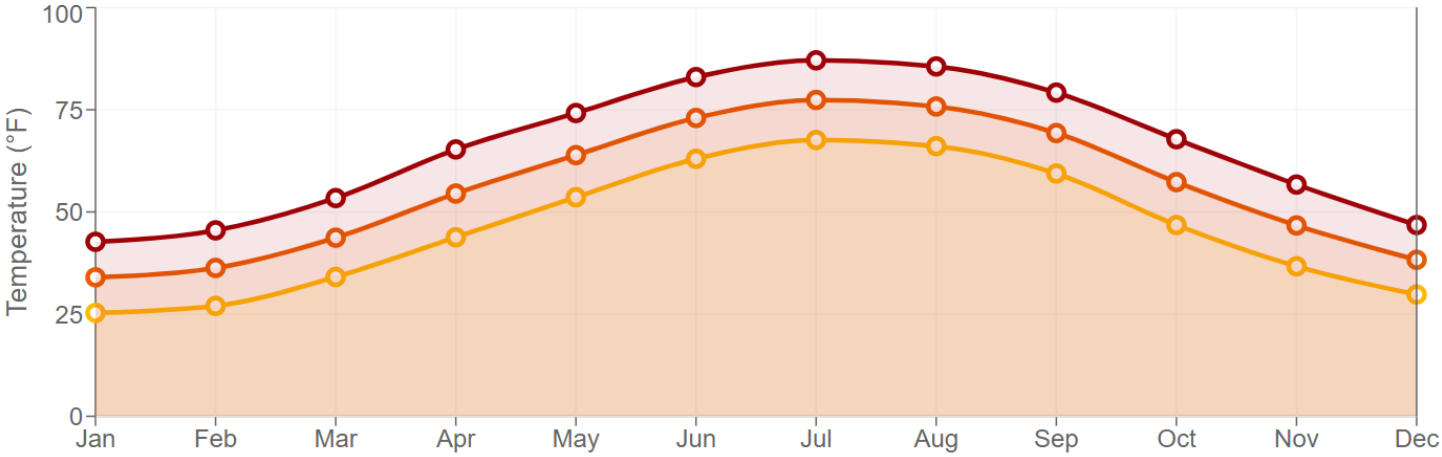
Credit: Shutterstock



Credit: Shutterstock

Scientists use a period of 30 years to show "climate normals." Tom realized that his 10 years of data was not enough to show average climate characteristics. The latest 30-year period (1991-2020) is the most recent "climate normal". Tom found a graph that shows the climate normals for Beltsville, Maryland. (See the graph below.) The dark red top line shows mean maximum temperatures for 30 years. The yellow bottom line is mean minimum temperatures for 30 years, and the middle orange line is the average temperature.

Beltsville, Maryland

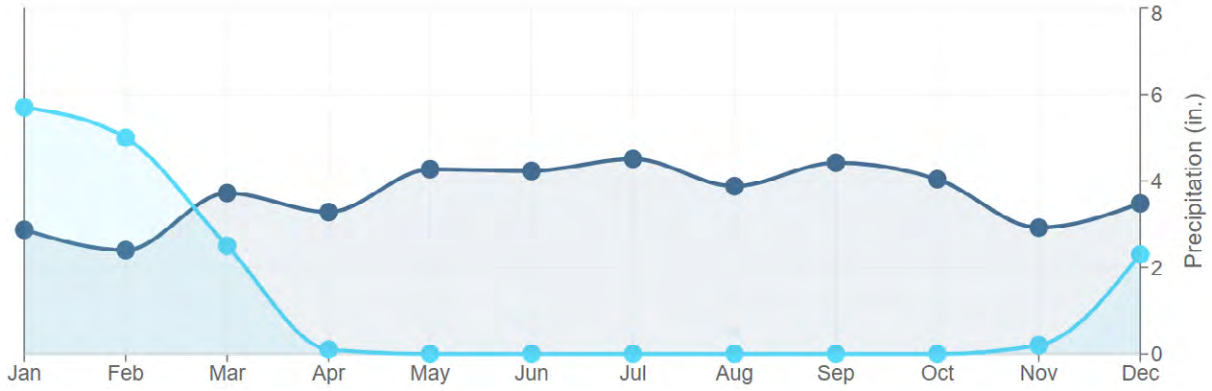


1. In July, the mean minimum temperature (climate normal) was 67.6 °F, and the mean maximum temperature (climate normal) was 87.1 °F. In which years were the maximum temperatures that Tom recorded higher than the climate normals?

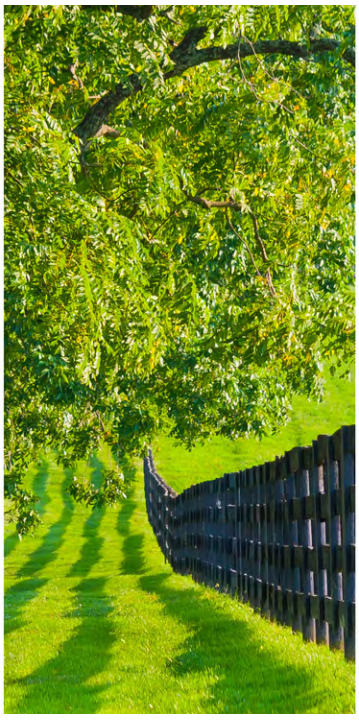
2. Do Tom's 10-year mean minimum and maximum temperatures in July fit within the 30-year climate normals? Explain.

