What's a Watt Worth?

Overview: Students will engage in an energy scavenger hunt to determine what household items use the most electricity while exploring the effort that is involved in generating electricity.

Keywords: Watt, Power, Mechanical Energy, Electrical Energy, Energy Conservation

Age / Grade Range: 5th-6th Grade students

Background: Electricity is the movement of electrons. Different appliances have different electrical requirements in order to function. Refrigerators use electricity when the compressor runs to cool off the food inside. Alarm clocks require constant electricity to run. There are some electronics that are considered phantom/vampire electronics; they still use electricity when in "off" mode such as a TV or microwave.

Watts are a measurement of electricity used. Watts are the amount of electricity being used at a specific moment. A 60 watt bulb will use 60 watts from the time it is turned on and at any point in time you measure the amount of watts being used, it will be 60[1].

Watt-hours is the amount of electricity an appliance uses over a 1 hour time frame. The same light bulb left on for 1 hour will be rated as using 60 watt/hours. However if the light bulb is only used for 30 minutes it would use only 30 watt/hours.

When considering energy efficiency the lower the amount of watts an appliance uses increases the efficiency of the appliance. Older appliances use more watts than newer appliances and are not energy efficient compared to newer appliances. Newer appliances use less watts to accomplish the same tasks as older appliances. Upgrading appliances would decrease the amount of watts used and increase energy conservation.

When studying household electrical energy use, watts are measured in kilowatts since there are many devices that draw on electricity in a house.

Next Generation Science Standards **MS-ESS3-4:** Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

[1] http://www.ucsusa.org/clean_energy/our-energy-choices/how-is-electricity-measured.html#.VPzqP-Gs6Dg

Common Core:

RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually.

WHST.6-8.7: Conduct short research projects to answer a question drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

7.RP.A.2: Recognize and represent proportional relationships between quantities.

Goals:

Students will explore the energy required to generate watts, which devices draw the most watts, and discover a pattern based on the amount of watts that device uses.

How can we use watts to measure energy conservation?
Why do we want to conserve energy?
What do we use to generate watts?

Objectives:

Watts can be used to evaluate energy efficiency of a device.
Devices that are "off" may still draw electricity.
Wasteful use of electricity can harm the environment based on the sources used to create electricity.
Students will be able to understand the effort required to generate electricity through using a generator.

Materials:

K-Tor Hand generator
Multi-light setup
1x 60 watt incandescent
1x 40 watt incandescent
1x 60 equivalent watt CFL
1x 60 equivalent watt LED
Watts up meter
Various household devices
Recording sheet
2x 6 inch C clamps

Set up:

Clear space for the K-Tor generator and light display and use the C clamps to secure the generator to the table.

You will need additional 2 minutes to setup and takedown the generator and lights.

Classroom Time:

30 minute community chore

Overview

1. Setup generator and lights
2. Students will use the generator to create electricity to power bulbs.
   a. All incandescent bulbs can be turned on at the same time.
   b. Once the light bulbs fully light up don't crank the pedals faster, you will risk destroying the bulb.
   c. Coordinate with other groups for time to use the generator.

3. Use the Watts up meter to measure the watts used by devices found around moss
   a. Devices with cpus that do not have battery backup cannot be tested
4. Record measurements on the appliance worksheet.
5. Debrief group with a comparison of the effort they used to generate a bulb for a few seconds to the devices they measured.

Introduction (Engage):

Note: Text in "quotations" signifies suggested dialogue to engage students in and is not intended to be a script. Use your best judgment when delivering these lessons.

"What in your home uses electricity? Does anyone know what unit we use to measure electricity use? What are watts?" (Field answers)

"We're going to do a scavenger hunt and try and solve which household items use the most electricity. We're also going to learn about watts and how create them."

