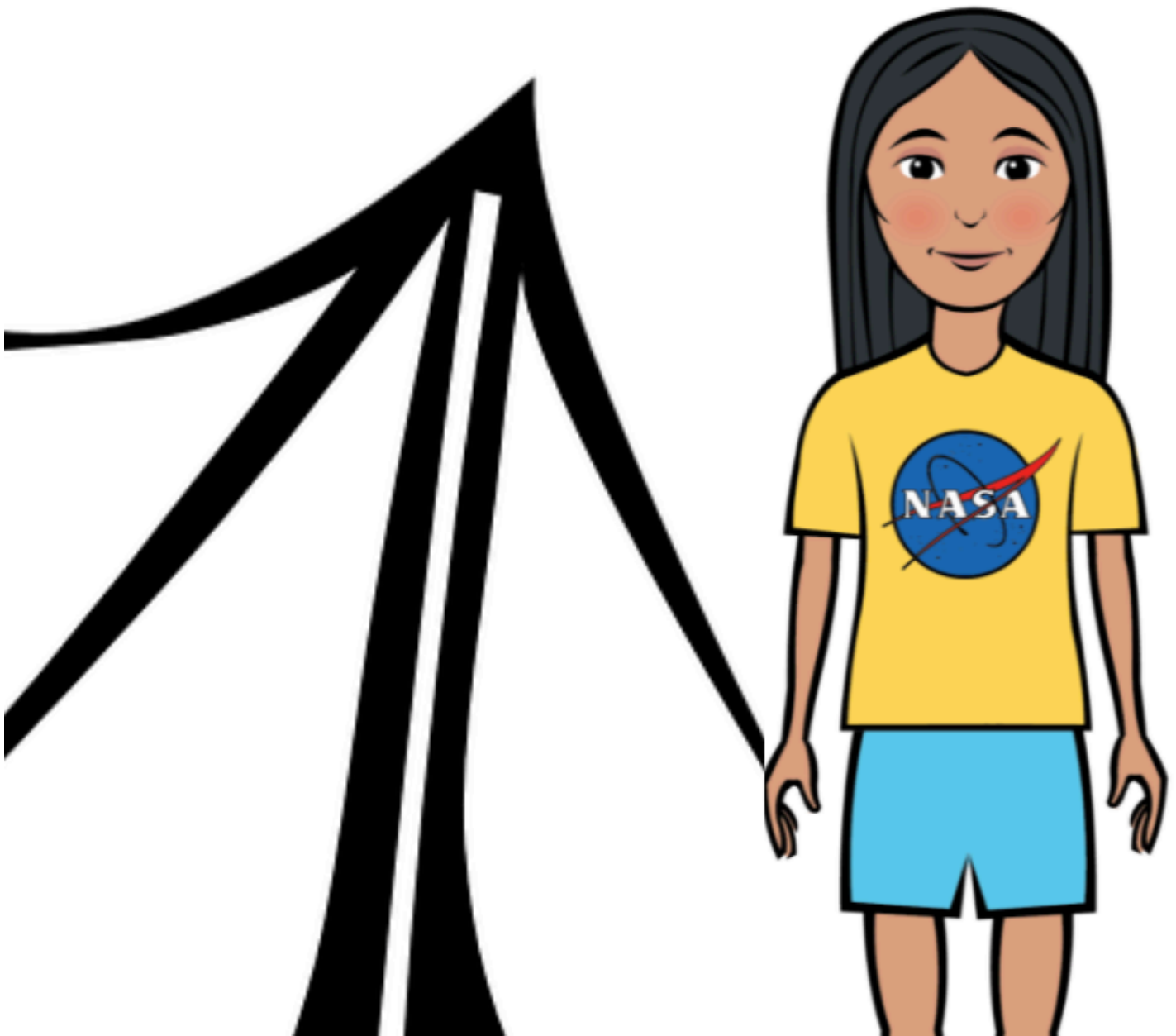


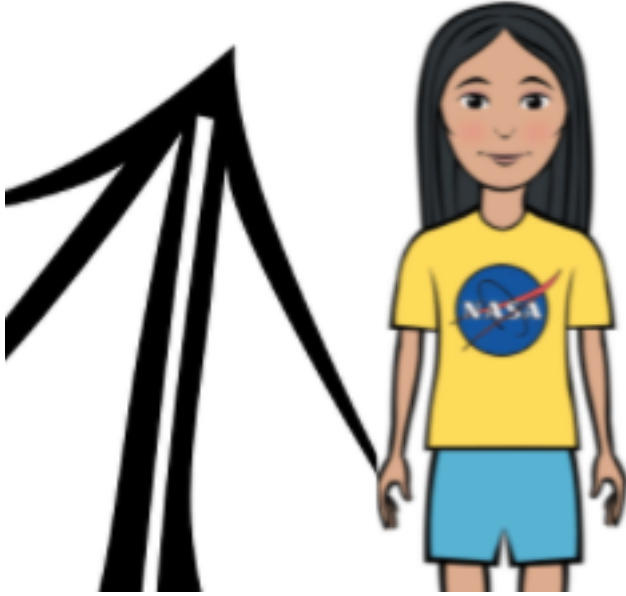
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## My NASA Data - Lesson Plans

### Awenasa Goes to Camp! Lesson Plan



#### Overview



This lesson, "Awenasa Goes to Camp!," is a data analysis activity that presents maps of NASA Earth satellite data for a variety of locations across the United States for four unidentified months throughout the year. Each location represents a real science camp that is actively using NASA and GLOBE data to explore the environment. Learners analyze the data in the maps and match the image to the month (January, April, July, October) that they think the map represents. They describe how the environmental characteristics change over time.

## Learning Objectives

- Analyze NASA satellite data
- Match mapped visualizations of satellite data to the month of the year that they believe it to represent (January, April, July, October)
- Describe how cloud cover, precipitation, surface temperature, and vegetation in specific locations change over the year

## Why Does NASA Study This Phenomenon?

NASA satellites have been mapping Earth for over 40 years. These global observations of the atmosphere, biosphere, land surface, solid Earth, and ocean enable an improved understanding of the Earth as an integrated system.

## Essential Questions

- How does environmental data change over the year?

