UTAH GOVERNOR'S OFFICE OF
ENERGY DEVELOPMENT

Utah Climate

Grade/Subject: 8th grade integrated science

Strand/Standard 8.4.4 Analyze and interpret data on the factors that change global temperatures and their effects on regional climates. Examples of factors could include agricultural activity, changes in solar radiation, fossil fuel use, or volcanic activity. Examples of data could include graphs of the atmospheric levels of gases, seawater levels, ice cap coverage, human activities, or maps of global and regional temperatures. (ESS3.D)

Lesson Performance Expectations:

- Students will analyze data sets to interpret factors changing Utah temperatures and its regional climate.
- Students will report on the comparison they research and apply it to Utah.

Materials:

- Student Sheet
- Digital device for research

Time: 1 60-minute period

Teacher Background Information:

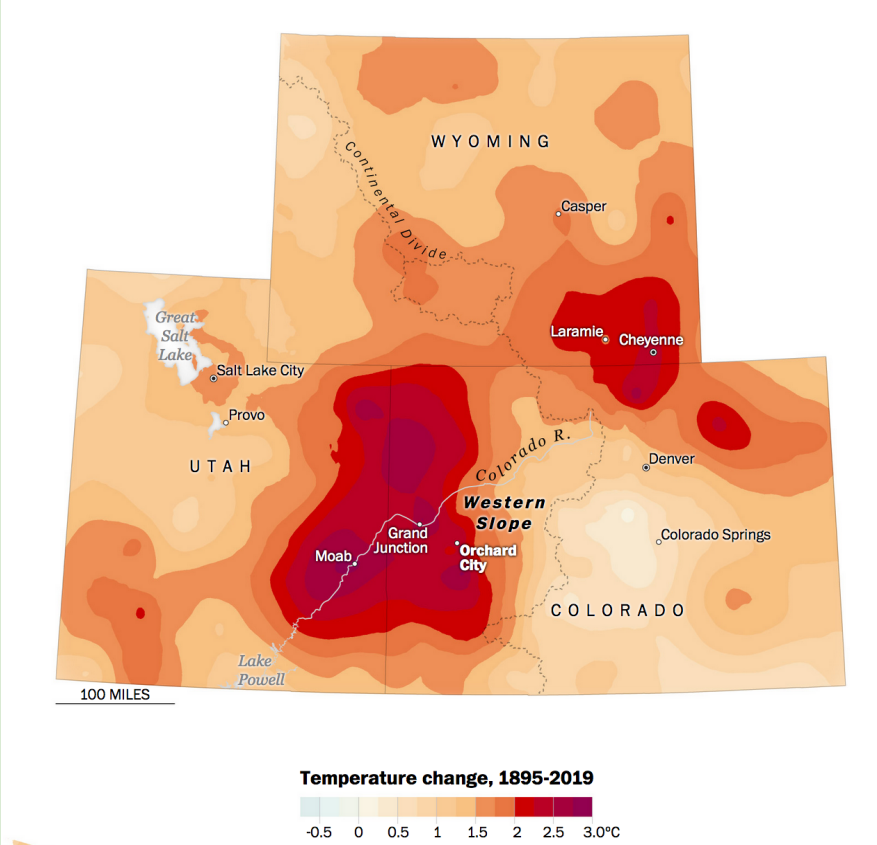
- Using reputable sources, students will evaluate cause and effect relationships of climate change.
- Utah is currently experiencing greater than average yearly temperature increases (Washington Post).

Student Background Knowledge:

- Students should understand the difference between weather and climate. Weather is the daily precipitation and temperature for an area that can change even within the hour. Climate is the average precipitation and temperature for an area over time (10 or 30-year models are the most commonly used).
- Students know that hydrocarbons have supported our standard of living today.
- Students know carbon dioxide is a greenhouse gas that releases with the burning of fossil fuels.
- Students know that plants absorb carbon dioxide.

Teacher Step by Step: A 3-D lesson should insist that students think deeply. Provide time and space for the students to experience the phenomenon and ask questions. The student sheet provided below provides guidance but is only an example of how students might respond.

