LESSON 1
What Should I Wear Today?

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.

Introduction

"I'm Teek from planet Queloz (kway-loe-z)…I come in peace…can you help me understand your planet for a school project?" This is the premise for a series of short videos that will help students understand important Earth science concepts.

In the first episode of the video series, NOAA Climatologist Tom Di Liberto teaches his extraterrestrial friend Teek about the difference between weather and climate on Earth. Teek and Tom investigate why it's helpful for earthlings to understand how the ocean influences weather and what the weather might bring days, weeks, or months in advance. They look at climate outlooks and weather trends weeks and months into the future and visit a farm to see how these outlooks can help with decisions on when to plant or harvest.

Over the course of this activity, students will develop their own explanations about the differences between weather and climate. Weather is the current atmospheric conditions, including temperature, rainfall, wind, and humidity. Climate is the usual weather conditions based on 30 years of averaged weather data for a location. Climate is what you expect. Weather is what actually happens.

A short career-focused segment in the video introduces a NOAA National Weather Service (NWS) forecaster who talks about why it's so important for scientists to predict what's to come and for people to be prepared. It's all about being weather-ready and climate-smart.

Lesson Summary

Students will examine the similarities and differences between climate and weather maps, investigate climate characteristics, and develop an explanation of climate and weather to help Teek with their school project. (Teek goes by the pronouns "They/Them/Their" in the videos).

Objectives

- Students will be able to define and contrast weather and climate.
- Students will investigate weather and climate parameters through maps and archived data.
- Students will develop working definitions of weather and climate and communicate their understanding through a visual graphic.

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 Episode 1 of Teek and Tom *"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. A full list of standards is available 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.
- **5-ESS2-1: Earth's Systems.** Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- **ESS2.D: Weather and Climate.** Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns.

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

- Materials for making a visual representation of weather versus climate. Crayons, markers, or colored pencils, poster board, scissors, and construction paper for individual students or groups of students working together.
- Students will need access to the NOAA NWS website homepage (https://www.weather.gov). Be sure to test the site for access from your school server.
- 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-1.zip)

Preparation

1. The teacher notes below include information about finding local maps/data.

2. The teacher notes/extensions, etc., below also include ways to explore the topic or activity further.

InvesTeekation Pathway

Part 1. Engage

1. Ask students how they decided what to wear to school today. Did they look outside? Did they look at the clouds? At a weather report? Did they ask an adult about what the weather would be? Did they make the right decision about what to wear?

2. Ask students to consider what items in their closet might help an alien like Teek understand more about the kinds of weather to expect in your location. Have them compare the contents of their closet to a person in a warmer or colder climate.

3. Ask students to think about the weather where you are. Is today's weather normal or typical? Is it what you'd expect? (That's climate!)

4. In small groups, have the students brainstorm what they know about weather and climate and complete the chart on their student record sheet. Spend a few minutes with class sharing.

Note: Depending on the sophistication of your students, cloud charts may be useful for looking at what is happening in your location. Clouds are a fun way to begin watching the weather. The slide set that accompanies this activity includes a cloud chart, and the Extensions section below provides a link to downloadable versions.

Part 2. Explore

Students will compare images of a weather forecast map and a climate outlook map. They will look for similarities and differences and record their findings on a bubble thinking map. Depending on your class needs, consider projecting both maps simultaneously or providing copies for each group of students. The weather forecast map is a snapshot from a past date. Discuss student observations of the two maps as a class.

Similarities:
- Both show a map of the United States.
- Both maps show state outlines.
- Both maps show precipitation.

Differences:
- Students should notice that the weather forecast map displays one day of time versus 30 years on the climate map.
- The weather map shows much more detail, including high and low pressure, fronts, and expected weather, such as heavy rain, thunderstorms, flash floods, and fire danger.
- The climate map shows average precipitation with the heaviest in the northwest and the southeast United States.

Credit: Shutterstock

Discussion questions

1. Explain the differences that you see between the weather forecast map and the climate outlook map.

   Weather maps are short term and have a lot of detail. Climate outlook maps are specific for one thing like precipitation. They show averages over long periods of time, not specific daily predictions.

2. Ask students to use what they have learned so far to create a one-sentence definition for weather and one for climate. This may be done in pairs or small groups.

   Students may have written something like, "Weather is a short term prediction about weather events, and climate is a longer-term average over many years."

The Extensions section of this lesson, located below, recommends additional resources for this activity.

EXPLAIN

Part 3. Explain

Students will investigate the parameters of a weather forecast more closely by first finding out what the current weather is in their location. They will need access to the NOAA NWS website (https://www.weather.gov/). Be sure to check that the website is up and working on your students' laptops/Chromebooks. An NOAA NWS glossary with common weather and climate terms is available. Simply search for "NOAA NWS glossary."

Students will compare temperatures from data collected in 2010 and 2020 in Washington, D.C., on Teek's birthday, January 15, 2010.

Discussion questions

1. How did the weather on the two dates compare?

   The high temperatures were similar, but the low temperatures were very different, causing the average to be much higher in 2020.

