

# MY NASA DATA Lesson: *See notes at the end of the lesson for data updates with the new Earth System Data Explorer*

## Solar Cell Energy Availability From Around the Country

### Purpose:

To determine areas of the country which are most likely to produce solar energy by analyzing differences in incoming solar radiation graphs.

**Grade Level:** 8 – 12

### Estimated Time for Completing Activity:

Two 45 minute class periods

### Learning Outcomes:

- Students will learn to use NASA Live Access Server (LAS) data
- Students will critically analyze line plots that are generated using satellite data. These plots will be used to compare variables from various locations in the United States.
- Students will determine the potential for solar panel use as it relates to geography

### Prerequisite

- Be able to convert a latitude and longitude location into a city-state location
- An introduction to the Live Access Server and lesson vocabulary
- Basic understanding of solar panel technology

### Tools

- Computer with Internet access
- Students worksheet (in Lesson Links)

### AP Environmental Science Topics



- Atmospheric circulation
- Solar electricity
- Solar energy
- Solar intensity and latitude

**Vocabulary:**

- [difference plot](#)
- [overlay plot](#)
- [solar radiation](#)
- [SRB](#)

**Lesson Links:**

- [Student Worksheet](#)
- [Live Access Server](#)
- [Teacher Guide](#)
- [Extension link 1 \(see answer on battery need\)](#)
- [Extension link 2](#)
- [Earth Observatory article on renewable energy resources](#)
- [Information about satellite orbits](#)
- [What is your carbon footprint?](#)
- [Earths Radiation Budget](#)
- [Paperless version of the lesson](#)

**Background:**

Solar cells have varying amounts of effectiveness depending on factors such as latitude and cloud coverage. For example, locations with more cloud coverage will produce less solar energy. Sheridan, Wyoming has a fair number of solar cells on homes and businesses, however effectiveness of these solar panels changes throughout the year. By comparing the monthly averages of surface downward radiation in various locations around the United States, students can analyze areas that would be more or less beneficial to having solar panels per month. This lesson will introduce students to time

series (line) plots and how they can analyze such information as it relates to a particular objective.

The solar energy data used in this lesson is gathered from various polar orbiting and geostationary weather satellites, including Geostationary Operational Environmental Satellite (GOES) and Polar Operational Environmental Satellite (POES). The Monthly Surface All-sky Short Wave Downward Flux data is compiled by the Surface Radiation Budget (SRB) project. For this data, the satellite measures the rate of transfer of solar energy (measured in watts) per unit area (measured in square meters or  $m^2$ ) as the radiation is reaching the surface of the Earth. More solar energy that reaches the surface will provide more electrical energy for the solar cell.

**Procedure:**

Using the student worksheet, students will explore the LAS data on a journey around the United States to determine the solar radiation available for use with a solar cell. Each student will follow two example problems comparing Sheridan, Wyoming to a higher latitude location and a lower latitude location. They will create both an overlay graph of the areas as well as a difference graph.

When finished with the example projects, each student then explores parts of the United States in which they want to live, using solar energy to power their home. As a requirement, each student must live part of the year in Sheridan, and can live up to four locations throughout the year. Through graphic analysis, students must identify locations that will produce enough solar radiation to meet their living requirements.

**Questions:**

Questions from Student Worksheet:

1. Differentiate between an Overlay Plot and a Difference Plot as seen plots on the page after the questions in this worksheet. Make some generalized statements as well as some specific to the plots.
2. Explain a problem with overlay plots in this activity. Suggest ways to correct the problem.
3. List at least two factors that contribute to a higher solar energy level in an area.
4. Create a plan describing where you will live each month of the year.
5. Determine one place you would like to live, but cannot due to low solar radiation.

**Extensions:**

1. Calculate average energy needs for your lifestyle using Extension link 1: 'Northwest Energy Storage – Alternative Energy Solutions'.
2. Determine the number of solar cells needed for your home using Extension link 2: 'How to Size a Grid-Connected Solar Electric System'.

*Lesson plan contributed by Teri Rowland, Sheridan, Wyoming*

[Click here for Teachers Notes](#)

[View lesson without Standards](#)



**Data Notes from Dr. Brad (12/2018):**

Up-to-date solar radiation data on the Earth System Data Explorer can be found at Atmosphere->All Data->Longwave and Shortwave Radiation at Earth's Surface->Monthly Flow of Energy into Surface by Shortwave Radiation.