Introduce Phenomenon *(on-screen or as a handout)*



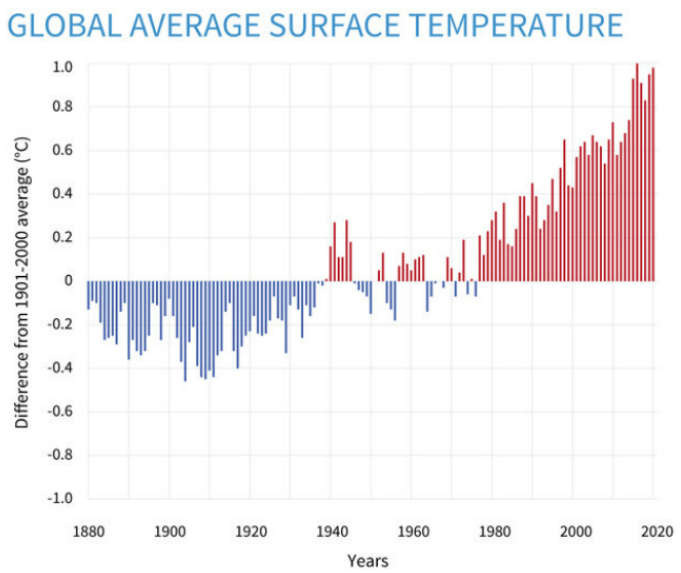
a. Ask students to observe and explain the phenomena.
b. Assign student pairs to analyze and present relationships between climate factors by using data.
c. Have students compare various climate factors using graphs of each factor from climate.gov. Students can select factors to research from this site, and they can draw pairs out of a hat from the list below (the list is not exhaustive). To prevent students from choosing the same pair, they can submit their selection electronically or write it on a board.
    i. Temperature vs. carbon dioxide
    ii. Carbon dioxide vs. snow
    iii. Sea level vs. arctic sea ice
    iv. Arctic sea ice vs. ocean heat
    v. Ocean heat vs. sun's energy
    vi. Sun's energy vs. glaciers
    vii. Glaciers vs. heat-trapping gases
    viii. Temperature vs. snow
    ix. Sea level vs. sun's energy
    x. Heat-trapping gases vs. sun's energy
    xi. Sea level vs. carbon dioxide
d. Explain "direct" and "inverse" relationships to students. A **Direct Relationship** means that if one variable increases, the other variable will also increase. If one decreases, the other will decrease as well. For example, a circle's radius and area are directly related since an increase in radius also increases the area.

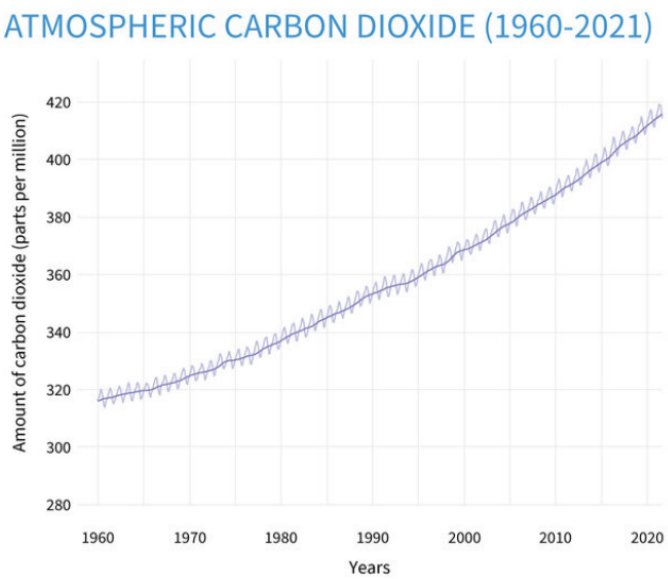
Similarly, if the radius decreases, so does the area. Two variables have an **Inverse Relationship** if one increases while the other decreases or decreases while the other increases. An example of an inverse relationship is the air temperature and cloud cover. When cloud cover increases, the air temperature often decreases.

e. Identifying a "feedback loop" may help students better understand these relationships. Once a variable has started, it may influence another factor to continue (positive feedback) or extinguish the factor (negative feedback).
f. Display graphs (see instruction C) through the projector while students present.
g. Present the rainfall map and give students time to compare it to the temperature map.

Assessment of Student Learning. Students will construct an explanation about how the movement of carbon can result in changes to one of the systems in their models. Students will use quantitative evidence from their model.

Standardized Test Preparation:



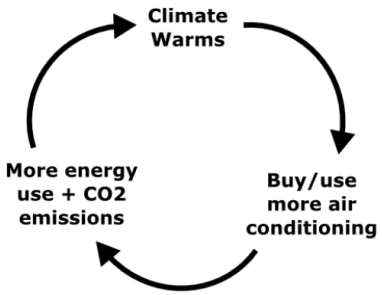


1. Scientists have long predicted that carbon dioxide put in the atmosphere through the burning of hydrocarbon fuels would warm the atmosphere. How does this data support the prediction?
   a. Global temperatures are rising as carbon dioxide levels are rising.*
   b. The carbon dioxide levels are rising more quickly than the global temperatures.
   c. The average global temperatures have an indirect relationship to carbon dioxide levels.
   d. The rising global temperatures are the reason for the increased carbon dioxide levels.