2. Let's see how the temperatures on those dates compare to monthly temperature averages. Look at the table below and record the average January temperature in Washington, D.C., for 2010 and 2020.

Monthly Average Temperature Jan 2010°F	Monthly Average Temperature Jan 2020°F
35.3°F	*42.4°F*

3. Now, compare the average temperature in January 2010 with the average January temperature in 2020.

   The average temperature in January 2010 was 35.3°F , and in 2020 it was 42.5°F . January 2020 is over seven degrees warmer than January 2010.

Appendix B (https://oceantoday.noaa.gov/teekandtom/educators-guide/appendix-b.pdf) contains data for Washington, D.C., for each month and year from 1871 through 2023. Students might appreciate the large amount of data saved from every weather station around the country.

Credit: Shutterstock

Part 4. Elaborate

Students will look at color-coded maps of average temperatures from the past. Point out that the data can be displayed in many ways and that these maps use the same data they were just analyzing. Temperatures are displayed using colors, with each color representing a 10-degree range.

Discussion questions

1. What was the average maximum temperature range where you live in January 2010?

   Answers will vary from 90 to less than 10°F, depending on where the student lives.

2. What was the average maximum temperature range where you live in January 2020?

   Answers will vary from 90 to less than 10°F, depending on where the student lives.

3. Find your state on the map and the temperature range that is shown. Compare the January maximum temperatures from 2010 on Map 3 that you identified earlier with the climate map that shows 30 years of data (Map 5). What is the difference in temperature between the two maps? What evidence do you have to support your answer?

   The climate map used here represents average values from 1991 to 2020. Having many years of data allows for better predictions in the future. Students should compare the 2010 January maximum identified earlier with the climate map. In general, temperatures are trending higher. Students should provide observational evidence from the maps to support their statements.

4. Let's look at data from over 70 years ago. Compare the January maximum temperatures from 1950 on Map 6 with the climate map that shows 30 years of data (Map 5). What is the difference in the temperature between the two maps for locations in your state? What evidence do you have to support your answer?

   Students should compare the 1950 January maximum with the climate map (Map 5). Students should provide observational evidence from the maps to support their statements.

Part 5. Evaluate

Ask students to create a visual, art piece, or graphic that Teek can use to help their classmates understand the difference between weather and climate. This can be done individually, in pairs, or in small groups. Depending on the materials you have on hand, allow students to use art options to express their understanding. Providing different outlets for expressing ideas may be especially important to ESL or students who struggle with writing. They should be able to explain how their art or visual demonstrates the difference between weather and climate. Post in your room as reminders about what they have learned.

Be sure to save the students' work. They will need to use it in the second lesson!

Credit: Shutterstock

Credit: Thinkstock Photos

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Extensions

Simple Cloud Chart (https://www.ncei.noaa.gov/sites/default/files/sky-watcher-cloud-chart-noaa-nasa-english-version.pdf)

Advanced Cloud Chart (https://www.noaa.gov/clouds/noaawise)

You can access the forecast section of Weather.gov using the menu header at the top of the website (https://www.weather.gov/forecastmaps).

If you would like to use additional maps to the ones provided, go to the NOAA National Centers for Environmental Information U.S. Climate Atlas webpage (https://www.ncei.noaa.gov/access/climateatlas/). Choose min temp or max temp, the year, and the month. Turn "Compare" on to add another set of variables to compare with the first data. Choose the same min temp or max temp, month, and year. You can choose to see the graphics in several different ways. Maps are available for a particular month and year from 1895 to the present.

Your students can also find out what the weather was in the city where they were born on their birthday.

1. Have them choose the correct forecast office in their birth state by clicking on the region of the state where they were born on the NOAA NWS Climate webpage (https://www.weather.gov/wrh/climate).

2. Choose the appropriate weather station, which is identified by city in a pull-down menu.

3. Click the "Daily Data for a Month" button, then select the birth date.

4. Hit "Go," and the weather parameters for that month will pop up.

These Ocean Today videos will be helpful for student understanding during the discussions about their ideas.

- Happening Now: State of the Climate in 2013 (https://oceantoday.noaa.gov/stateoftheclimate/)

- Old Weather (https://oceantoday.noaa.gov/oldweather/)

Student Record Sheets

PART 1. Our extraterrestrial friend, Teek, has asked for help with their class project about the Earth. What do you know about weather and climate? Work in a small group to complete the brainstorm chart below. Share your ideas with the class.

