

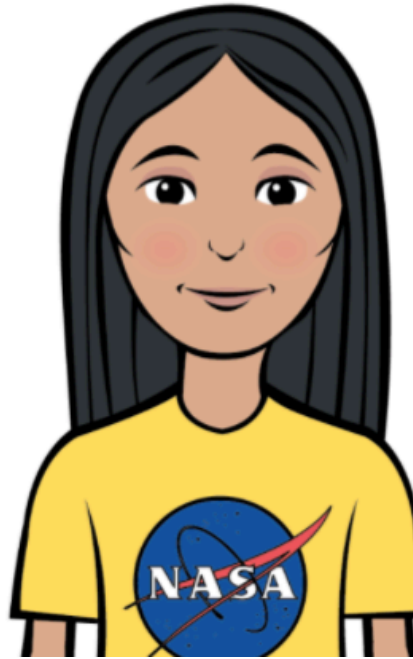
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## My NASA Data - Lesson Plans

### Where in the United States is Awenasa? Lesson Plan



#### Overview



This lesson, "Where in the United States is Awenasa?" is a data analysis activity that presents maps of NASA Earth satellite data for a variety of locations across the United States for four months throughout the year. Each location represents a real science camp that is actively using NASA and GLOBE data to explore the environment. Learners use clues in the environmental data to locate the camp where Awenasa travels to over the year. This lesson is based on the GLOBE lesson, [Where in the World...?](#).

The intention of this activity is to provide four different environmental variables that can be presented either separately or in conjunction. Educators may also prefer to facilitate learning through a Jigsaw activity to have different groups of learners work on different variables (Clouds, Precipitation, Surface Skin Temperature, Vegetation) or four different months of the year (January, April, July, October).

## Learning Objectives

- Analyze NASA satellite data to determine campsite locations
- Explore seasonal patterns in data from the Atmosphere, Biosphere, and Geosphere.

## 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 do Earth science variables vary across the United States over the year?

## Materials Required

- [Educator Presentation](#)
- Learner Sheets

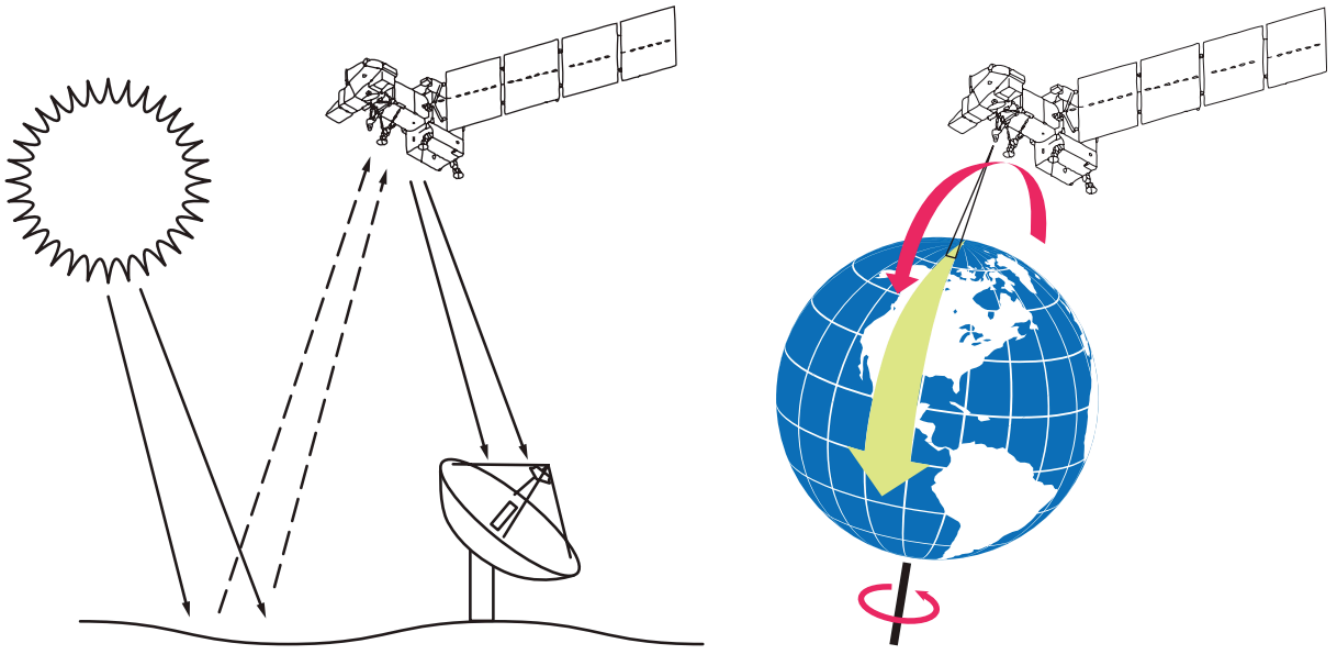
- Image Sheet ([Google Doc](#))
- Data Sheet: Surface (Skin) Temperature ([Google Doc](#))
- Data Sheet: Normalized Vegetation Difference Index ([Google Doc](#))
- Data Sheet: Cloud Coverage ([Google Doc](#))
- Data Sheet: Precipitation ([Google Doc](#))
- Optional:
  - Map Cube and Questions ([PDF](#)) or Google Forms ([link](#))
  - One large world map to display on the wall or screen