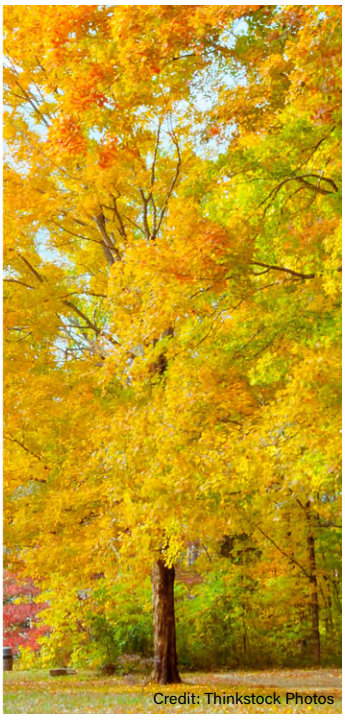
3. The precipitation climate normals for Beltsville between 1991 and 2020 look like the graph below. The dark blue line represents monthly rain, and the lighter blue line represents monthly snow. The average monthly rainfall (climate normal for 1991-2020) in Beltsville in July over 30 years was 4.51 inches. How did the rainfall that Tom recorded in July over 10 years compare to the climate normal?

Beltsville, Maryland



4. Compare the accuracy of Tom's 10 years of data and 30 years of climate data.





Credit: Thinkstock Photos

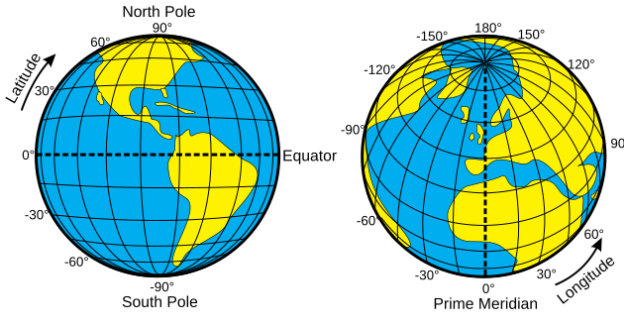
PART 3. The temperatures of a region are affected by many factors. These may include latitude, where the region is within a land mass, or if it is near ocean currents. Below are four factors that influence **temperature**. You will also find four graphs of climate normals for cities in the U.S.

Match the city climate graph with the description of the influencing factor. **Read the graphs carefully.** The months are always along the x-axis. Temperature is on the y-axis. Note that some cities reach higher temperatures, so the y-axis numbers may be different on the graphs.

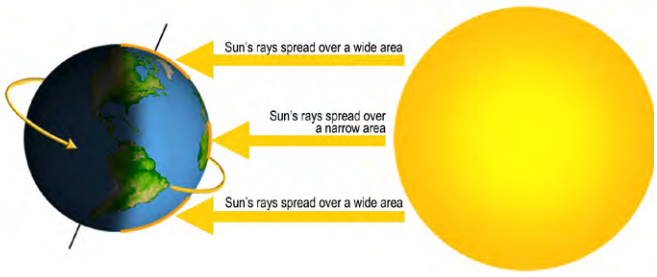
FACTORS THAT INFLUENCE TEMPERATURE

Latitude

Latitude is the measurement of distance north or south of the equator. The equator is the line of 0 degrees latitude. Ninety degrees north of the equator is the North Pole, and 90 degrees south of the equator is the South Pole. Places near the equator are warmer. Places near the poles are colder.



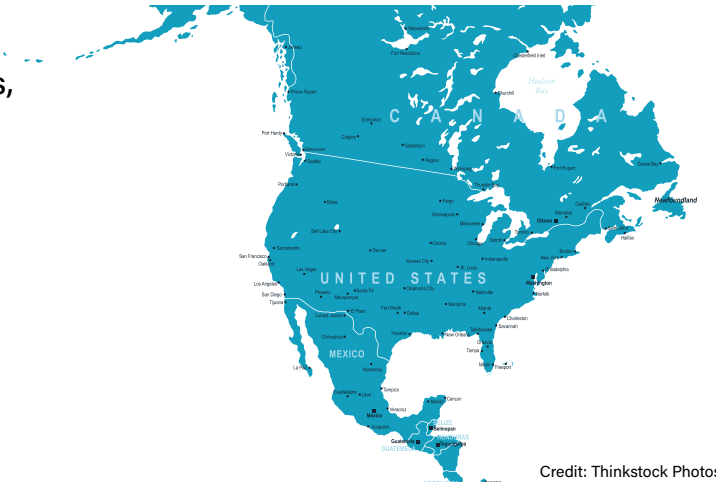
Credit: Wikimedia Commons



Credit: slideshare.net

Landmass

Locations near the center of a large landmass, like a continent, tend to have wide ranges in temperatures. This includes big differences between day and night. Summer may be very hot, and winters may be very cold.