WEATHER	CLIMATE

Credit: Shutterstock

Credit: Shutterstock
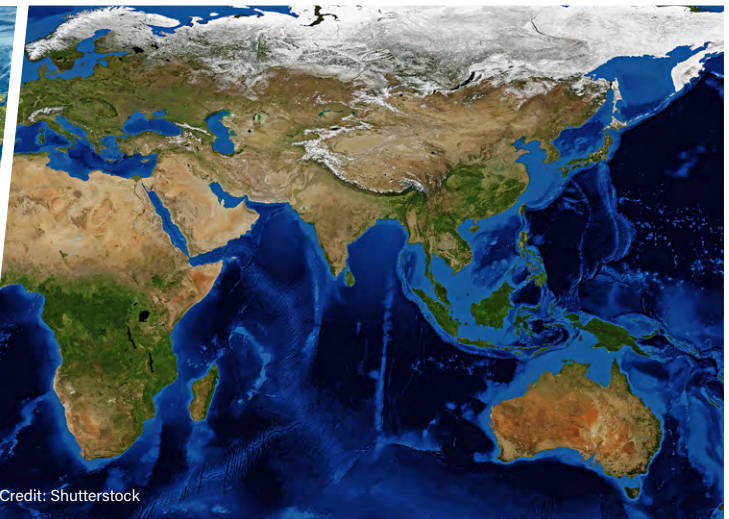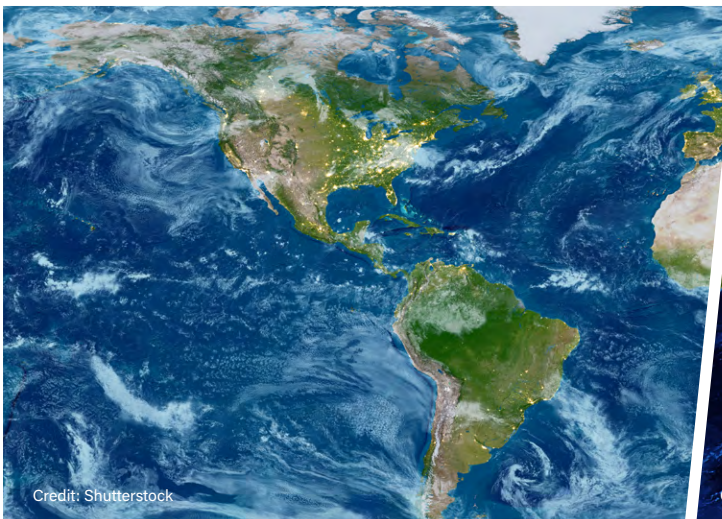
PART 2. You will be shown two maps. One is a weather forecast map, and the other is a climate map. Look carefully at the information on each map. Describe what you see in the table below. Then, list some similarities and differences between the two maps in the bubble chart.
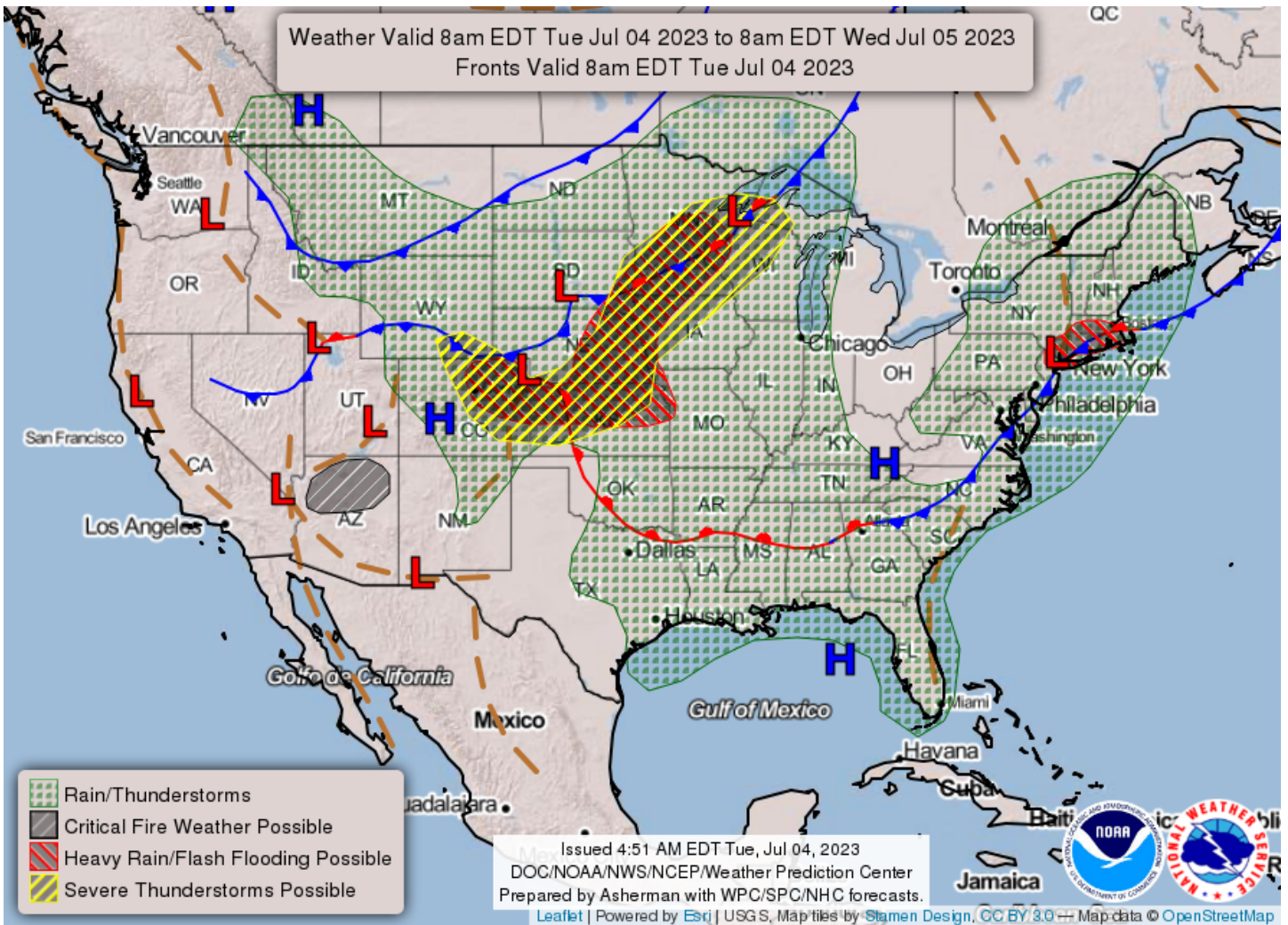
WEATHER FORECAST MAP	CLIMATE MAP

