ENERGY TRACKER

ET 7 - Power Meter Activity

LESSON OVERVIEW

This lesson provides students with the experience of using a power meter to measure power and understand more about energy use by calculating the energy (kilowatt-hour), carbon dioxide, and cost of different electric items.

Challenge: Redesign your home to conserve energy.

Power Meter Activity	Estimated time
Introduction to the Power Meter Activity	10 minutes
Power Meter Activity	30 minutes
Homework: Power Meter-Home Investigation	5 minutes
Total	**45 minutes**

LESSON LEARNING OBJECTIVES

- The students will develop experience measuring the power use of different electrical devices and calculating the energy use over a given time.

BACKGROUND FOR TEACHERS

The power meter-monitoring device will be used to monitor power use and energy consumption much more closely in our homes. In time, it is very likely that we will have applications that will allow us to see how much energy is being consumed by each piece of equipment in our home (lights, water heaters, appliances, etc.). With the power meter users can observe the voltage (potential energy), amperage (current), and watts (power) as well as kWh (energy) and track these units of electricity over time. In addition, the meter can be used to detect vampire loads, or situations where devices draw power even when they are not in use.

NEXT GENERATION SCIENCE STANDARD:
MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

SCIENCE and ENGINEERING PRACTICES:
Analyzing and Interpreting Data: The students will measure and analyze the amount of power generated by some appliances and specific light bulbs. This practice will help them develop an understanding of the physical difference of the items and how to plan to reduce the impact of each in their homes or schools. In addition, it may introduce them to the concept of "power" and the unit used to measure it (W). The students may be able to recognize the terms in other items around their homes that they use in their daily lives.

CROSSCUTTING CONCEPTS:
Influence of Science, Engineering and Technology on Society and the Natural World: As technology becomes more affordable and available for the general public, tracking different metrics of our daily activities such as electricity and water consumption, gas usage, air quality, health, among others has become more popular and easier for individuals. With the use of apps and portable instruments humans are able to analyze and regulate their resource usage and habits. The students will use power meters at home to discover patterns, analyze data, and encourage behavioral changes.

TYING IT ALL TOGETHER

The students start analyzing the energy consumption of common household items to continue building their understanding of how electricity is used at home and in their environments. The more they understand the inner workings of this items, the better they can design plans for energy reduction.

ANTICIPATED CHALLENGES AND TEACHER TIPS

The students will be using the power meter to measure power. Therefore, the necessary arrangements should be made to ensure the safety of the students while handling the electric items. If there is not enough resources for each student to use a power meter, have access to a lamp, or electricity outlets, the students should be divided in teams or a class demonstration ran by selected students should be conducted to perform the activity. In addition, based on the amount of resources, speed of the students to perform the experiment, and ability to perform the corresponding calculations, this lesson may extend to an additional class period.

VOCABULARY

- **Baseline -** A minimum or starting point used for comparisons.

- **Conservation -** Is the act of preserving, protecting, or wisely use of biodiversity, environment, and natural resources.
- **Kilowatt-hour -** kWh is a unit of energy, and stands for 1000W * 1 hour, or in words, using a 1000 watts of energy for one hour. It's a very common unit of energy, and typically what is used in everyone's electricity bill.
- **Watt -** A watt is a measured of the instantaneous energy usage (power).

LIST OF MATERIALS & PREP TIPS

For the class:

- Computer with Internet connection and with access to a projector for the instructor.
- A power meter
- A lamp to be used with two light bulbs:
  - Incandescent (75 watts)
  - LED (15 watts)

Note: If a lamp cannot be used, other electrical appliances can also be measured.

For the students:

- Each student should get a copy of the *Power Meter: Demonstration Guide* worksheet.
- Calculator (optional)

ACTIVITY PLAN

1. **Introduction to Power Meter Activity (10 minutes)**
   Discuss with the students the first 4 questions of section "**A**" of the *Power Meter: Demonstration Guide* to reinforce the importance of the activity and how it translates into their daily lives.
2. **Power Meter Activity (35 minutes)**
   Introduce the concept of measuring energy using the scientific method. Ask the students to name the 5 parts of the scientific method and write them on the board. The students should fill out each part of the scientific method of section "B" of the in the *Power Meter: Demonstration Guide* as the activity develops.
   a. **Question:** Is there a difference in energy use between two different types of light bulbs? An incandescent bulb (regular light bulb) and a LED light?
   b. **Hypothesis:** Have students answer the question and state which light bulb they think will use less energy.
   c. **Method:** Use the power meter to measure and quantify how much power (in Watts) each light bulb will use.
      i. Power Meter Demonstration. Remember to have familiarized yourself with the power meter to make on the fly corrections when needed.
         - Plug your power meter into a wall outlet.
         - Plug the lamp into the power meter, put in a light bulb and turn it on.
         - Press the middle button to display Watts.

- Read the power used by the light bulb in Watts (W). Repeat and compare with the other light bulb or any electrical device.

d. Result: Perform the experiment by using the method and record the data. Now show students how to calculate energy (kilowatt-hour) from the power meter (Watts). Energy (kWh) = power (W)/1000 * time (hours)

e. Conclusion: Have students state whether or not their prediction or hypothesis was correct.

3. Homework: Power Meter-Home Investigation

Assign one meter to each of the students to take home. They will choose a home appliance and will use the power meter to keep track of its energy use until the data is analyzed on Lesson ED14.

EXTENSIONS

1. Ask the students to do a short write up (3 paragraphs) on how they would answer if someone asked them, **"Which light bulb should you buy and why?"** The students should use the data and the results from the experiment to support their answer. Don't forget to keep in mind the following criteria: energy use, cost, durability, and CO_2 emissions.

In their write ups, the students should mention something similar to the following: *The amount of energy used over the lifetime of the LED light bulb is more than 5 times smaller compared to the incandescent light bulb. Similarly, CO_2 emissions and total cost associated with using an incandescent light bulb for 25,000 hours are also five time larger compared to the LED light bulb. Although the LED has a higher up front cost, the person who purchases an LED light bulb can save over $200 over the lifetime of the LED bulb.*