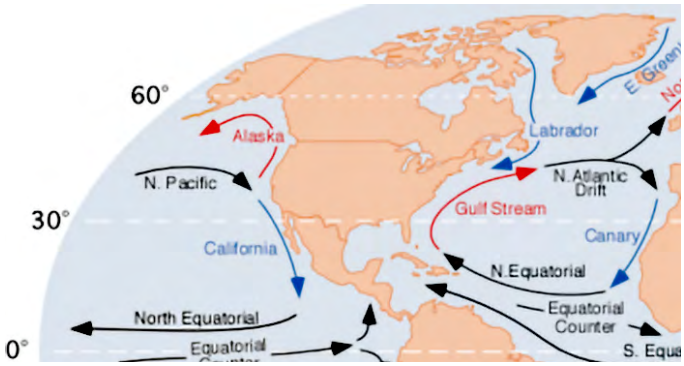
Credit: Thinkstock Photos

Large Bodies of Water

The ocean or the Great Lakes have a moderating effect on temperatures of coastal areas. These regions usually do not have very big differences in temperature between day and night. They also don't have big swings in temperatures during the seasons.

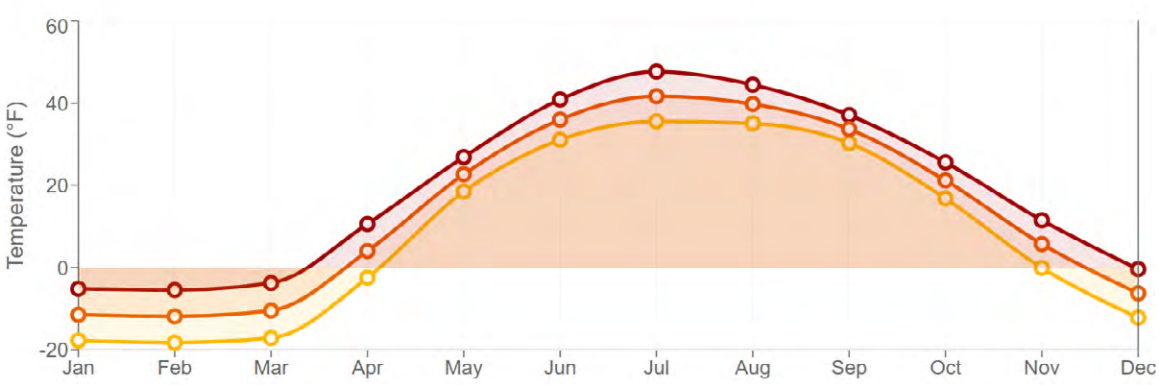
Ocean Currents

Ocean currents are driven by global wind patterns that are fueled by energy from the sun. These currents transfer heat from tropical regions of the Earth to the polar regions, influencing local and global climate. Ocean currents tend to warm temperatures of eastern coastal areas and cool temperatures of western coastal areas.