Differences

CLIMATE MAP

Similarities

WEATHER MAP

Differences

Map 1. Weather Forecast Map for July 4-5, 2023

Weather Valid 8am EDT Tue Jul 04 2023 to 8am EDT Wed Jul 05 2023
Fronts Valid 8am EDT Tue Jul 04 2023

Legend:
- Rain/Thunderstorms
- Critical Fire Weather Possible
- Heavy Rain/Flash Flooding Possible
- Severe Thunderstorms Possible

Issued 4:51 AM EDT Tue, Jul 04, 2023
DOC/NOAA/NWS/NCEP/Weather Prediction Center
Prepared by Asherman with WPC/SPC/NHC forecasts.

H This symbol represents an area of high air pressure. High air pressure generally brings light winds and clear skies.

L This symbol represents an area of low air pressure. Low pressure generally brings clouds and precipitation.

This symbol represents a cold front. An advancing cold front can bring sudden and intense storms.
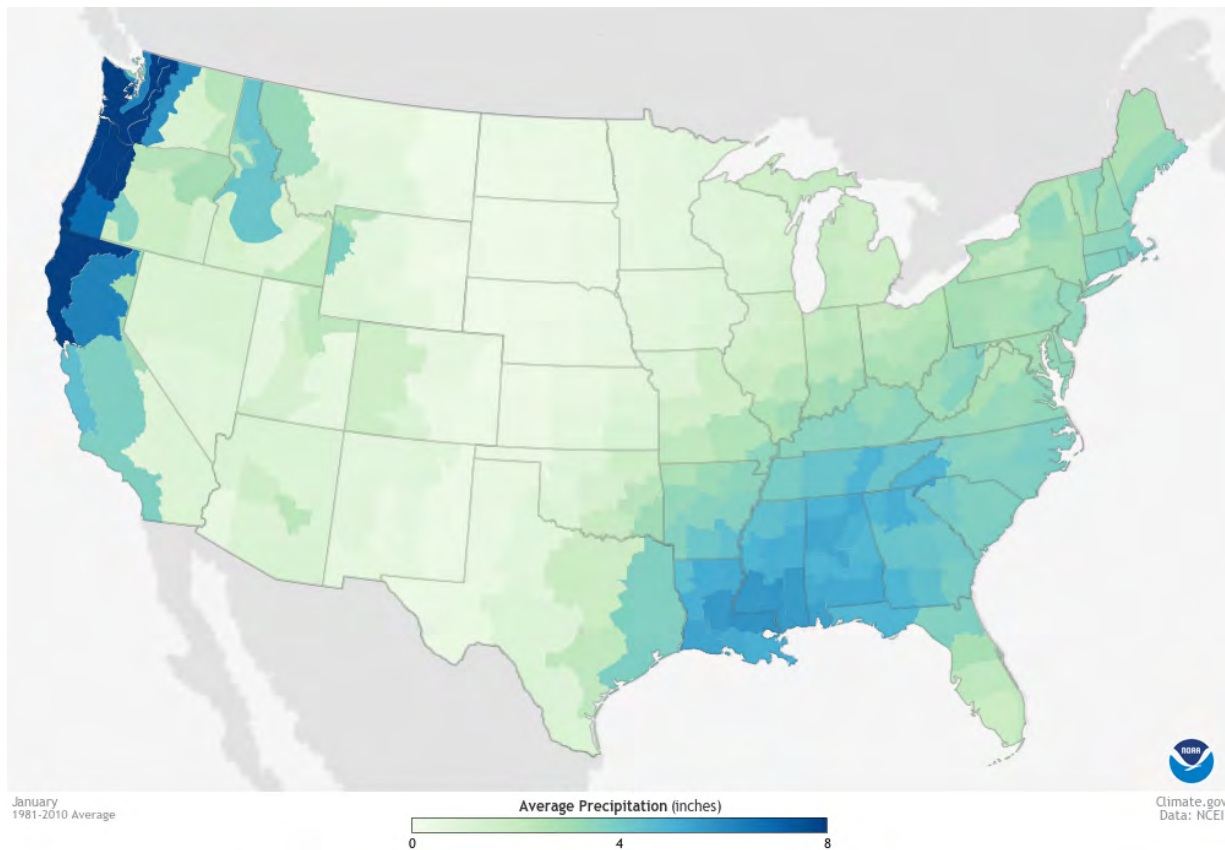
This symbol represents a warm front. An advancing warm front can bring slow steady rain.

