

# Climate Change or Climate Variability?

## Key Concepts:

- Climate
- Climate change
- Climate variability
- Climate zones
- Precipitation
- Temperature
- Water cycle
- Weather

## WHAT YOU WILL LEARN

1. You will learn the difference between weather and climate.
2. You will analyze national and regional precipitation and temperature data to determine if our climate is changing.
3. You will calculate the mean, median, mode, and range of the temperature and precipitation data for the United States and for the central U.S.
4. You will think about how a change in temperature might impact the water cycle.

## *Engage Your Thinking*

Global warming and climate change are international concerns. Scientists from around the world are working hard to determine if human activities are impacting the Earth's climate and causing changes in global temperature and precipitation. In this activity you will analyze the United States' climate data—temperature and precipitation data—to determine if climate change is occurring in the United States. Before starting the activity, however, answer the following questions based on what you currently know and think.

1. What is the difference between weather and climate?
2. What is the difference between climate change and climate variability?
3. Do you think the climate in the United States is changing? Please explain your thinking.
4. How could climate change impact U.S. temperature and precipitation patterns?

## Explore and Explain

We experience weather every day and the weather forecast is given on television. We plan our daily activities and how we dress (for warm or cold days) based on weather, but what is weather? **Weather** refers to the physical conditions of the lower atmosphere; the temperature, precipitation, humidity, wind speed, and cloud cover for a given location over a short time period, such as a day or week. Thus, weather changes from day-to-day and from place-to-place.

Although weather varies from day-to-day, the same types of weather patterns will recur over the years for a given location. This recurring weather pattern for a location is known as climate. **Climate** consists of the average weather conditions for a location over a long time period. Thus, people living in the Midwest can expect snow and cold temperatures in January and rain and warm temperatures in July. Average temperature and average precipitation are the two main weather conditions that determine a location's climate. For example, the climate in a Midwestern summer is generally warm, but the weather might be rainier on one day than on the next. Locally, climate is affected by latitude, terrain, altitude, and nearby water bodies.

5. Why do you think climate scientists use average temperature and average precipitation as the main weather conditions for determining climate?

Wladimir Köppen, a German climatologist, divided the Earth into six major **climate zones** or regions based upon temperature profiles and latitude: tropical (zone A), dry or arid (zone B), warm temperate with cool winter (zone C), cool temperate with cool winter (zone D), polar (zone E), and highland (zone H).

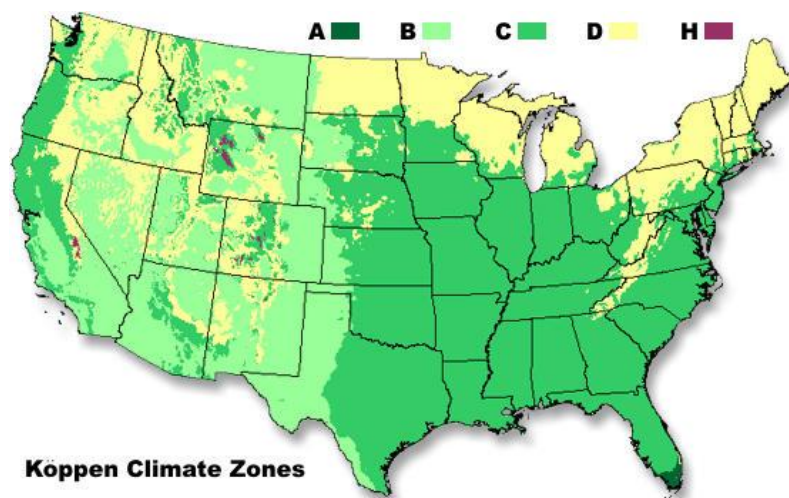


Figure 1. U.S. Climate Zones. Source: NOAA

6. Based on the climate map for the U.S. (Figure 1), in which climate zone is your school located?
  
7. Based on the above climate map (Figure 1), which is the dominant climate zone for the U.S.?

Climatologists have been collecting climate data—temperature and precipitation—for the U.S. since 1895. This data plays an important role in determining whether or not the climate is actually changing. In the next part of this activity, you will analyze the data to determine for yourself whether or not you think the climate in the U.S. is changing.

Scientific Question 1:

- *Does the temperature and precipitation data support the notion that the climate in the U.S. is changing?*

In order to answer this question, you will analyze:

- the average winter (Dec.-Feb.) precipitation and temperature data for the U.S.
- the average summer (June-Aug.) precipitation and temperature data for the U.S.

To help you answer Scientific Question 1, your teacher will provide you with the precipitation and temperature data that you will analyze. Do the exercises below and answer the questions which follow.

Draw 40 temperature and precipitation chips (samples) from each container. Create a data table and line graph for the winter and summer data.

- 8 What pattern(s) or trends do you see in the data, the graphs? How would you explain these patterns/trends?

9 What does this tell you about the climate in the United States?

10 Calculate the mean, median, mode, and range of the data for the first 20 years and the last 20 years and record in Tables 1 and 2 below.

