



Solar vs. Wind

How much Energy do YOU use?

AUTHOR: Craig Marais

GRADE LEVELS: 7-8

LESSON DURATION: 2 days

SUBJECT AREA(S): science, power, energy, electricity, Watt, Kilowatt, Kilowatt-hour, energy consumption

LESSON OVERVIEW:

Students will learn the difference between energy and power. They will then use this new understanding to compare the energy and power difference of light bulbs (incandescent, halogen, fluorescent, and LED) using a tool called a “Kill-A-Watt” meter. Students will also perform simple calculations to find the total amount of energy used if the power usage and number of hours a device is used is known. This lesson is related to Debbie Frankel’s lesson, called “Home Energy Consumption”.

OBJECTIVES:

Students will be able to:

- Explain the difference between power and energy
- Proficiently use a “Kill-A-Watt” meter to determine the power and total energy usage of everyday devices
- Compare the total energy used by common household devices
- Brainstorm different ways we can conserve electrical energy

NEXT GENERATION SCIENCE STANDARDS:

MS-ESS3-3

- Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-PS3-3 (*Crosscutting concept*)

- The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS3-3).

Solar 4R Schools™ is a program of BEF.

**BONNEVILLE
ENVIRONMENTAL
FOUNDATION** :: 240 SW 1st Avenue
:: Portland OR 97204
:: 503-248-1905
:: www.b-e-f.org

STUDENT BACKGROUND: This lesson assumes a basic knowledge of electricity and types of energy.

EDUCATOR BACKGROUND: Know how to use the “Kill-A-Watt” meter and be comfortable performing simple calculations involving energy and power. Here are two short tutorials that are quite good, although there are many others:

- https://www.youtube.com/watch?v=1l_mo1jwh8Y (Kill A Watt Meter – altE Video Tip)
 - <https://www.youtube.com/watch?v=BmnmiBCwHr4> (Kill A Watt Meter: Stuff I Like #1)
-

KEY VOCABULARY:

- Power
- Watt
- Kilowatt hour
- Energy
- Kilowatt

MATERIALS NEEDED:

- Computer and projector access to show: “Energy and Power Lesson” PowerPoint
- Copies of “Energy Consumption Cards” in Ziploc bags – 1 per pair of students
- Copies of “Activity Sheet #3 – How Much Energy Do You Use?” – 1 per student
- 8 “Kill - A -Watt” meters – enough for one per group (or more if you can get more).
- **Optional Homework:** Copies of “Energy Consumption Worksheet” – 1 per student
- **Optional:** Bring in as many of the following devices as possible (you probably won’t be able to bring in all of them). Incandescent bulb (45 W-75W), Florescent bulb (equivalent brightness to the incandescent bulb), LED light bulb (equivalent brightness to the incandescent bulb), halogen bulb (equivalent brightness to the incandescent bulb), cell phone charger, Video game console, LCD Television, Laptop Computer, Desktop Computer, Space Heater, Window Fan, DVD Player, Hair Dryer or any other device you or the students want to test!

Teacher Note:

Most likely you won’t have all of the above devices available. Wattage data can be found online for all/most of the following appliances: Clothes Dryer, Refrigerator, Room Air Conditioner, and Dishwasher. Students may also obtain data from their homes using the Kill-a-Watt meter and share the data with the class.

PREP:

1. Make copies and cut out the “Energy Consumption Cards”. You will need a complete set of the 18 cards in individual Ziploc bags (one bag per pair of students.)
2. Make copies of the “Energy Consumption Worksheet” - one per student (if you want to give homework)
3. Obtain as many common, household devices from the first column of “Activity Sheet #3: How much Energy Do You Use?” as you can. Set them up around the room as labeled stations.
4. Label the Kill-a-Watt meters using a Sharpie/tape with Group number (one device is probably sufficient for each group).

Solar 4R Schools™ is a program of BEF.