## Materials Required

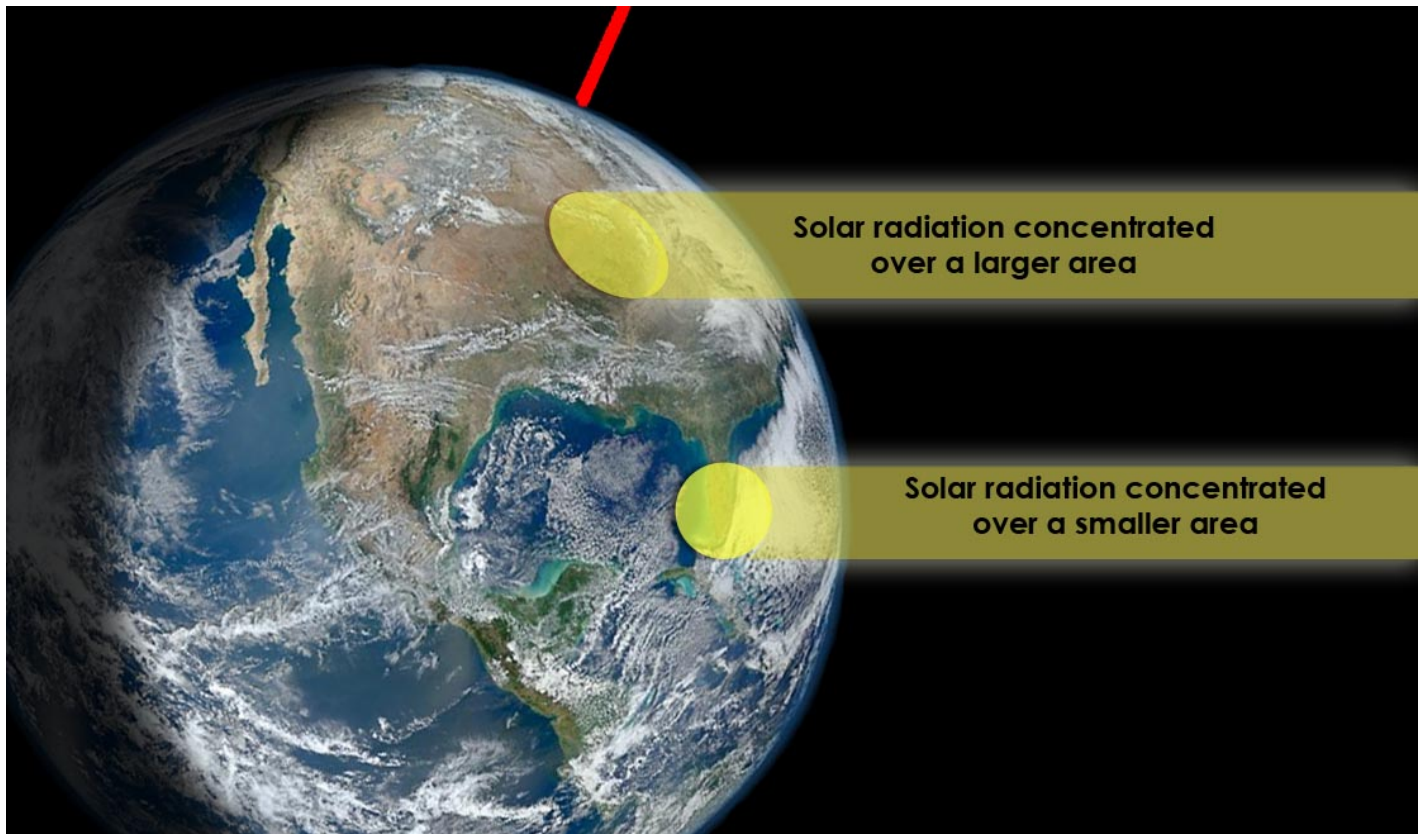
- [Educator Presentation](#)
- Image Cards
  - Images printed in color (and laminated, for durability) for the camp location/s of interest and cut into cards in random order

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- Images are also offered in this [Google Slide](#) to be printed in color and cut out
  - Optional:
    - Map Cube and Questions ([PDF](#)) or Google Forms ([link](#))
    - One large world map to display on the wall or screen

## Technology Requirements

- Standalone Lesson (no technology required)
- Color Printer

## Teacher Background Information



Earth's seasons are caused by a shift of sunlight—which is controlled by Earth's orbit around the Sun and the tilt of the Earth as it rotates on its axis. The 23.5-degree tilt of the Earth's axis results in changes of the angle of incident sunlight.

The angle of incoming solar radiation influences seasonal temperatures of locations at different latitudes. When the sun's rays strike Earth's surface near the equator, the incoming solar radiation is more direct (nearly perpendicular or closer to a 90° angle). Therefore, the solar radiation is concentrated over a smaller surface area, causing warmer temperatures. At higher latitudes, the angle of solar radiation is smaller, causing energy to be spread over a larger area of the surface and cooler temperatures. Because the angle of radiation varies depending on the latitude, surface temperatures on average are warmer at lower latitudes and cooler at higher latitudes (even though higher latitudes have more hours of daylight during the summer months).

Every day, Sun's energy enters the Earth system when sunlight penetrates the top of the atmosphere. Energy goes out in two ways: 1. reflection by clouds, aerosols, or the Earth's surface; and 2. thermal radiation—heat emitted by the surface and the atmosphere, including clouds. The rest of the light is absorbed by the atmosphere, land surfaces and oceans, and this absorption keeps

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Earth warm. The difference between how much solar energy enters the Earth system and how much heat energy escapes into space is called "net radiation," sometimes called net flux; it is the balance between incoming and outgoing energy at the top of the atmosphere. Some places absorb more energy than they give off back to space, so they have an energy surplus. Other places lose more energy to space than they absorb, so they have an energy deficit. The oceans and atmosphere continually move energy from regions with an energy surplus to regions with an energy deficit. Net radiation is the total energy that is available to influence the climate. The global average net radiation must be close to zero over the span of a year or else the average temperature will rise or fall.