## Technology Requirements

- Internet Required
- One-to-One (tablet, laptop, or CPU)
- One-to-a-Group
- Teacher computer/projector only
- Color Printer

## Teacher Background Information

### 1. What is remote sensing?



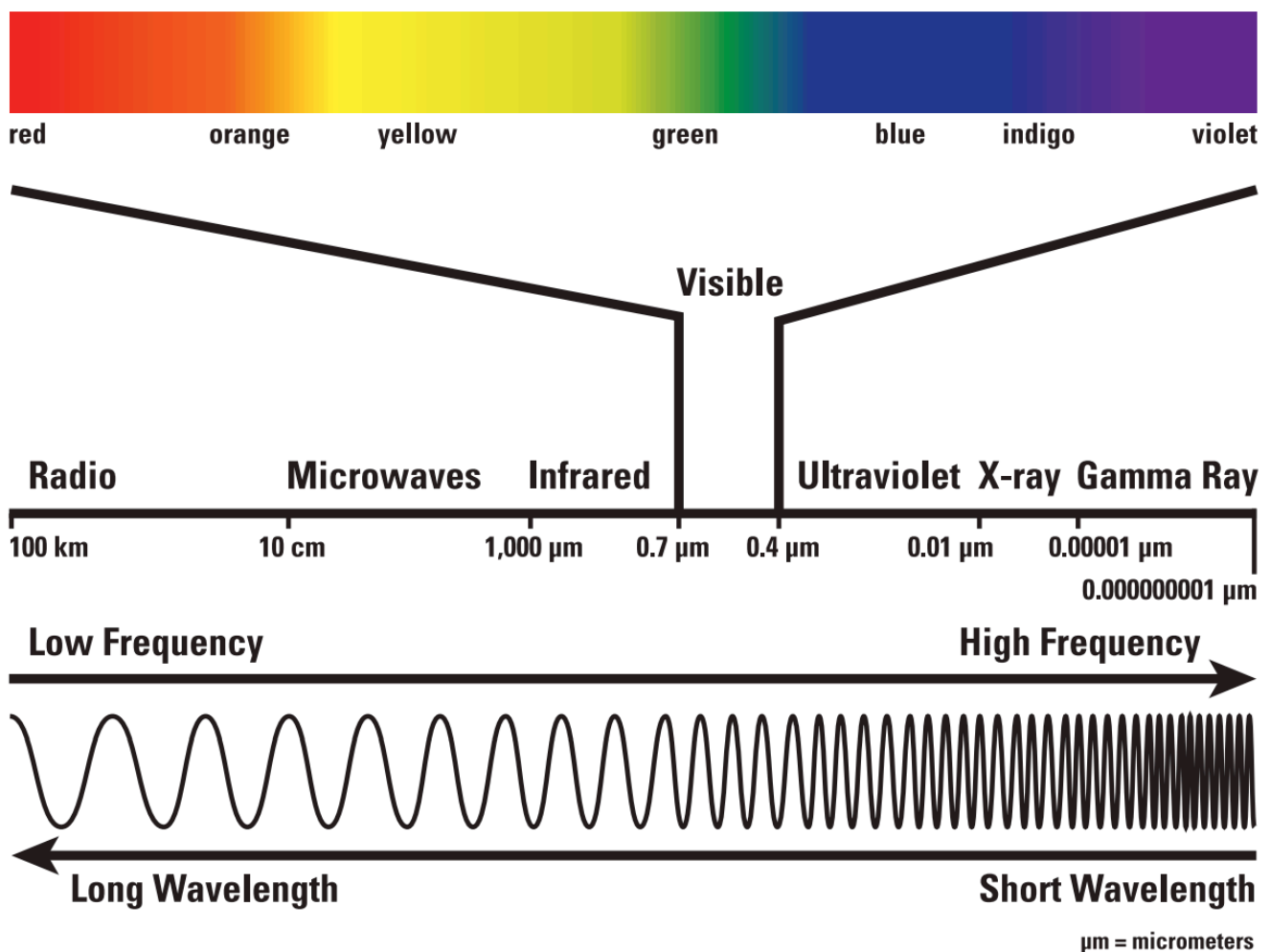
Remote sensing means observing something from a distance. Satellites in space observe the Earth from a distance and help scientists study large tracts of land and how that land changes over time. Optical remote sensing satellites use reflected light to detect electromagnetic energy on the Earth's surface. The level of energy is represented by the electromagnetic spectrum, which is the range of energy that comes from the Sun or any other object in the Universe. The light from the Sun that we can see is only a small part of the electromagnetic spectrum and includes the colors of the rainbow. Satellite sensors can detect light that we can't see.