Credit: Public Domain

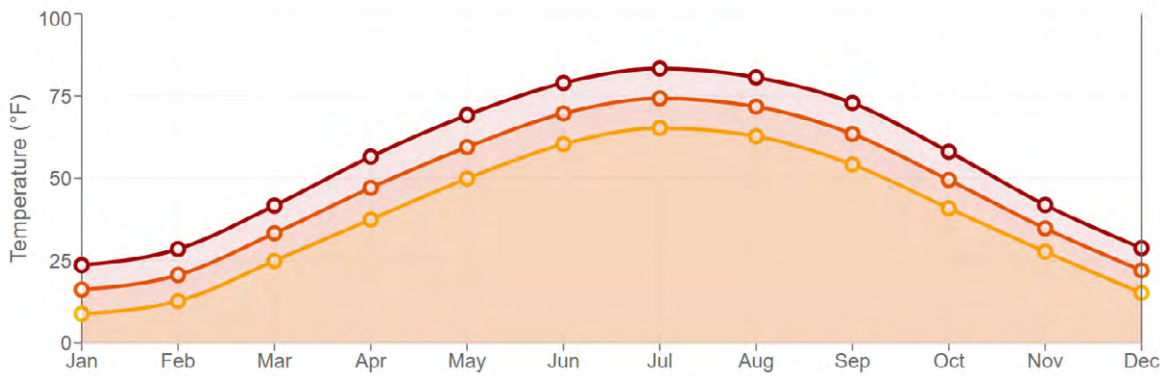
Utqiagvik, AK



1. Which temperature factor do you think affects Utqiagvik, Alaska, the most? Explain.

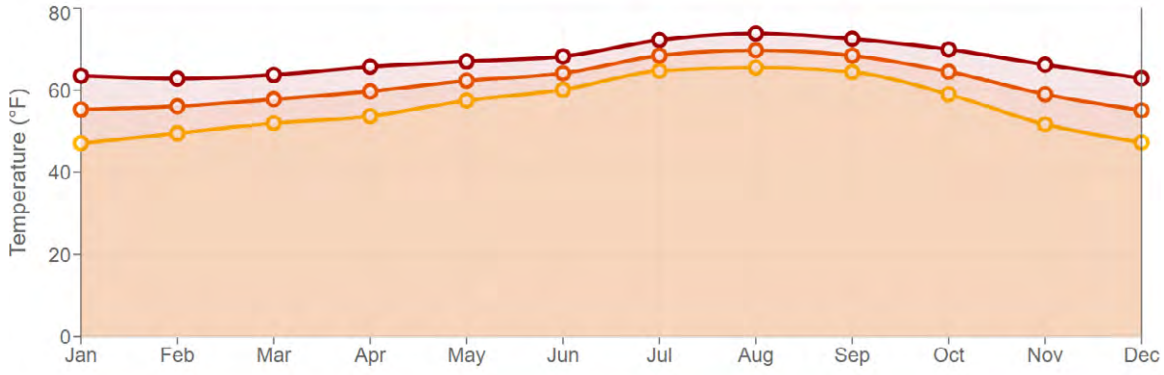
Credit: Shutterstock

Minneapolis/St. Paul, MN



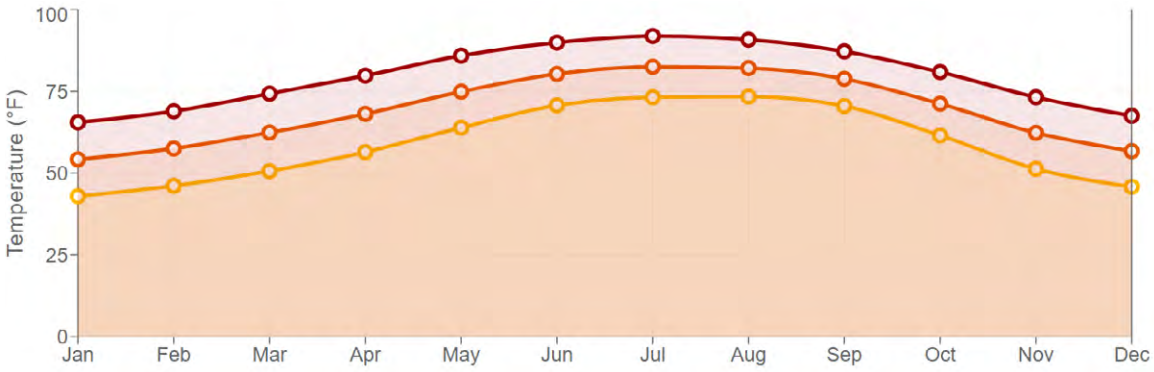
2. Which temperature factor do you think affects Minneapolis/St. Paul, Minnesota, the most? Explain.

San Diego, CA



3. Which temperature factor do you think affects San Diego, California, the most? Explain.

Jacksonville, FL



4. Which temperature factor do you think affects Jacksonville, Florida, the most?

Earth Curiosities

It's a Hot One!

Death Valley in California holds the record for the world's highest surface air temperature ever recorded: 134°F. From May to October, temperatures often reach over 100°F. The valley is a long, narrow basin 282 feet below sea level. It is surrounded by high, steep mountain ranges. The clear, dry air and very few plants allow sunlight to heat the desert surface.


Credit: Shutterstock

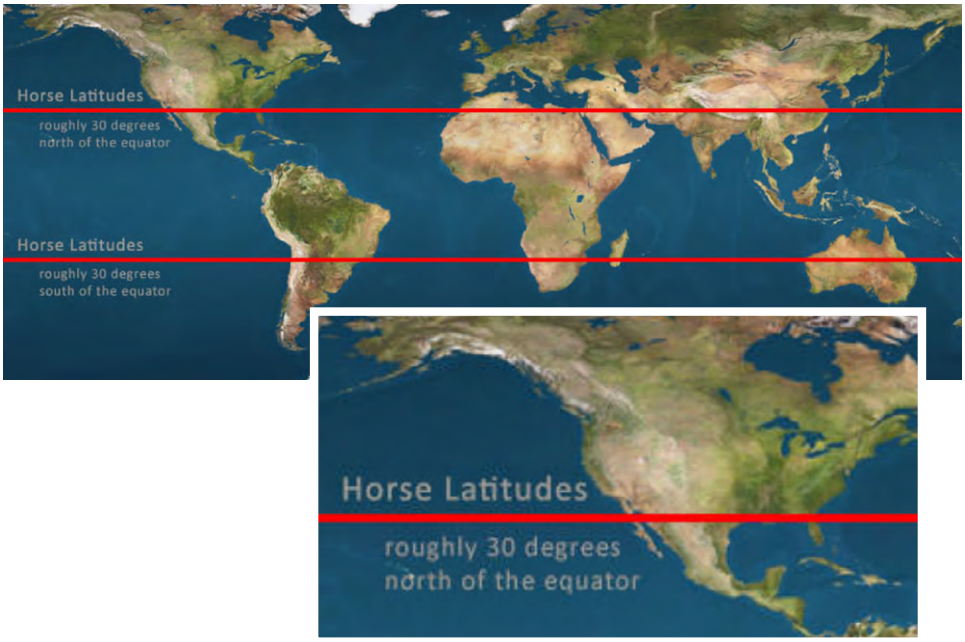
A region's precipitation can be affected by being close to mountain ranges or large bodies of water and the direction of the winds. Below, you will find four factors that influence **precipitation.** You will also find four graphs of climate normals for cities in the U.S. Match the city climate graph with the description of the influencing factor.