To learn more about the Earth's Energy Budget, check out:

[Video: NASA: Why does the Sun Matter for Earth's Energy Budget?](#)

Video

NASA: Why does the Sun Matter for Earth's Energy Budget?  
| <https://www.youtube.com/watch?v=82jE-yvB8xU> | Source: NASA Goddard

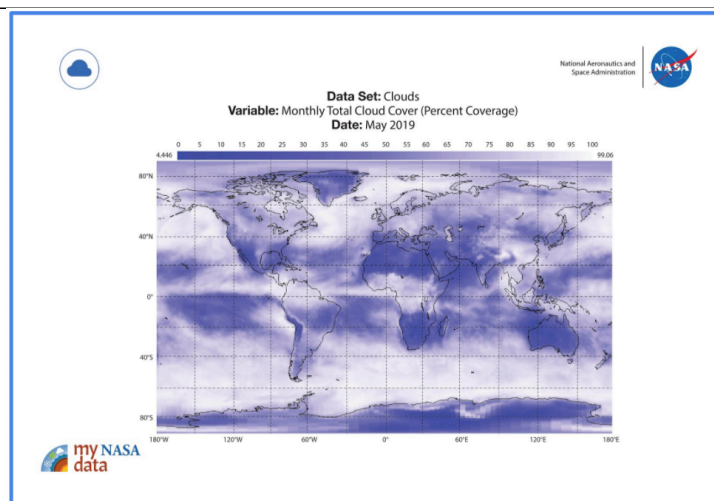
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## Exploring Earth Science Variables using Maps Collected by Remote Sensing

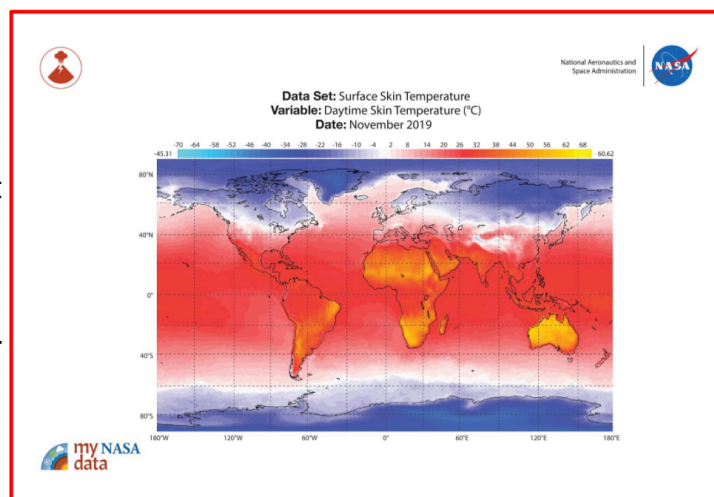
Variables featured in this lesson include the following.

**Cloud Cover** - Monthly Total Cloud Coverage (percent coverage) This quantity describes the total percent cloud cover at all levels in the troposphere. These data have a grid spacing of 1 degree longitude and 1 degree latitude. The percent coverage is the amount of the sky that would be covered by all types of clouds if you