This symbol represents a stationary front. A stationary front can result in several days of cloudy skies.

Map 2. Climate Map – Average Monthly Precipitation for 1981-2010

January
1981-2010 Average

Average Precipitation (inches)
0   4   8

Climate.gov
Data: NCEI

Earth Curiosities

Temperature Extremes

Mesquite Flat Sand Dunes, Death Valley National Park. (USGS)

It's hot! Death Valley is famous for being one of the hottest and driest places in North America. In fact, Death Valley holds the record for the world's highest surface air temperature ever recorded: 134 °F observed at Greenland Ranch on July 10, 1913.
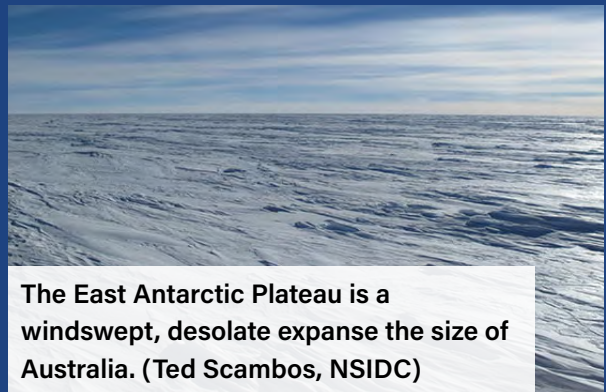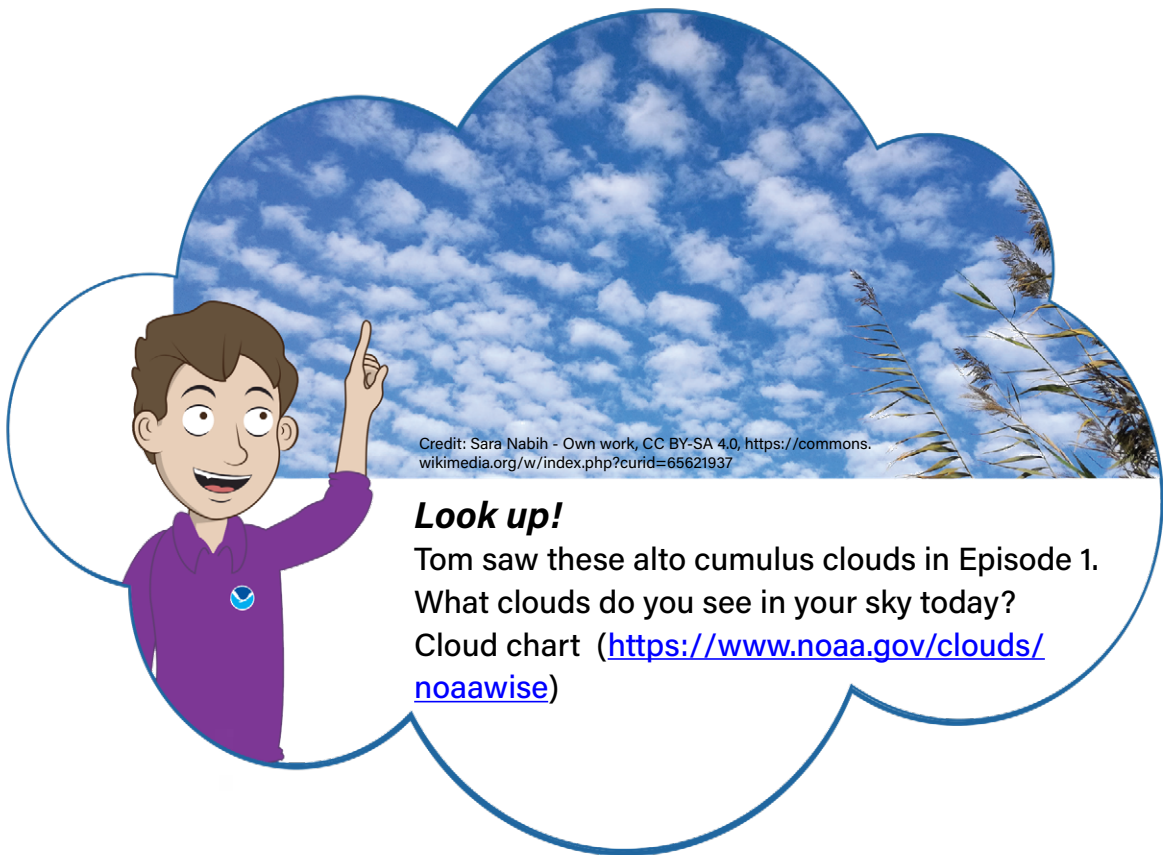

The East Antarctic Plateau is a windswept, desolate expanse the size of Australia. (Ted Scambos, NSIDC)

It's cold! The coldest place in the world is a high ridge in Antarctica, where temperatures can dip below minus 133.6 °F.