NOTE: Read the graphs carefully. The months are always along the x-axis, and the precipitation in inches is on the y-axis. However, depending on the range needed, the numbers may be very different between the graphs. The dark line is rain, and the lighter line is snow.

FACTORS THAT INFLUENCE PRECIPITATION (RAIN OR SNOW)

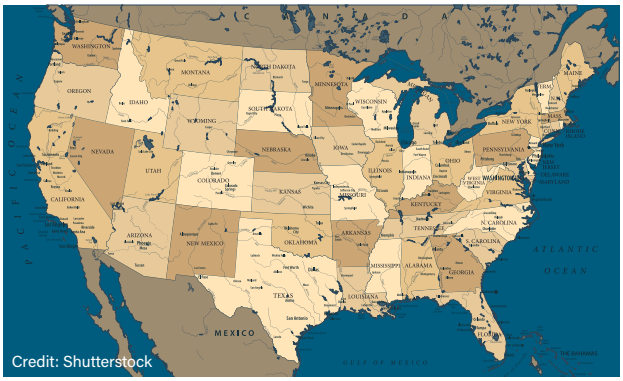
Latitude

The horse latitudes are located at 30 degrees north latitude and 30 degrees south latitude. They are subtropical regions known for calm winds and little precipitation.



Landmass

Locations near the center of a large landmass tend to have drier climates.



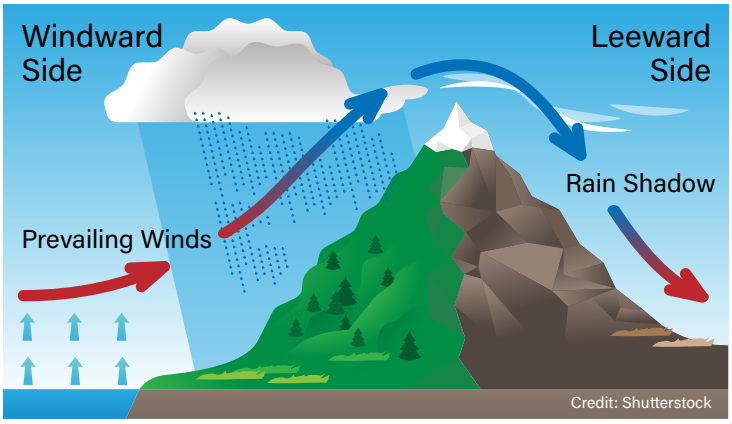
Large Bodies of Water

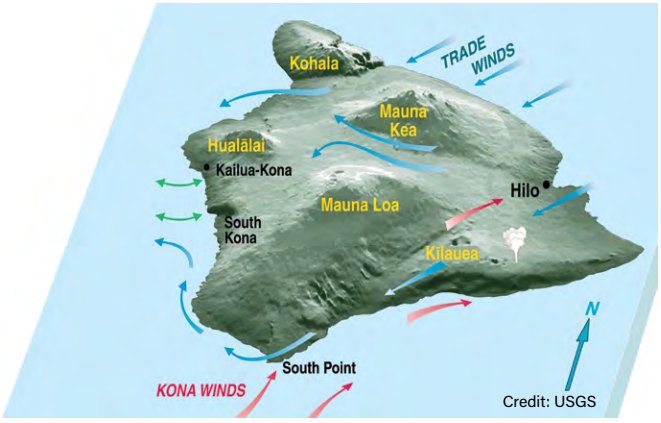
Areas near large bodies of water like the Great Lakes tend to have higher-than-average precipitation (rain or snow). Moisture is picked up as the wind travels across the water from the west and is released further downwind.

FACTORS THAT INFLUENCE PRECIPITATION (RAIN OR SNOW) (continued)