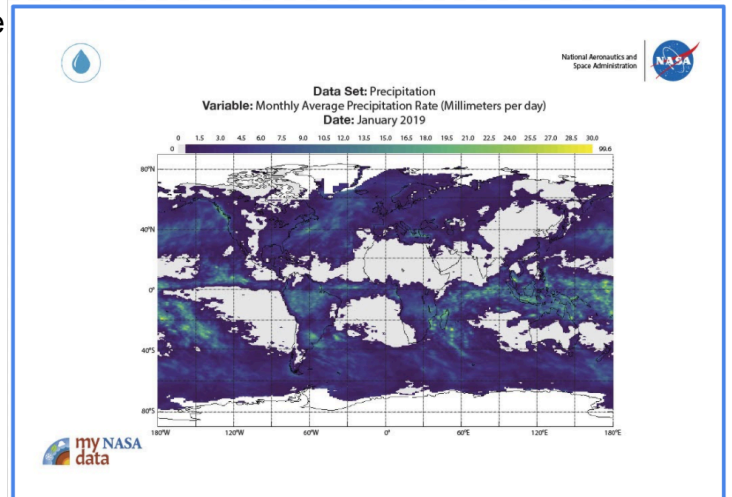
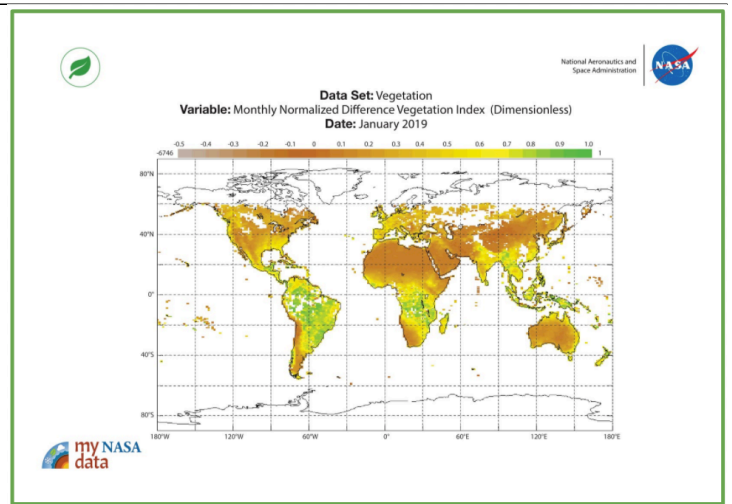
were on the ground and you looked up.



**Surface Temperature** - Monthly Daytime Surface (Skin) Temperature (degrees Celsius) This quantity describes the temperature of the land or ocean surface in the topmost layer (first few centimeters at the top of the surface). It is different than the surface air temperature, which is a measure of the temperature of the air closest to the surface. Daytime skin temperature is greatly affected by solar energy absorbed, especially over land. Dark surfaces have a daytime skin temperature much greater than the temperature of the air above the surface. These data have a grid spacing of 1 degree longitude and 1 degree latitude.



**Vegetation** - Monthly Normalized Difference Vegetation Index (dimensionless) This quantity measures the health of plants on the Earth's surface, by how much near-infrared radiation is reflected at the surface. Plants with green leaves (from chlorophyll) using photosynthesis reflect more near-infrared radiation, so like the leaf area index, the normalized difference vegetation index (NDVI) is more positive for healthy and highly productive plants. These data have a grid spacing of 0.5 degrees longitude and 0.5 degrees latitude.



**Precipitation** -Monthly Average Precipitation Rate (Satellite Observed) (millimeters per day) This quantity provides the monthly average precipitation rate in millimeters per day. Precipitation includes both rain and snowfall, with snowfall contributing as the amount of liquid created when the snow is melted down. The total monthly precipitation at any location can be calculated by taking the precipitation rate and multiplying by the number of days in a month. The rate is an average; it does not mean that precipitation consistently falls at this rate throughout the month at any location. These data have a grid spacing of 0.5 degrees longitude and 0.5 degrees latitude.

## Prerequisites Student Knowledge

This activity is ideal for learners (grades 4-8). The following skills are used in this activity.

- understand basic cause-and-effect relationships
- ability to read simple maps
- able to make simple data comparisons
- know basic weather-related phenomena
- are able to create, interpret, and make predictions from charts based on information provided

For younger learners, or learners who do not possess these skills, educators may need to provide more input and provide clues at various steps, while for learners with more experience looking at graphs of data, less educator input would be necessary. Consider using the [Mapped Data Cube](#) to help scaffold learners' data analysis.