1. Explain the differences that you see between the weather forecast map and the climate outlook map.

2. Use what you have learned so far to create a one-sentence definition for weather and a one-sentence definition for climate.

Credit: Sara Nabih - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=65621937

Look up!
Tom saw these alto cumulus clouds in Episode 1. What clouds do you see in your sky today?
Cloud chart (https://www.noaa.gov/clouds/noaawise)

PART 3. **What is the expected weather today?** Go to the NOAA NWS website (https://www.weather.gov/) and click on the part of the state where you live now. You should see a graphic with town names. Click on the town closest to you. Record today's weather information below.

Expected High Temperature	Expected Low Temperature	Current Wind Speed	Humidity	Visibility

Let's find out about some weather readings from the past. Teek was born on January 15, 2010, on the planet Queloz. Let's find out what the weather was like 10 years later on Earth in Washington, D.C., where Tom Di Liberto lives.

	January 15, 2010°F	January 15, 2020°F
Maximum Temperature	57	58
Minimum Temperature	24	40
Average Temperature	40.5	49
Precipitation	0	0
Snowfall	0	0

1. How did the weather on the two dates compare?

2. Let's see how the temperatures on those dates compare to monthly temperature averages. Look at the table and record the average January temperature in Washington, D.C., for 2010 and 2020.
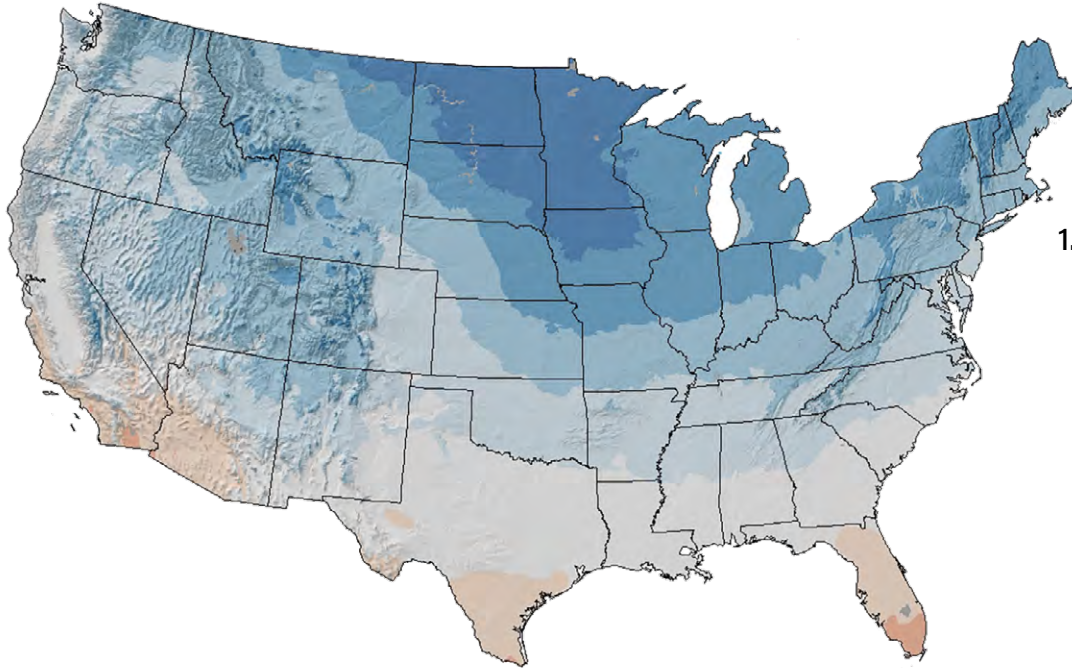
Monthly Average Temperature Jan 2010°F	Monthly Average Temperature Jan 2020°F

3. Now, compare the average temperature in January 2010 with the average January temperature in 2020.

| YEAR	JAN
2010	35.3
2011	33.7
2012	40.8
2013	40.3
2014	32.3
2015	35.6
2016	34.9
2017	42.1
2018	35.7
2019	37.2
2020	42.4
NORM	37.5