**BONNEVILLE
ENVIRONMENTAL
FOUNDATION** :: 240 SW 1st Avenue
:: Portland OR 97204
:: 503-248-1905
:: www.b-e-f.org

LESSON 3:*Energy Usage Predictions (5-10 minutes)*

Pass out “Activity Sheet #3: How Much Energy Do You Use?” For Part 1 under the 2nd column titled, “Predicted Power Ranking”, have students work in pairs to rank each device according to how much power (Watts) they use on a scale of 1-4 (1 = highest power, 4 = lowest power).

Power Scale for Household Appliances

Rating	Power Used	Description
1	1-10 W	Low Power
2	11-100 W	Moderate Power
3	101-500 W	High Power
4	501-2000 W	Very High Power

Make sure students ONLY fill in the second column of the table at this point

Power vs. Energy PowerPoint (15-20 minutes) – Time estimate based on students taking notes on “Activity Sheet #3”

- Show “Energy and Power Lesson” PowerPoint (or let students access the PowerPoint from their own computers if there is at least 1 computer/pair of students).
- Have students answers the questions for Part 2 of their “Activity Sheet #3: How Much Energy Do You Use?” during the PowerPoint.

Teacher Note:

This PowerPoint is simply supposed to help students understand the difference between power and energy. The basic concept is that power is the rate that energy is being used/transformed and energy is the total amount of energy transformed. Students will not be “experts” in power or energy but hopefully become proficient in using and differentiating the two terms. Our goal is for students to be able to go home and use a Kill-A-Watt meter to find out the amount of power and energy their devices are using so they can perform an energy audit.

Station Activity: How Much Power Do Common Household Devices Use (15-20 minutes)

- Show students how to use the “Kill-A-Watt” meter to find Watts. You can ignore the other settings at this time such as voltage etc.
- Next, have students bring their “Kill-A-Watt” meter from station to station and find and record the Watts in Column 2 entitled, “Actual Power Used” for Part 1 of their “Activity

Solar 4R Schools™ is a program of BEF.

**BONNEVILLE
ENVIRONMENTAL
FOUNDATION** :: 240 SW 1st Avenue
:: Portland OR 97204
:: 503-248-1905
:: www.b-e-f.org

Sheet #3: How Much Energy Do You Use?" sheet. It seemed to work great with about 8 "Kill-A-Watt" devices.

- After students have tested all of devices around the room using their "Kill-A-Watt" meters, simply pass out the "Energy Consumption Cards" in the Ziploc bags and have students read the Watts from their card for any devices they were not able to test and fill in the remaining devices under the 3rd column, "Actual Power Used". This column should now be complete.

After you have the power rating for each device, the class can continue. . .

- Have students return to Part 1 and fill in the 4th column, "Estimated Number of Hours Device is Used in a Day" on "Activity Sheet #3: How Much Energy Do You Use?" as a class. For this part, try to come to a general consensus for how many hours a device is used. Finally, have students calculate the 5th column "Total Energy Used per Day" in kilowatt-hours using the following formula:

$$\text{Total Energy} = \frac{(\text{Power in Watts}) \times (\text{Number of Hours Used})}{1000}$$

Discussion Following Activity (5-10 minutes)

A good discussion to have with students is to have them look over their lists and share which devices use the LEAST/MOST power. However, help them to see that although some devices use large amounts of power, they may only be used occasionally; therefore, they don't use that much energy in a month (examples include: toaster, waffle iron, curler, and microwave. These devices use large amounts of power, but not that much total energy because they are only used for a few hours or less a day).

Homework: "Home Energy Consumption Worksheet" (10-15 minutes)

Teacher Note: You may need to quickly review the last few slides of the "Energy and Power Lesson" PowerPoint with students so they feel comfortable finding the kilowatt-hours as well as using a "Kill-A-Watt" meter. Recommendation: it would be good if each group of 4 students were able to try the "Kill-A-Watt" meter for various devices in the room so they can see how they work before they take them home.

Homework: Hand out the homework assignment, "Home Energy Consumption Worksheet" to each student. If available, hand out "Kill-A-Watt" meters for interested students to check out and use at home. Students may leave the Kill-A-Watt meters plugged in for a 24-hours period at home or in the classroom to see how accurate their predictions were on their "Activity Sheet #3: How Much Energy Do You Use?" sheet.

Special thanks to Debbie Frankel for her work, which greatly inspired this lesson.