The electromagnetic energy reflects off the Earth's surface and up to the satellite sensor, which collects and records information about that energy. That information is transmitted to a receiving station in the form of data that are processed into an image.

## 2. How do satellite sensors work?

We can only see an object because light bounces off of it and to our eyes. Human eyes can detect only visible light—the colors of the rainbow. Satellite sensors can also detect ultraviolet and infrared light. The sensors record this information in different portions of the electromagnetic spectrum, which is measured in wavelengths.

### Electromagnetic Spectrum



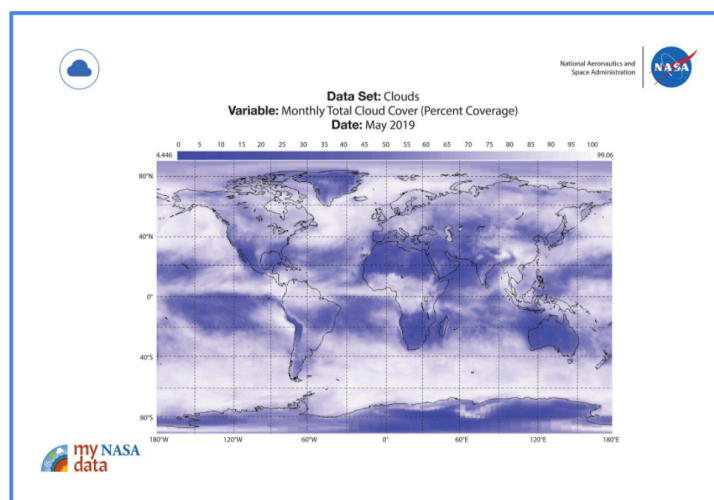
(For more information about Remote Sensing to study Earth, visit the **Related Resources** in this lesson.)