## Student Misconception

- A common misconception among learners is that the seasons are caused by the distance between the Earth and Sun. In fact, summer in the Northern Hemisphere occurs at aphelion, the farthest distance between the Earth and Sun, and follows summer solstice when incident

sunlight is most concentrated along the Tropic of Cancer, 23 degrees 26 minutes 22 seconds.

- “The intensity of sunlight at a place does not change from day to day during the year (AAAS Project 2061, n.d.).”
- “Thermal energy cannot be transferred between air and water (AAAS Project 2061, n.d.).”

## Procedure

1. Present the following question, "How does your favorite park (school location or camp) change over the course of the year?" and have learners brainstorm the various ways that the environment changes. Facilitate a class brainstorm of the various environmental parameters that change throughout the year (e.g., precipitation, vegetation, clouds, and surface temperatures). (See Teacher Background Section for more information on these variables.) *The educator may wish to select only one of these variables to address at a time.* (If the learners have collected these data in the GLOBE program, have them reflect and examine these data.)

1. When during the year is the lowest data value? The highest value? Why?
2. How does their geographic region play a role in these values?



Big Spring Park in Huntsville, Alabama

2. Introduce Awenasa to the learners. Awenasa is an adventurous camper who loves to be outdoors exploring the natural world around her. Throughout the year, Awenasa visits different park locations

around the United States with her family. Awenasa is an active learner and citizen scientist who observes the camp environment using the GLOBE program before she moves on to the next camp location. She keeps a detailed science journal and using NASA satellite data to compare her observations. (Present the map of the locations across the United States where she visits over the year.)

1. Ask learners why they think it is important to use more than just Awenasa's observations to characterize the environment.
2. Why does she use NASA data AND her GLOBE data?