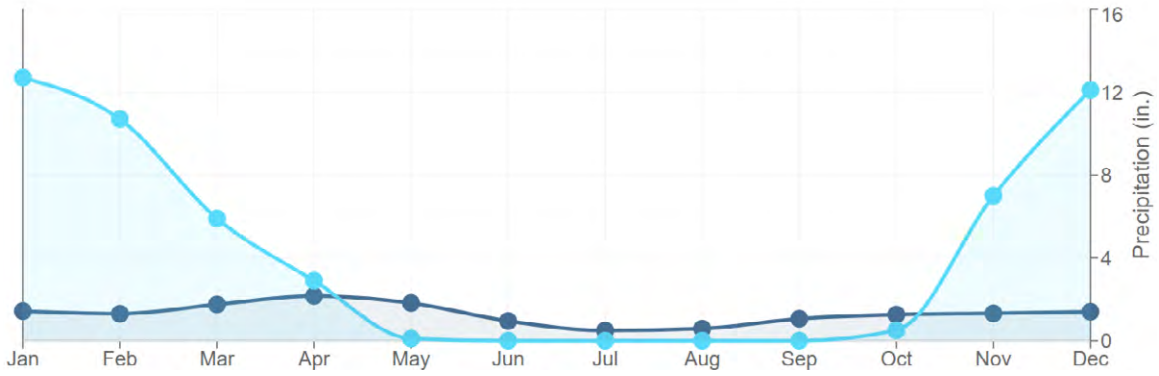
Mountains

An island's windward side faces the prevailing winds. An island's leeward, or downwind side, faces away from the winds and is sheltered from prevailing winds by hills and mountains. As winds blow across the ocean, they pick up moist air from the water. When the moist air reaches an island's hills or mountains, it often releases the moisture as rain. As the air continues to move to the other side of the island, it warms up and dries out. An island's windward side is wetter than its drier leeward side.





Salt Lake City, UT

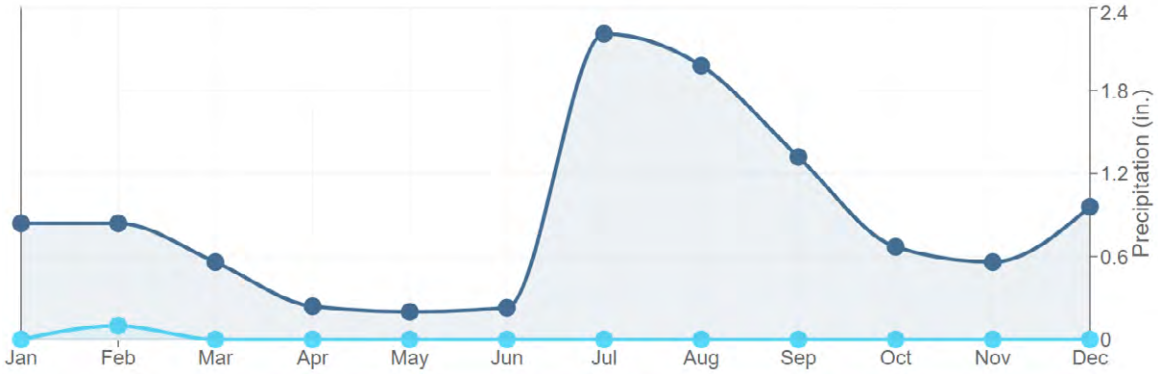


5. Which precipitation factor do you think affects Salt Lake City, Utah, the most? Explain.

Hilo, HI

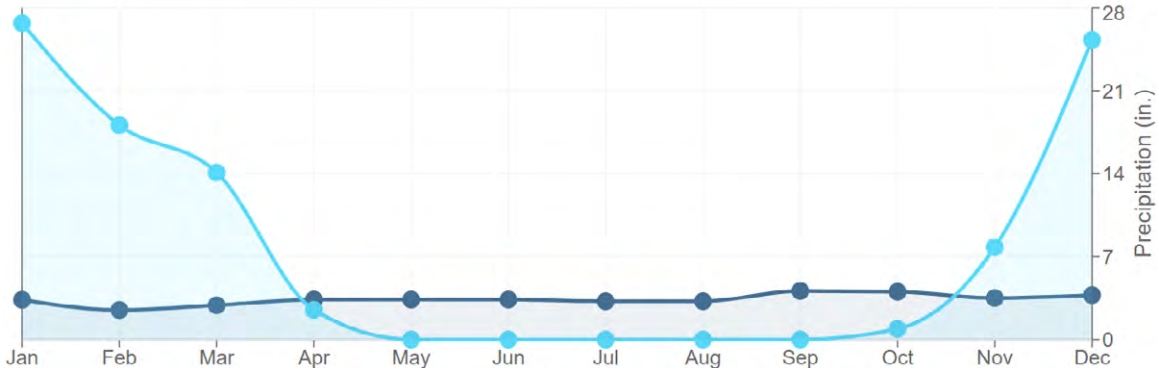
6. Which precipitation factor do you think affects Hilo, Hawaii, the most? Explain.

