**Subject area/course:** Mathematics/Algebra I

**Grade level/band**: 9-10

**Task source**: Generation Texas San Antonio (GenTX SA), Educational Policy Improvement Center (EPIC); Original Author: Tracy Anderson

**Solar Energy Estimate**

**TEACHER'S GUIDE**

1. **Task overview**:

In this task, students will write an estimate for a potential client who is interested in installing solar energy panels. They will provide figures on the initial purchase of the solar energy panels along with the charge per kilowatt-hour. They also will estimate when the potential client will see their investment pay off. Students will calculate these amounts by using one-variable linear functions.

Students will write a persuasive letter that provides mathematical calculations to encourage a fictional business to invest in solar energy panels. The letter will be addressed to a fictional business and will be signed by the student as if he or she were leading the estimate for that client.

1. **Aligned standards:**
2. **Primary Common Core State Standards**

[CCSS.Math.Content.HSA-CED.A.1](http://www.corestandards.org/Math/Content/HSA/CED/A/1)Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions*.

[CCSS.Math.Practice.MP3](http://www.corestandards.org/Math/Practice/MP3) Construct viable arguments and critique the reasoning of others.

[CCSS.Math.Practice.MP4](http://www.corestandards.org/Math/Practice/MP4) Model with mathematics.

[CCSS.ELA-Literacy.W.9-10.1](http://www.corestandards.org/ELA-Literacy/W/9-10/1/) Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

[CCSS.ELA-Literacy.W.9-10.4](http://www.corestandards.org/ELA-Literacy/W/9-10/4/) Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

[CCSS.ELA-Literacy.L.9-10.1](http://www.corestandards.org/ELA-Literacy/L/9-10/1/) Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

[CCSS.ELA-Literacy.L.9-10.2](http://www.corestandards.org/ELA-Literacy/L/9-10/2/) Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

1. **Secondary Common Core State Standards**

[CCSS.ELA-Literacy.W.9-10.5](http://www.corestandards.org/ELA-Literacy/W/9-10/5/) Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

[CCSS.ELA-Literacy.W.9-10.6](http://www.corestandards.org/ELA-Literacy/W/9-10/6/) Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology’s capacity to link to other information and to display information flexibly and dynamically.

1. **Critical abilities**

Modeling, Design, and Problem Solving: Use quantitative reasoning to solve problems arising in everyday life, society, and the workplace, e.g., to plan a school event or analyze a problem in the community, to solve a design problem or to examine relationships among quantities of interest. Plan solution pathways, monitoring and evaluating progress and changing course if necessary, and find relevant external resources, such as experimental and modeling tools, to solve problems. Interpret and evaluate results in the context of the situation and improve the model or design as needed.

Use of Technology: Present information, findings, and supporting evidence, making strategic use of digital media and visual displays to enhance understanding. Use technology, including the Internet, to research, produce, publish, and update individual or shared products in response to ongoing feedback, including new arguments or information.

1. **Time/schedule requirements:**

Students should be given approximately one week to complete this assignment.

1. **Materials/resources:**

* Access to *Business Letterhead (Level Design)* from Microsoft Word, either on student computers or through the school computer lab
* Solar Energy Estimate Letter Requirements handout (attached to student handout)
* Laptops or a visit to the computer lab for one class period

1. **Prior knowledge:**

* Students should be familiar with calculating the cost of an electric bill based on the current rate per kilowatt-hour and the total number of kilowatt-hours used per month. (For example, rate per kilowatt-hour = $0.13 & kilowatt-hours used per month = 1400. Total monthly bill = 0.13 X 1400 = $182.00.)
* Students should be able to calculate savings over different periods of time by using percent discounts.
* Students should be familiar with the form of a business letter.
* Vocabulary: energy, federal tax credit, kilowatt, kilowatt hour, percent, power

1. **Connection to curriculum:**

This assignment shows how employees must be knowledgeable not only about a product, but they must also be able to perform mathematical operations to give clients accurate estimates about the cost of the product. They must be capable of persuading a client through written communication using the correct tone as well as appealing to the client by providing cost-saving figures. The value of the skills developed in this task can be transferred to include college or work situations in which a student or employee needs to justify his or her efforts and products. The task has value for the individual as well, showing how mathematical solutions can be translated into cost-saving measures.

1. **Teacher instructions:**

* Introduce the task with a discussion about what solar energy is. Mention interesting facts about solar energy: (1) it’s a renewable resource, (2) solar panels (or photovoltaic cells) can be found on some calculators, and (3) it produces a fraction of the global energy demand.
* If necessary, explain the difference between power and energy. For the purpose of this assignment, the students need to know that a kilowatt-hour is a measure of energy just as a calorie is a measure of energy. A kilowatt is a measure of power, and power is a measure of how fast something is generating or using energy.
  + For example, when referring to Solar Energy Systems, clarify that the amount of kilowatts produced by a 1 kW (a simplified approximation for this assignment) is 1600 kilowatt-hours per year. Students might mistakenly convert the amount of kWh produced by a 1 kW system as 1000 kWh per year due to the prefix *kilo*. A 2 kW would produce 3200 kilowatt-hours per year, and so on.
* Tell students that they will be drafting a persuasive letter to convince a business to invest in solar energy panels, and they will need to include mathematical calculations to support their reasoning.
* Discuss the term kilowatt-hour with the class. Go on to mention how you can determine the number of kilowatt-hours a house or business uses by finding the total monthly charge and dividing it by the rate-per-kilowatt-hour. It might be helpful to bring an example of a utility bill to further explain how monthly electric bills are generated and what average use may look like during different months of the year.
* For example: Rate per kilowatt-hour = $0.13
* Kilowatt hours used per month = 1400
* Total monthly bill = 0.13 X 1400 = $182.00
* Distribute the Solar Energy Estimate Letter Requirements handout to students. Discuss the requirements for the mathematical calculations and allow the students to work with partners for that part of the assignment.
* Discuss the requirements of a business letter. Inform students that they need to follow *Business Letterhead (Level Design)* from Microsoft Word, as specified on theSolar Energy Estimate Letter Requirements handout. The students need to proofread the letter for grammar, spelling, and punctuation. The letter should be clear and concise in its message to the client.
* Remind students that in their future careers they will be expected to use logic and to back it up with facts or calculations to persuade colleagues and clients. Ask students if they can think of any careers that might use mathematical computation to persuade others.
* Give the students at least one class period to begin research about the benefits of using solar energy.
* Provide three more days for students to work through their solutions and develop their business letters.
* Have students turn in their completed, revised drafts of their business letters.
* Conclude the activity by asking students to articulate their takeaways from completing this task. Point out that successful college students and employees are often required to persuade others of their positions, and that logically backing up a point of view is a powerful persuasive approach.

1. **Student support:**

The following suggestions are examples of scaffolding that can be used to meet the diverse student needs within the classroom.

* Conduct frequent checks for understanding when introducing how to calculate kilowatt-hours and rates per kilowatt-hours.
* Provide specific, guided tutoring for students who are having trouble getting started.
* Let students work with partners during the mathematical calculation portion of the lesson.
* Model the thinking process for students with “think aloud” talk.
* Provide materials in the students’ first language.

1. **Extensions or variations:**

One possible extension is to visit a company that has installed solar panels or invite a representative from the local power company to visit your class.

1. **Scoring:**

Student work can be scored using the SCALE Math Performance Assessment Rubric (Grade 9-12).