Challenge #2
Solar Array

Due Tuesday, April 14

On February 1, 2020 Occidental College hosted the Second Technical Workshop. During the Solar Car Building Workshop, the attendees in that session built and raced a balsa wood solar powered car.

This challenge focuses on solar power and building an efficient solar array. Students that didn't attend that session can still do this challenge, as the resources below will help explain the information you need to complete the challenge.

Challenge details:

- **Utilize the Pasco Scientific website:**
  - For this challenge, you need to use the link below to access materials from Pasco Scientific, which are made available free to students during this time of shutdown.
  - **Student Access - Essential Physics 3rd Edition**
    Student Access Code: NGSS58653-EP3-SB-0720-M5UJJ

- **Complete Part 1 of the attached worksheet:**
  - After you sign in, select the "Video" icon.
  - Select Chapter 1, Physics of Solar Power
  - Watch the video in the Design Challenge Section of the page
  - Use the information from that video and other materials in that section to answer the questions in Part 1 of the attached worksheets.
- **Complete Part 2 of the attached worksheet:**
  - Stay in Chapter 1, Physics of Solar Power on the Pasco Scientific website.
  - Complete the Interactive Simulator to design a solar array as detailed on the attached worksheet.

Your answers are scored similar to how we score the races. The best response will receive 100 points and everyone else will receive a lesser score. In this case, the winner will be the one who answers the most questions correctly in Part 1 and designs an array with the lowest cost per kWh of power in Part 2.

While you're on the Pasco website feel free to look at the other chapters, there is so much good information which may help you with your regular school classes.

Responses can be emailed to Julie Miller Kalbacher at jamiller@mwdh2o.com Make sure to include your name and school name on your responses.

Good luck with this challenge and with all of your schoolwork.

Challenge #2 Worksheet

Due Tuesday, April 14

The winner of this challenge will be the person that gets the most questions correct in Part 1 and makes an array which has the lowest cost per kilowatt hour in Part 2.

To start, use the access code and click on the link below to begin the challenge:

Student Access - Essential Physics 3rd Edition
Student Access Code: NGSS58653-EP3-SB-0720-M5UJJ

After you sign in, go to the "Video" section and use the materials and videos in Chapter 1 to complete this worksheet:

Part 1: Using the video and materials as a guide, answer the following questions:

1) How much energy does the sun produce? _____

2) What is the distance from the earth to the sun? _____

3) What is the formula for intensity? _____

4) What is the inverse square law? _____

5) How much of the sun's power reaches the top of the earth's atmosphere? _____

6) In the wintertime, how much power hits a sq. meter of ground in downtown LA?

   Show your work: _____
   _____

7) In the summertime, how much power hits a sq. meter of ground in downtown LA?

   Show your work:_____
   _____

8) Draw a sketch of a PV cell and briefly describe how it works:

9) What is the efficiency of an average PV cell? _____

10) What are the three most common materials used to make a PV cell?

Part 2: Designing a PV System

Now use the simulator to make a PV system. Your goal is to make a system with the best cost efficiency. Use the information in the video as a guideline.

- Your results will be penalized if you use numbers outside of the guidelines given in the video.
- To verify your results, enter the values below for the nine variables used in the simulation.
- We will use your numbers to verify your results.

For your simulation, use the following assumptions. Fill in the rest of the blanks using the numbers for your maximum efficiency:

- **Location**: Downtown LA
- **Months**: Average and July
- **Area of array**: 100 sq. meters

1) Latitude: _____
2) Mounting Angle: _____
3) Months: _____
4) PV Technology Used: _____
5) Reflection and Transmission Estimate: _____
6) Battery Efficiency: _____
7) Length: _____
8) Width: _____
9) Lifetime of Array: _____

Your cost per kilowatt hour Average: _____

Your cost per kilowatt hour for July: _____