Tucson, AZ



7. Which precipitation factor do you think affects Tucson, Arizona, the most? Explain.

Buffalo, NY



8. Which precipitation factor do you think affects Buffalo, New York, the most? Explain.

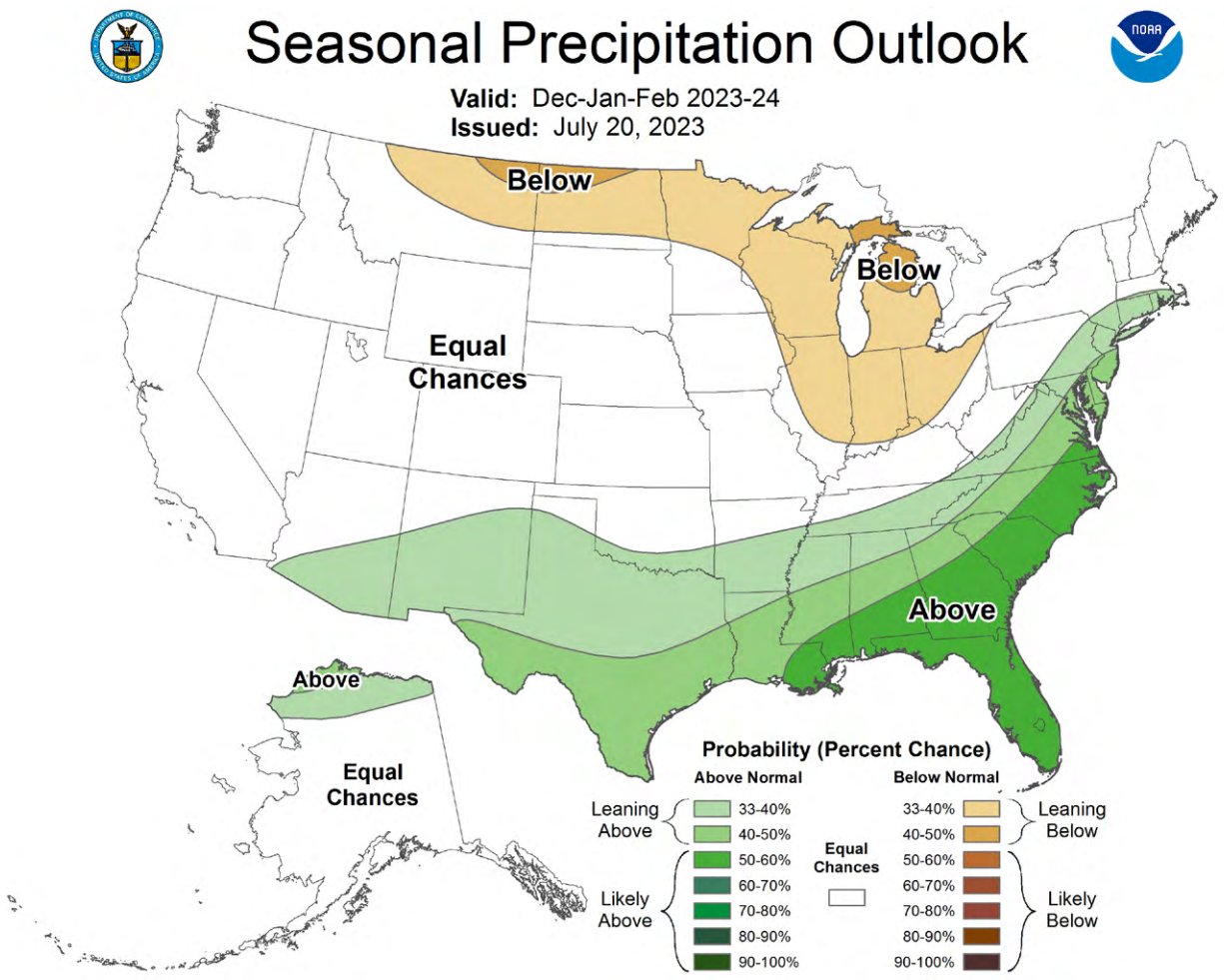
Earth Curiosities

Dust Storms!


Credit: Shutterstock

Dust storms and haboobs can occur anywhere in the United States but are most common in the Southwest. Haboobs occur as a result of winds coming from thunderstorms. These winds can start a dust storm that can drastically reduce visibility. A dust storm usually arrives suddenly in the form of an advancing wall of dust and debris which may be miles long and several thousand feet high. They strike with little warning. Blinding dust can quickly reduce visibility, causing accidents that may involve chain collisions. Dust storms usually last only a few minutes. Don't enter a dust storm area if you can avoid it.

PART 4. During episode 1, Teek and Tom visit a farm, and Tom introduces the idea of climate outlooks. A climate outlook gives the probability that certain temperature or precipitation conditions will be below normal, normal, or above normal. The map below shows a U.S. seasonal outlook for precipitation.



1. When was this climate outlook map issued? _____

2. What time period does this climate outlook map cover? _____

3. Describe what areas of the country will see "likely above normal" precipitation. Do you think that the precipitation will be rain or snow in those areas? Explain.

4. Describe what areas will see “leaning below normal” precipitation. Do you think that precipitation in those areas during that time period will be rain or snow? Explain.

5. How would this outlook map help you if you were responsible for preparing a city for heavy rain events?

6. How would this outlook map help you if you were responsible for preparing a city for snowstorm events?

Credit: Shutterstock

PART 5. You will have a chance to envision the climate of a place where you would like to live. You have seen the precipitation and temperature graphs of many cities. You have also seen the factors that can affect temperatures and precipitation.

- Imagine a place with a temperature range and precipitation that you would want to experience year-round.
- Think about whether you like to have four seasons with a wide range of temperatures.
- How much precipitation would you like? Would it fall as rain or snow?

Describe or draw the type of weather that you would like to experience at your imaginary place.

