MSOSW Curriculum
Lesson Six: Using the Belkin Meter

How can we measure the amount of standby power a device uses?

Overview: In this lesson, the student will learn how to use the Belkin meter to measure the standby power used by several different devices.

Objectives:

The student will:

- Use a metering device to measure the amount of energy used by various devices in the home.

Standards Addressed:

- Science as Inquiry (Content Standard A): Identify Questions That Can Be Answered Through Scientific Investigations (p145); Use Appropriate Tools and Techniques to Gather, Analyze, and Interpret Data (p145); Understandings About Scientific Inquiry (p148)
- Physical Science (Content Standard B): Transfer of Energy (p156)

Suggested Grade Levels: Middle School (6^{th}-8^{th})

Timeline: 1 class period

Materials:

Day 1:

- How-To Guide Belkin
- Extension cords (1/group)
- Belkin Meter Measurement WS (completed)
- Belkin devices (1/student)
- Assorted appliances/devices
- Class Belkin Meter spreadsheet

Procedure:

Day 1: **Using the Belkin meter**

- Ask students to answer the question, "What device in your home uses the most standby power?" Have students brainstorm answers as well as discuss how they could discover a scientifically accurate answer to this question.
- Hand out the How-To Guide (unless it's already in the packet).
- Hand out the Belkin meter devices and go over the buttons with the students so they're familiar with them.
- Using the device:
    - Have students plug the Belkin meter into a plug-in appliance.
    - Explain how to scroll through the different functions to find the measurement we're looking for – the watts being used,

the CO_2 and the amount of money used (per month and per year). Explain that the reading is in watts on the Belkin but will be multiplied by .001 to get kilowatts. To get kWh, they will need to multiple kilowatts by the number of hours (ex. 24 hours in a day).
    - Go over the protocol for how students will use the devices at home – read over basics (amount of time plugged in, measuring, and having an adult monitor).
    - Students should plug their device into the Belkin meter and observe if standby power is being used. The students can then turn their appliance on and measure how much power is used.
    - With each appliance, students should record on their own papers how much energy is being used when the device is on versus off and any questions they're generating while completing this activity.
    - Have groups trade devices, giving each student a chance to turn the Belkin meter on, plug in an appliance, and measure.
- Hand out the completed Belkin Measurement Worksheet class list created in Lesson 5. Have students determine which of the 5 items they are able to measure in their homes. Make sure each appliance has at least 2-3 students measuring it so they can compare their results.
- Hand out Belkin Energy Monitoring Worksheet and read over the instructions together so that students understand what they're doing. (Be sure to stress the importance of timing and adult supervision as well as reminding students that they'll only complete those devices listed that they have in their homes.)
- Check out the Belkin meters to the students. You may want to have student work in groups to measure different rooms, and then combine their measurements on one group sheet.
- Individual student data should be entered into a class spreadsheet. A blank template and an example spreadsheet are provided. When the spreadsheet is complete, upload it to your class page on the wiki.

Assessment Options for this Lesson:

- Have students demonstrate individually how to use the device correctly
- Belkin Meter Measurement Worksheet
- To ensure the students return the devices promptly (so you can stay on track with the curriculum timeline), you may choose to reward them with a "free" homework grade for turning the meters back in on time.

Extension Options for this Lesson:

- With permission from the administration, have small groups check power usage of appliances in and around the school for a class period and analyze the data.

- Examples of appliances to measure:
  - Microwave in a workroom or cafeteria
  - Printers, scanners, etc.
  - Copy machine
  - Lab computers
  - Laptops
- Each group should present to the class how much standby power their device used.
- With the teacher's assistance, have the class estimate how many hours per day the appliance is drawing that level of standby power
  - Ex: the lab computers are turned on when first used in the morning and turned off at 4pm each day. If most computers are turned on during 1st period (say 8:30) and used for 2-3 periods (1-1.5 hours) during the day, you might estimate that they are in standby mode for 6 hours each day.
  - The teacher can then provide data on the total number of each appliance that the school has (i.e., 3 copiers, 24 laptops, etc.).
- Analysis of Data
  - Using the above information, have students calculate the kilowatt-hours spent each day, each week, and each month on standby power at the school.
- Students can then brainstorm ways the school can conserve that standby power. Start with open-ended brainstorming, then have the students examine each idea to see if it is realistic to implement on a regular basis. (For example, turning off the computers between every class may not be realistic in a school that uses their computers regularly throughout the day, but making sure laptops are fully turned off before storing is a realistic solution.)
- Students can then calculate how much energy could be saved by each of the solutions.
- Further extension – have students create a report to send to the administration. The report can show the data they collected, the conclusions drawn from that data, and the proposals students generated to reduce energy costs along with the data as to how much energy/money would be saved.