Lesson Title   The Power of the Sun
Length of Lesson   50 minutes
Created By   Corey Ladner
Subject   Geometry
Grade Level $10^{th} - 12^{th}$
State Standards   4c
DOK Level   DOK 2
DOK Application   Cause/Effect, Infer, Interpret, Distinguish, Make Observations, Relate, Compare.

National Standards   Geometry
Use visualization, spatial reasoning, and geometric modeling to solve problems.

Measurement
Apply appropriate techniques, tools, and formulas to determine measurements

Graduate Research Element   In my research, solar energy is used to power stationary stream monitoring equipment. A solar panel with the necessary energy capacity is mounted in the optimal direction to the sun, and then attached to an interface module that continuously records rainfall, stream water level, and stream water temperature. It is important to know how large of a solar panel surface area is required to generate the amount of energy needed.

Student Learning Goal:
Students will solve real-world and mathematical problems involving surface area. This lesson will focus on a real-world problem involving the installation of a rooftop solar panel grid to exercise the students' skills of surface area measurement in deriving a solution to the real-world problem.

National Standards:
Geometry:
- Use visualization, spatial reasoning, and geometric modeling to solve problems.

Measurement:
- Apply appropriate techniques, tools, and formulas to determine measurements.

Materials Needed (supplies, hand-outs, resources):
Calculators, construction paper, rulers, pencils, markers

Lesson Performance Task/Assessment:
The students will be assessed on their understanding of how surface area can be applied to real-world situations. As the assessment, Students will be presented with a simulated real-world problem where they must determine the amount and size of solar panels needed to cover a specific roof top, how much energy will be generated from the solar grid, and how long it will take to pay for the installation cost with the profit made from unused solar energy. Refer to guided and independent practice for details.

Lesson Relevance to Performance Task and Students:
The lesson provides the students with real world problems involving the practice of surface area measurements that can be used to make important decisions concerning economics, energy, and climate.

Anticipatory Set/Capture Interest
The teacher will capture the students' interest by presenting them with a real solar panel and initiating a discussion about :
- What is a solar panel?
- What does a solar panel do?
- What things are needed for the solar panel to perform well and fulfill its purpose?

Guided Practice:
Students will be introduced to solar panels with the initial anticipatory discussion. Additionally, the teacher will explain how solar panels are used in stream monitoring research. Following the introduction, the students will be presented with the following real-world problem: Riverside Renewable Energy, LLC has initiated a $31 million rooftop solar powerplant project (largest in North America) at the Gloucester Marine Terminal in New Jersey. The surface area of the rooftop is 1.1 million square feet (23 Football Fields). Riverside has planned for the use of 80 electric invertors; therefore, allowing for 80 rows of solar panels on the roof top. Each individual solar panel has a surface area of 40 square feet. Using the information provided above, determine how many individual solar panels are needed to cover the entire surface area of the rooftop. When installation is complete, the solar panel grid is calculated to output 9 megawatts of clean energy annually, producing 11 million kilowatt hours of electricity each year. If this amount of electricity was produced with coal energy, the electricity would cost approximately 10 cents per kilowatt hour. Using this information calculate how long it would take for Riverside to cover the initial $31 million installation cost with the renewable solar energy production?

Interesting Facts for the Students
Capturing 9 Mega Watts of clean energy is the yearly equivalent to:
- Eliminating 16 MILLION pounds of CO_2 emissions from the atmosphere
- Removing 1,200 cars from our streets and highways
- Enough energy to power 1,500 homes
- Planting 400,000 trees (2,300 acres)

Independent Practice:
Students will receive a hands-on project that requires them to use the geometrical concept of surface area measurement to develop a solution to the problem proposed in the guided practice. Once students have performed the necessary calculations, they will construct a model of the rooftop solar grid with construction paper.

Remediation and/or Enrichment:
Remediation:
In the case that remediation is needed the student can meet with the instructor for individual tutoring. The student can also be grouped with a higher performing student that understands the lesson.
Enrichment:
In situations where there is complete understanding and performance, the lesson can be extended by having the students calculate the rooftop surface area of their homes and determine how many solar panels could be installed on the rooftop, and how much electricity could be generated if the solar grid could be installed.

Check(s) for Understanding:
The teacher will check for understanding by asking the students the following questions:
- How does surface area affect the amount of solar energy that can be captured from the sun?
- Is surface area an important factor involved in determining if solar power in economically beneficial for the consumer?
- What factor affected the total number of solar panels used in the grid?

Closure:
The teacher will close the lesson by reiterating the importance of solar panels in continuous stream monitoring equipment. The teacher will show the students the type of information that can be generated from the stream monitoring equipment and viewed online from anywhere, all because of solar power.

Possible Alternate Subject Integrations:
This lesson can be easily incorporated into high school algebra and physical science courses.

Teacher Notes:

References for Guided Practice Scenario:
- http://www.youtube.com/watch?v=D1SKW6vNpmk
- http://www.holtlogistics.com/riverside-renewable-energy
- http://www.electricrate.com/residential-rates/new-jersey/