Credit: USGS

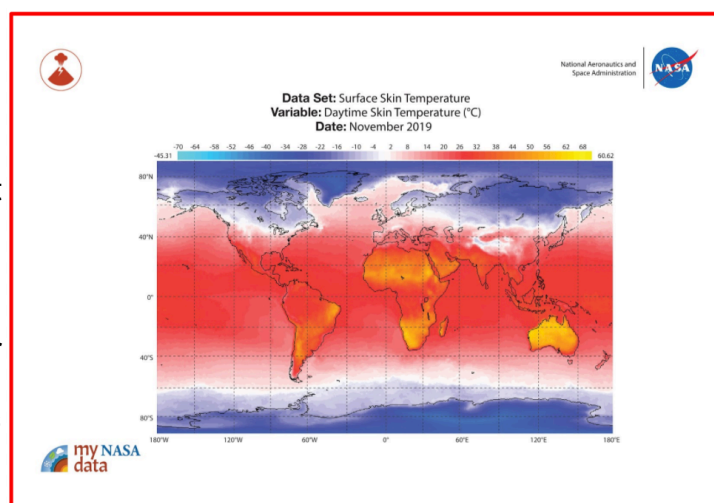
## 3. Exploring Earth Science Variables using Maps Collected by Remote Sensing

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.

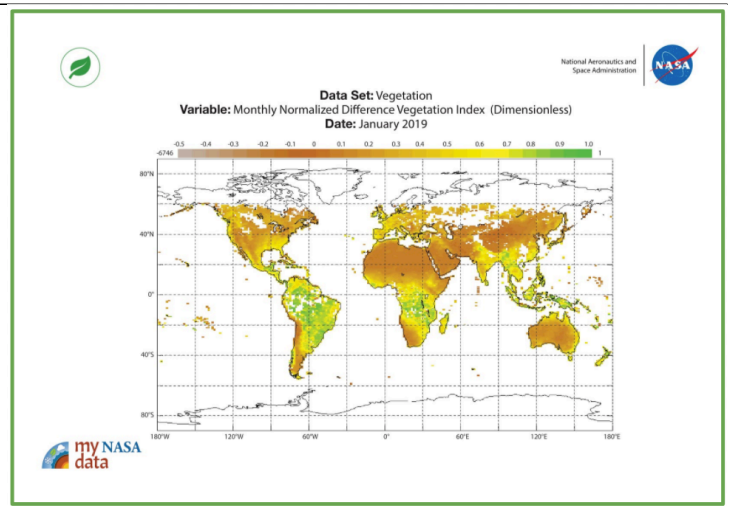


**Surface Temperature** - Monthly Daytime Surface (Skin) Temperature (degrees Celsius) This quantity describes the temperature of the land or ocean surface in the topmost layer (first few centimeters at the top of the surface). It is different than the surface air temperature, which is a measure of the 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.

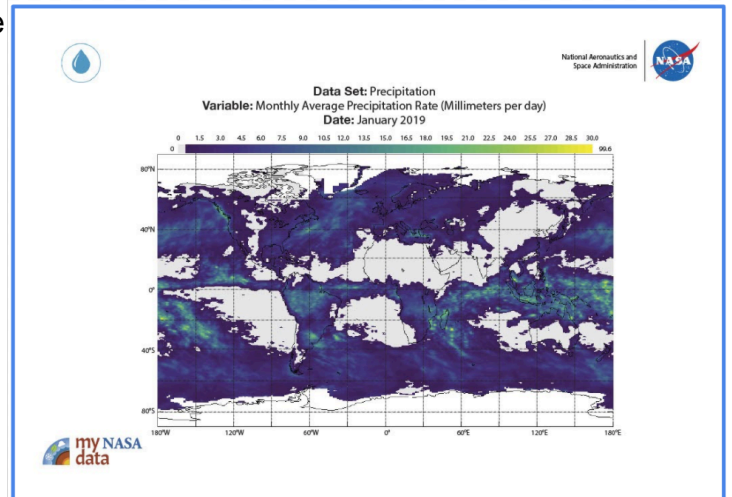


**Vegetation** - Monthly Normalized Difference Vegetation Index (dimensionless) This quantity measures the health of plants on the Earth's surface, by how much near-infrared radiation is reflected at the surface. Plants with green leaves (from chlorophyll) using photosynthesis reflect more near-infrared 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.