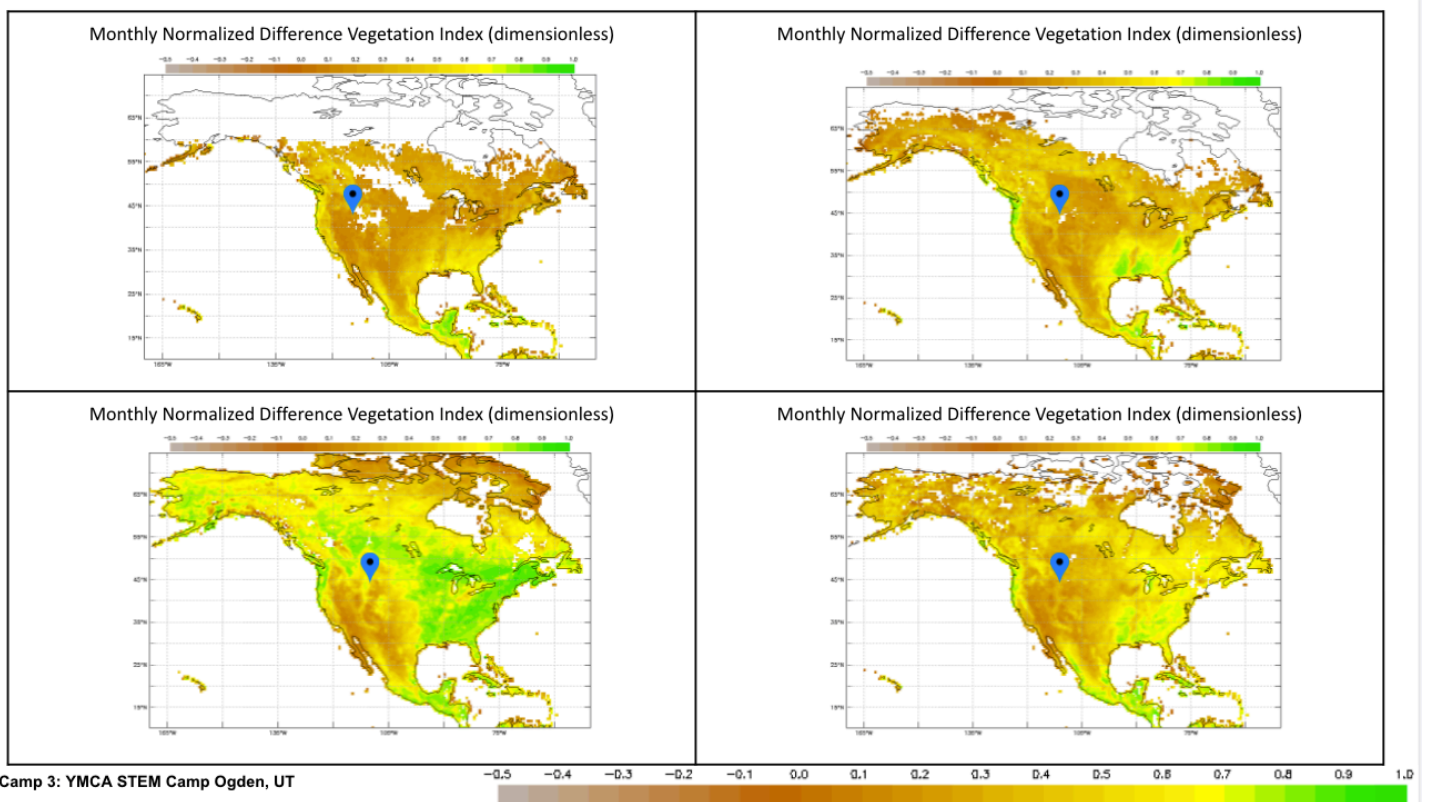


11 Camp Locations

3. Present the map to the learners. Have learners generate questions about these environmental characteristics about the park that is closest to them.

4. Divide learners into groups and distribute the four (precut) cards for 2019 (per variable that the instructor wishes to address) for a particular camp location. Draw attention to the camps' locations and labels. Discuss the variable, units, and how scientists use these data to help understand the Earth system. See **Teacher Background** for more information on these variables and related information.





5. Write the following months on the board: January, April, July, and October.

1. In a Think-Pair-Share, direct learners to brainstorm independently how their location would change with respect to the variable of interest over time (e.g., "I expect vegetation to increase in the Spring and Summer months and decrease in the Fall and Winter months.")
2. Have learners work in teams to match the cards to the four months using prior knowledge about seasonal variation in the Earth system. Learners will present their matchings to the class and their observations and evidence to support their claim.

6. Learners present their findings to the class. Next, present the correct answer keys for the variable/s. Ask learners what evidence they used to base their decisions. What additional information would they like to add to increase their confidence in their conclusions?

7. Play the following video. Discuss with learners the factors that affect the changes in variables over the course of a year.

[Video: NASA: Why does the Sun Matter for Earth's Energy Budget?](#)

Video

NASA: Why does the Sun Matter for Earth's Energy Budget?  
| <https://www.youtube.com/watch?v=82jE-yvB8xU> | Source: NASA Goddard

For more information about matter and energy cycles, visit [Earth System: Matter and Energy Cycles](#) and common [Earth System Interactions](#).

8. As an evaluation activity, consider having learners connect the sphere's of the Earth System using the data from their camp location in the following Graphic Organizer.

The graphic organizer is a central template for a project. At the top center, it features the NASA logo and the 'my NASA data' logo. Below these is the title 'Earth System Graphic Organizer' in a large, bold, blue font. In the center of the organizer is a rounded rectangular box containing the text 'Seasonal Changes in the Earth System'. Surrounding this central box are five empty rectangular boxes for notes or data, each with a distinct color and a circular icon in its corner: a green box with a leaf icon (top-left), a blue box with a water drop icon (top-right), a blue box with a cloud icon (bottom-left), a purple box with a snowflake icon (bottom-center), and a red box with a volcano icon (bottom-right).