Table 1. Temperature and Precipitation Data for the First 20 Years

	Mean		Median		Mode		Range	
	Winter	Sum	Winter	Sum	Winter	Sum	Winter	Sum
Temperature								
Precipitation								

Table 2. Temperature and Precipitation Data for the Last 20 Years

	Mean		Median		Mode		Range	
	Winter	Sum	Winter	Sum	Winter	Sum	Winter	Sum
Temperature								
Precipitation								

11 Explain how the temperature and precipitation data either supports or refutes the notion that the climate in the U.S. is changing:

12 Based on your data, what temperature and precipitation predictions (projections) can you make for the United States' climate in the future?

**Thinking about your data sets**

Look back at your data sets for temperature and precipitation, answer the following questions:

13 How does the time scale (number of years) of your sample influence your interpretation of the data?

14 How does the sample size (the number of data points) influence your interpretation of the data?

## *Extend Your Thinking*

In the previous investigation you analyzed the average winter and summer precipitation and temperature data for the U.S. In the next activity you will consider the differences in annual precipitation and temperature data for the U.S. and the central U.S.:

Scientific Questions 2 and 3:

- *Does a difference exist between the United States' annual precipitation and temperature data compared to data in the central U.S.?*
- *Does the temperature and precipitation data support or refute the notion that the climate in the U.S. is changing?*

To answer these questions you will analyze and compare the:

- annual precipitation and temperature data for the U.S.
- annual precipitation and temperature data for the central U.S.

Your teacher will provide you with the precipitation and temperature data that you will analyze. Follow the procedures and answer the questions below.

Draw 40 temperature and precipitation chips (samples) from each container and create a data table and line graph for the U.S and Central U.S. temperature and precipitation data.

15 What pattern(s) or trends do you see in the data, the graphs? How would you explain these patterns/trends?

16 Calculate the mean, median, mode and range of the data for the first 20 years and the last 20 years and record in Tables 3 and 4 below.

Table 3. Temperature and Precipitation Data for the U.S.

	Mean		Median		Mode		Range	
	First 20	Last 20	First 20	Last 20	First 20	Last 20	First 20	Last 20
Temperature								
Precipitation								

Table 4. Temperature and Precipitation Data for the Central U.S.

	Mean		Median		Mode		Range	
	First 20	Last 20	First 20	Last 20	First 20	Last 20	First 20	Last 20
Temperature								
Precipitation								

17 How does the annual precipitation and temperature data for the U.S. compare to the annual precipitation and temperature data for the central U.S.?

18 Explain how the temperature and precipitation data either supports or refutes the notion that the climate in the U.S. is changing?

## Apply What You Have Learned

The **hydrologic cycle** (water cycle) involves the continuous circulation of water between the Earth's land surface and atmosphere and is driven by the sun's energy (Figure 2). First, water in the atmosphere condenses and falls to the land surface and oceans as precipitation (e.g., rain, snow). When this precipitation reaches the land surface, it may run off the land into streams and lakes (called surface runoff) or it may infiltrate into the soil where it is taken up by plants or it collects as groundwater.

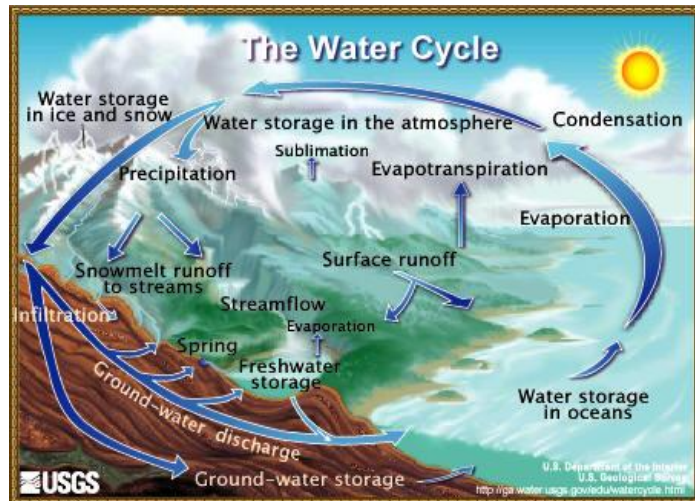


Figure 2. The Hydrologic Cycle. Source: USGS

Second water returns to the atmosphere as vapor either from surface water (ocean, lakes, and streams) evaporation or transpiration from plants. The warmer the Earth's temperature, the more water evaporates from the Earth's surface, which leads to more precipitation. Due to the complex interactions among global circulation patterns and local weather conditions, changes in future precipitation levels are difficult to predict.

19 How would a change in the Earth's temperature affect the hydrologic cycle?

20 How could a change in the Earth's temperature affect the distribution of water in the United States, cause some regions to experience drought conditions?



## *Reflect on What You Have Learned*

21 What is the difference between weather and climate?

22 What is the difference between climate change and climate variability?

23 Do you think the climate in the United States is changing? Please explain your thinking.

24 How could climate change impact U.S. temperature and precipitation patterns?

25 Please explain how your ideas and thinking about climate change in the United States has changed.