2. How is the area covered by arctic glaciers affecting the average global sea level?
   a. The increase in sea level area melts the arctic glacier ice.
   b. The reduction in sea ice area makes more of the ocean's surface visible.
   c. The reduction in glacier ice is due to melting which adds water to the sea.*

d. There is a direct relationship between glacier ice area and sea level average.

Feedback Loop



3. Air conditioning relies on an energy source that is likely based on fuel burning. Why is this an example of a positive feedback loop?
   a. The loop begins with a human cause.
   b. The loop and its effects diminish over time.
   c. The loop is circular with no end or starting point.
   d. The loop and its effects become greater over time.*

4. Trees and other vegetation absorb carbon dioxide as they grow. Planting trees creates which type of feedback loop?
   a. negative, the number of trees will increase as the amount of carbon dioxide goes down.
   b. negative, the number of trees will increase as the amount of carbon dioxide goes up.
   c. positive, the number of trees will increase as the amount of carbon dioxide goes down.*
   d. positive, the number of trees will increase as the amount of carbon dioxide goes up.

Extension of lesson:

- Students can mine the climate data for their city or county. They can create graphs comparing variables similar to this activity. Students can compare state-by-state climate data and projections at this site: https://statesummaries.ncics.org/ or climate.usu.edu
- Students can take precipitation and temperature measurements at the school and create climate data for part of or the whole school year. If continued, students could eventually compare school climate data from previous years and make projections for the future. Instruments could include simple rain gauges and outdoor thermometers or more sophisticated weather stations if funding is available.

Career Connections:

- Careers in weather and climate include private and government positions. Local meteorologists will sometimes speak in classrooms to describe their pathway.
- Ask students to investigate software like GIS and ENVI and how remote sensing technologies are used to illustrate this data on map projections. Explore career options, education, and certifications students can pursue with this technology.

Utah Climate

Name_____

Phenomenon: Observe the phenomenon. Ask three questions about what you see.

1.

2.

3.

Explanation: What do you think is the cause of this phenomenon?

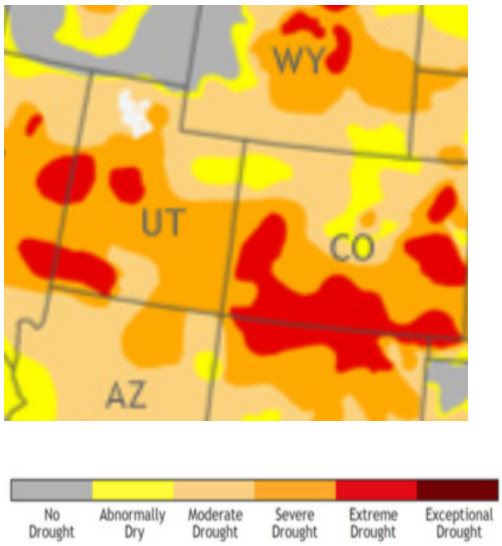
Procedures:

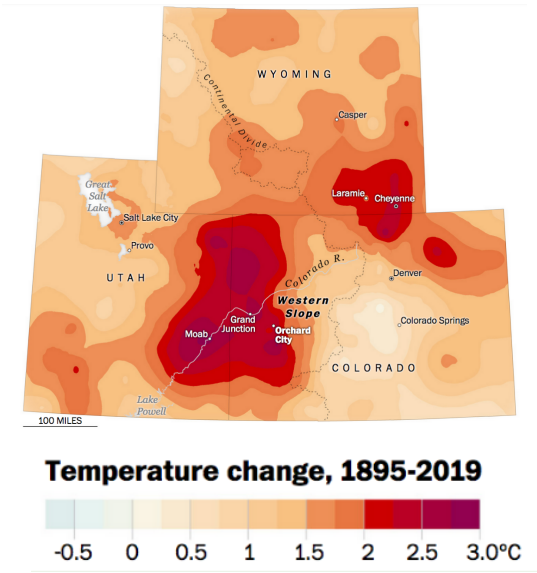
1. Get started with a single comparison of two factors. With your partner, visit climate.gov to select your two factors. What are they?
2. Click the "learn more" tab on your climate factors. Develop an explanation to present to the class about how these factors affect one another. Use the chart below to summarize other presentations.

Factor 1	Factor 2	Relationship (direct, indirect)	Explanation	Feedback Loop? (pos, neg)

3. Now back to the phenomenon. Given the relationships you have just examined, how does the temperature change map help you understand the drought situation?

Drought in the Western US





climate.gov

Interpret:
Which factor affects all other world climate factors? Why? Give two examples.