PART 4. Let's take a look at some graphic temperature averages from the past. Temperatures are displayed using colors, with each color representing a 10-degree range. Look at the temperatures in the part of the state where you live.
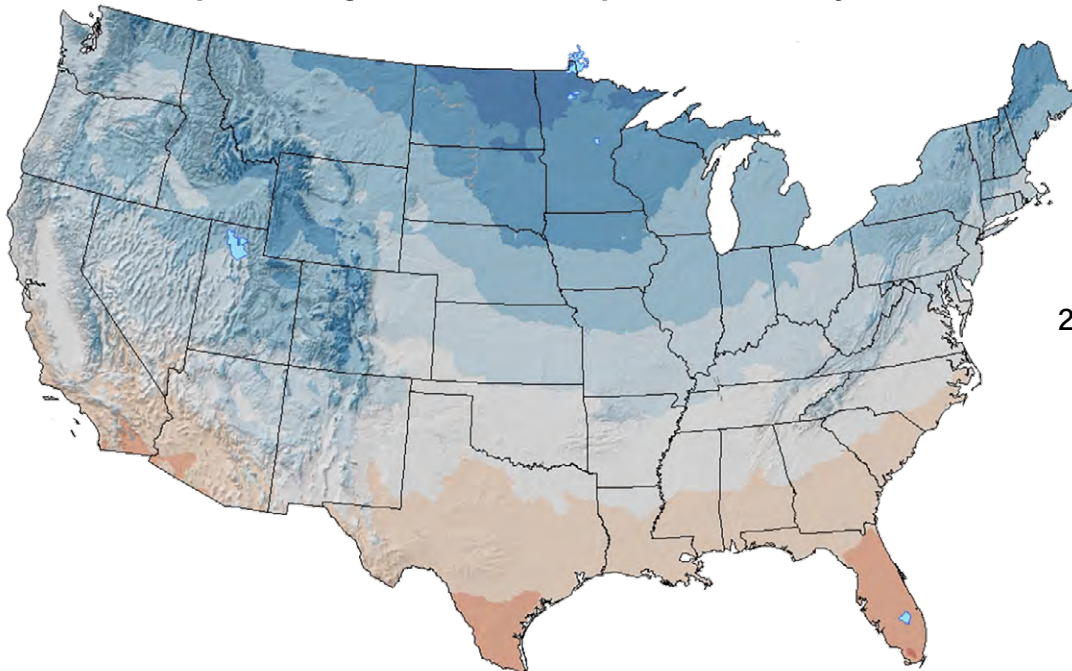
Map 3. Average Maximum Temperature January 2010

Average Maximum Temperature (F)
January 2010

| < 10 | 11 - 20 | 21 - 30 | 31 - 40 | 41 - 50 | 51 - 60 | 61 - 70 | 71 - 80 | 81 - 90 | 91 - 100 | > 100 |

1. What was the average maximum temperature range where you live in January 2010?
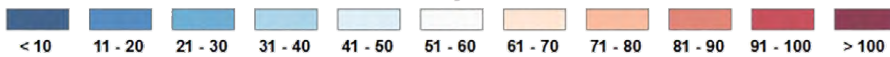
Map 4. Average Maximum Temperature January 2020

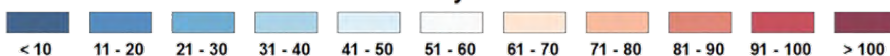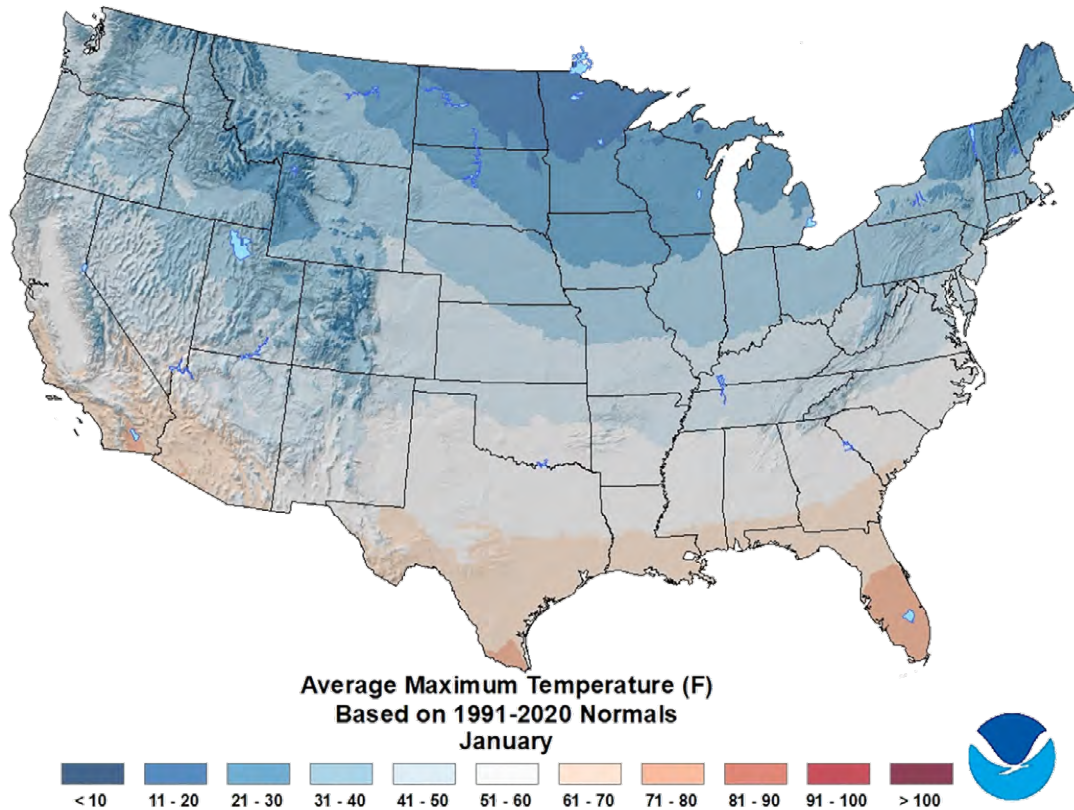Average Maximum Temperature (F)
January 2020