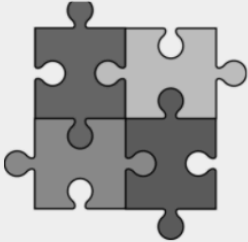
#### 4. Jigsaw Teaching Strategy

Not familiar with Jigsaw? See [link](#) for this and other strategies.

## JIGSAW METHOD

Explore a segment of subject matter with students. This is an effective way to get students to work collaboratively and learn how to rely on people/ be reliable within a team.

(ARONSON, 1970)



1. Divide the class up into small groups of 4-5 students each.
2. The teacher should then distribute a separate reading to each table and explain that this is the information they must learn as a group in order to become experts in their assigned area of study
3. Next, the teacher should clearly state to the whole class that each table will be given \_\_\_\_ amount of time to learn and discuss the material with their expert group.
4. When the time on the clock has run out, the teacher should tell the students that they will now be assembling into new groups, where each of them will take turns speaking and spend \_\_\_\_ amount of time teaching the material that they learned to the members of a new, mixed group.
5. When the time on the clock runs out, the teacher can congratulate the student experts for educating their peers on their area of study, then tell the groups that they will now be given a group task where they will need to combine everything they have learned up to that point in order to complete.



[Return to Table of Contents](#)

See Instructional Strategies at <https://mynasadata.larc.nasa.gov/basic-page/instructional-strategies-earth-science-classroom> for more information.

## Prerequisites Student Knowledge

This activity is ideal for learners (grades 4-8) understand basic cause-and-effect relationships; the ability to read simple maps and are able to make simple data comparisons; know basic weather-related phenomena; and 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.

## Procedure

We highly encourage learners to complete the "Awenasa Goes to Camp!" lesson prior to conducting this activity.

1. Present the map below to the learners. Have learners generate research questions about the parks' environmental characteristics.



## 11 Camp Locations

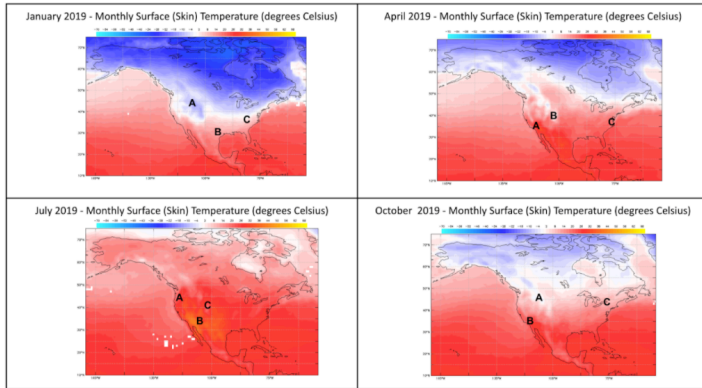
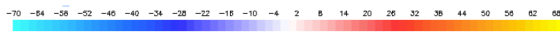
- Assign learners to one of the 11 the different camp locations to work in pairs and brainstorm how the data values of the featured variable vary over the year.
  - (For advanced learners, have them create a hand drawn line graph showing how they think the data values would change over the following months: January, April, July, and October. Have them label their graph with the title of the variable they are brainstorming. Keep this posted in the classroom as a reminder of their first predictions.) After the groups have finished, ask what problems they experienced in determining the shape of the data. What additional clues might be valuable? Help them to understand that location or geographic distribution – where these camps are located relative to each other – could be useful.
- Display/distribute the maps of the appropriate variable/s to the groups and the learner data sheet for the said variable/s.





Where in the World is Awenasa?

Monthly Surface (Skin) Temperature (degrees Celsius)



My NASA Data



Student Name: Date: Period:

Where in the World is Awenasa?

Data Sheet: Surface (Skin) Temperature (degrees Celsius) - April

Directions: Let's find Awenasa! Observe your three maps and respond to The questions below:

- 1. In April, Awenasa was still traveling in the United States. What was the season in April?
2. During the month of April, Awenasa traveled to five places in the United States.
3. Using the clues below, find the places where Awenasa was camping.