From what you have learned in this lesson, select the temperature and precipitation factors that influence this place. Explain why you chose those factors.

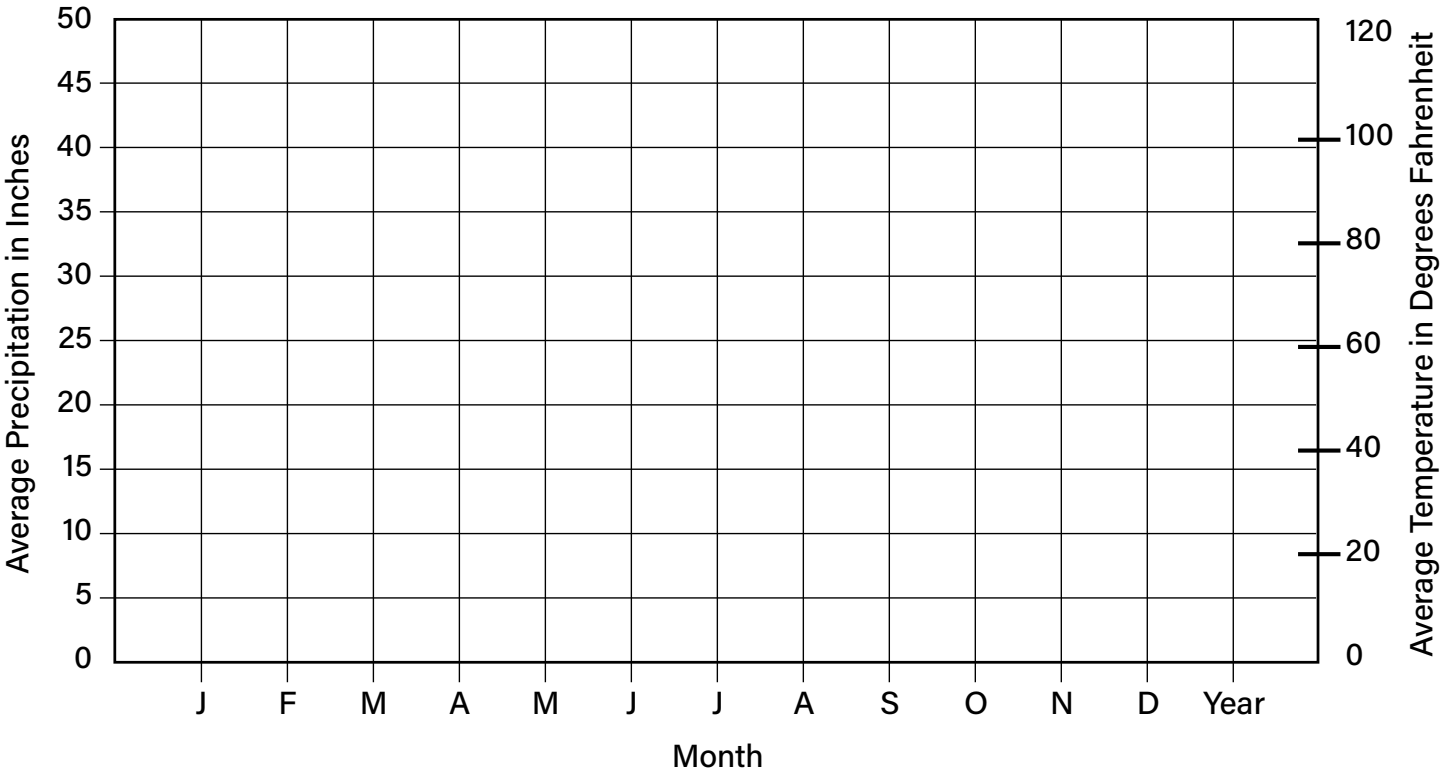
Based on what you know about the factors that influence temperatures and precipitation of your imaginary place, complete the data table below with the minimum and maximum temperatures and precipitation for each month. Imagine that this data represents 30-year averages. Check back with other cities that you have learned about for ideas.

Month	Minimum Temperature (° F)	Maximum Temperature (° F)	Precipitation (Rain in Inches)	Precipitation (Snow in Inches)
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				

Construct a climate graph that includes precipitation and temperature with the data you just created.

1. The x-axis represents the date, labeled with just the first letter of each month (e.g., January is 'J,' February is 'F', etc.).
2. The left y-axis is "Temperature in degrees Fahrenheit."
3. The right y-axis is "Precipitation in Inches."
4. Using lines of different colors, plot the minimum and maximum temperatures using a line graph. Indicate the colors that you chose in the data table below and on the legend on the side of the graph.
5. Using different colors, plot rainfall and snow using a line graph. Indicate the colors that you chose in the table below and on the legend on the side of the graph.

	Line color
Minimum Temperature (°F)	
Maximum Temperature (°F)	
Precipitation as Rain in Inches	
Precipitation as Snow in Inches	



Student Name

Key to Data

Does your imaginary place include precipitation or temperature data that resembles one of the cities that you previously reviewed? Explain.