| < 10 | 11 - 20 | 21 - 30 | 31 - 40 | 41 - 50 | 51 - 60 | 61 - 70 | 71 - 80 | 81 - 90 | 91 - 100 | > 100 |

2. What was the average maximum temperature range where you live in January 2020?
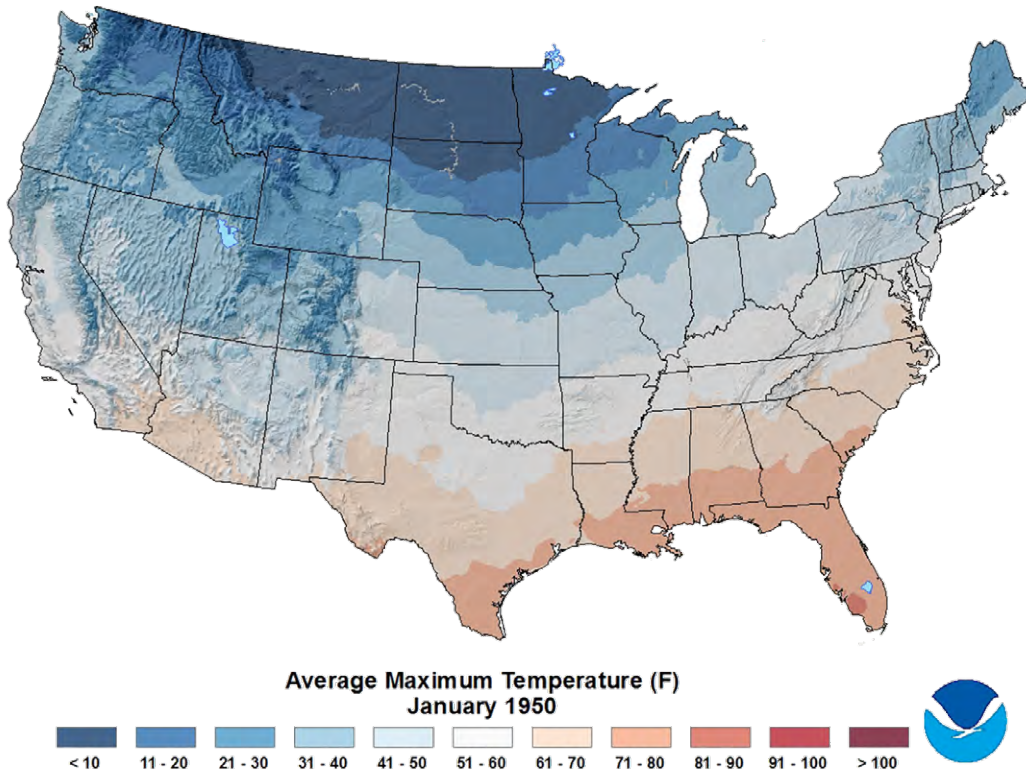
Map 5. The climate map below is a record of the average maximum temperature. It is based on **30** years of data from 1991-2020. The map presents data from thousands of U.S. weather stations located across the 50 states and territories. Having many years of data allows for better predictions in the future.

Average Maximum Temperature (F)
Based on 1991-2020 Normals
January

| < 10 | 11 - 20 | 21 - 30 | 31 - 40 | 41 - 50 | 51 - 60 | 61 - 70 | 71 - 80 | 81 - 90 | 91 - 100 | > 100 |

3. Find your state on the map and the temperature range that is shown. Compare the January average maximum temperatures from 2010 on Map 3 that you identified earlier with the climate map that shows 30 years of data (Map 5). What is the difference in the temperature between the two maps? What evidence do you have to support your answer?

Map 6. Average Maximum Temperature January 1950

**Average Maximum Temperature (F)
January 1950**

| < 10 | 11 - 20 | 21 - 30 | 31 - 40 | 41 - 50 | 51 - 60 | 61 - 70 | 71 - 80 | 81 - 90 | 91 - 100 | > 100 |

4. Let's look at data from over 70 years ago. Compare the January average maximum temperatures from 1950 on Map 6 with the climate map that shows 30 years of data (Map 5). What is the difference in the temperature between the two maps for locations in your state? What evidence do you have to support your answer?

PART 5. Use what you have learned and materials in your classroom to design and create an art piece, a visual, or a graphic that Teek can use to help their classmates understand the difference between weather and climate. These will be posted around the room.