- A. The first place where Awenasa was camping in April had an average temperature of 55f.
B. The second place where Awenasa was camping in April had an average temperature of 65f.
C. The third place where Awenasa was camping in April had an average temperature of 45f.

circle The best answer for each sentence below:

- A. The first place where Awenasa was camping was a b c d e
B. The second place where Awenasa was camping was a b c d e
C. The third place where Awenasa was camping was a b c d e

4. Finish the sentence below:

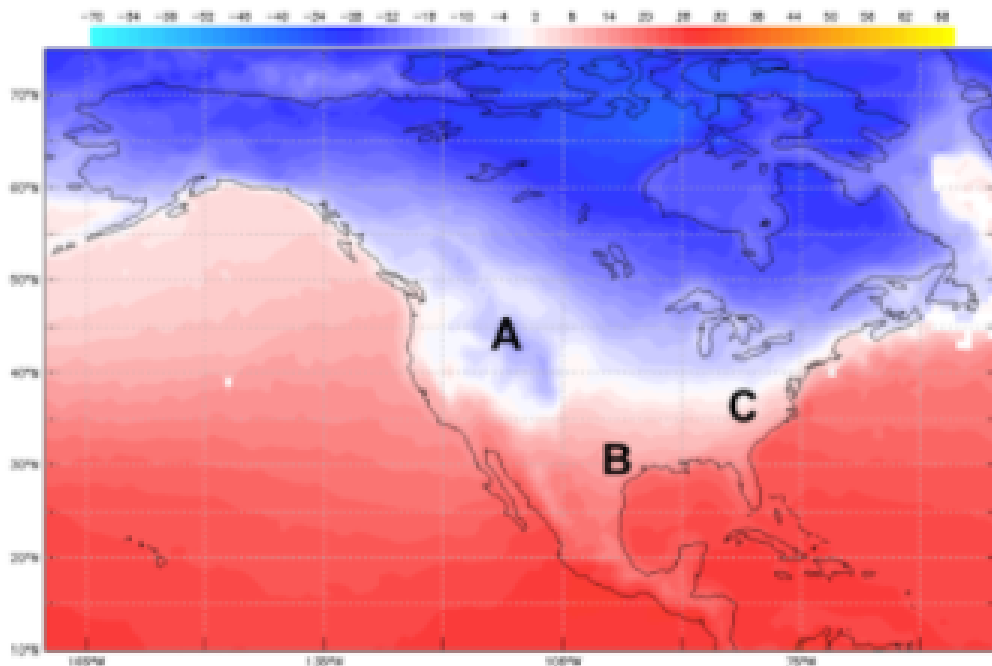
The clues and the map helped me find Awenasa's camping places in April because....

Example of images learners will examine. These maps show Monthly Surface Skin Temperature (January, April, July, October)

Example of data sheet. This one shows Surface Skin Temperature for April.

4. Learners work in groups to analyze the maps and answer the questions on the data sheets. (Note: They are no longer assigned to any particular location.) The groups should work independently to estimate the data values for the locations (based on the color bar on the maps).

January 2019 - Monthly Surface (Skin) Temperature (degrees Celsius)



- The first place where Awenasa was camping in January had an average temperature of 4 °C.
- The second place where Awenasa was camping in January had an average temperature of -10 °C.
- The third place where Awenasa was camping in January had an average temperature of 8 °C.

Example of data analysis questions from Surface Skin Temperature Learners Data Sheet related to data collected in January.

5. Discuss as a class how well these data fit into their original ideas (or graphs, for advanced learners). Advanced learners sketch out a new graph based on the data values offered on the maps. Discuss as a class how well these data fit into their sketched graphs.
6. Discuss how scientists make predictions based on previous knowledge and then incorporate new information as it becomes available into their predictions, making them more accurate. Explain that, through collecting data, GLOBE schools and partnering locations (like camps) can help enhance science models used by scientists to better predict Earth system phenomena.