Activity (Explore):

Review with students before starting the activity:

- What are watts? Watts are a measurement of electricity a device uses; more watts = more electricity being used.
- Watt's up device. Show students how to use the device. You may want to create roles for students to fulfill so everyone has a job to do.
- For the generator, if more than 1 group is doing Energy Audit, coordinate with the other group on when to use the generator so both groups can use the generator.
- REMINDER: Only crank the generator in the direction of the outlet. If the outlet is facing away from you, the pedals should be moving away from you. If the outlet is facing towards you, the pedals should be moving toward you. Also the lower wattage bulbs can be overloaded if the generator is cranked fast enough. Tell students to crank until the light becomes steadily lit then maintain that speed.

"Watts are a unit that we use to measure the amount of electricity a device uses. The higher the watts, the more electricity. This device can measure the amount of watts a device uses." (Let students view the watts up device)

"Before we start I thought you'd like to experience what it's like to generate watts. Here we have a generator and some different light bulbs, you'll get to feel what it's like to generate watts. When using the generator move the pedals away from your body." (this applies if the outlet is facing away from you)

"You'll want to generate enough electricity to power the bulb, when it lights up fully don't crank any faster just maintain your speed or you might destroy

the bulb. (Sort through who would go first, let them go as long to power the bulb, have them move at a steady pace no quick starts. After they powered one bulb cycle down in wattage. Start with 60 watt incandescent to CFL to LED, or you can go in reverse. You can let multiple students try as you have time for)

"How did that feel as we went from incandescent to LED?" (Field answers) These bulbs require different amounts of watts to power. Since you are the source of the electricity that meant different amounts of effort to power the bulbs." (If there is time later you could turn them all on and see if they can power them, you should devote time to testing next. Also you could use the watts up probe to confirm the watts each bulb uses)

Reminder : If there are two groups doing Energy Audit at the same time, one can start with the generator discussing watts while the other can begin the scavenger hunt and switch materials halfway through the lesson so each group has access to the same materials.

"Now that we know what it takes to power these bulbs lets go see how much some familiar devices use and what do they do!" (You can have a recorder, plug finder, data reader roles for students. These roles can rotate through the group so everyone has something to do)

Reminder: **Do not** use the following devices for Energy Audit

- Copier
- Smart Board
- Desktop
- Anything with a cpu that DOES NOT have a battery backup for constant power. Laptops and labquests are ok.

Explanation

"After looking at our data, which devices use the most wattage? Which devices use the least? What do these devices do? Did we find any readings where the device drew power while it was off? Are there any patterns you can find?" (Field answers)

Note: This explanation might be covered by the program host during the morning meeting so you might skip this portion.

"Devices that heat or cool take up the most amount of electricity in a house. This is a energy intense process. Remember how much energy you had to do to power just 1 bulb? Imagine doing that for any of these devices that we tested. When we discuss energy conservation, two topics are often focused on. The first topic is to use devices that use less electricity to accomplish tasks. Newer technology uses less electricity than older technology. The second topic is to use electricity only when it's needed. Every second you

leave a light, or TV on when it's not needed is wasting energy and creating greenhouse gases when the energy is not needed. What if you had to power appliances and lights in your house. If someone used the TV you would have to power it. If someone left it on and did not watch it, would you still have to power the TV? (Field answers) Electricity has to come from somewhere, remember where that source comes from and what is needed to produce it."

Elaboration/ Content Tie-in:

What are some ideas that we could do to reduce the amount of carbon dioxide released into the atmosphere by reducing the amount of energy used? (field answers)

This activity ties-in with Energy Explorations.
Energy Explorations: Students explored the sources and generation of electricity, this activity explores how those sources are used by devices.

Evaluation:

With your field group discuss ways to reduce the amount of watts being used by coming up with an energy conservation plan they can use at home.

Additional resources:

Energy Star
http://www.energystar.gov/index.cfm?c=lighting.pr_what_are
http://www.energystar.gov/index.cfm?c=cfls.pr_cfls_about

US Department of Energy
http://energy.gov/energysaver/articles/frequently-asked-questions-lighting-choices-save-you-money#longer

See Appendix B for materials