Our Energy Smart School

Student Objectives
The student:
- will explain ways that electricity can be saved in the school
- will explain ways that they can save electricity at home
- will explain where the electricity they use comes from
- understands that personal actions can have a beneficial impact on larger environmental problems.

Key Words:
compact fluorescent
electricity
fluorescent
incandescent lightbulb
kilowatt hour (kWhr)
LED lightbulb
power plant

Time:
1 - 1 ½ hours

Materials:
- Kill-o-Watt (or similar) plug in electricity monitor
- Science Journal

Background Information

Electricity is an energy carrier–a secondary energy source. Electricity is generated from the conversion of other sources of energy, such as coal, natural gas, nuclear, solar or wind energy. These sources can either be renewable or nonrenewable, but electricity itself is neither renewable or nonrenewable.

Electric Production – The majority of our homes and businesses use electricity that is made many miles away at power plants by huge generators. Most fossil fuel power plants burn fuel (or split atoms in nuclear plants) and use the heat from this process in a boiler where water is turned to steam to turn a turbine. The spinning turbine creates an electrical current from the relative motion between a magnetic field and a coil (conductor).

The electrical power that is produced is between 138 and 765 kilovolts. This enables the power to be pushed over long distances with less loss, on very tall high-voltage transmission lines. In cities and towns, the voltage is lowered at local substations to between 2 and 35 kilovolts, then it is sent on smaller (distribution) power lines. The voltage of the electricity is reduced one more time to 240 volts, at residential transformers that are placed close to the homes and businesses being serviced. These transformers may be seen on top of a pole or in a box on the ground. The electricity then enters the home through a meter that measures how much is consumed, goes through a service panel (breaker box) and to the lights and outlets throughout the building.

According to the U.S. Energy Information Administration, in 2014 the United States generated about 4,083 billion kilowatt hours of electricity. About 67% of this electricity was

generated from fossil fuels (coal, natural gas, and petroleum), whereas in Florida, 84% of the electricity generated was from fossil fuels (coal and natural gas). The breakdown of energy sources by percent share for the country and the state of Florida for 2014 was:

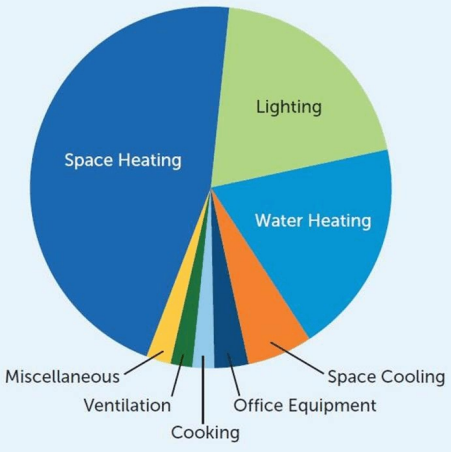
	U.S. Total	Florida Total
Coal	39%	23%
Natural gas	27%	61%
Nuclear	19%	12%
Hydropower	6%	0.1%
Biomass	4.4%	1.1%
Geothermal	0.4%	0%
Solar	0.4%	0.05%
Petroleum	1%	0%
MSW/Landfill gas	<1%	0.8%

Residential Electric Usage – Florida's household electricity usage is 40% more than the national average, and Florida's residential electricity usage is second only to Texas. Of the electricity used in Florida households, approximately 40% is used for cooling and heating. The remainder is divided up by: water heater 19%; refrigerator/freezer 8%; washer/dryer 9%; range 4%; and other appliances 20%.

It is also interesting to note that transformers and power plugs from battery devices (cell phones, laptops, etc.), and "instant on" electric devices (television, cable boxes, etc.), that are left plugged in after the device is removed, waste up to 10% of the total electricity usage of a household. These loads have been termed 'vampire loads' since they are draining electricity and essentially not doing anything useful at all!

School Electric Usage – According to the Department of Energy in a 2006 report, energy usage in K-12 schools breaks down as follows:

FIGURE 1 BREAKDOWN OF ENERGY USE IN K-12 SCHOOLS



Source: U.S. DOE, 2006b.

By implementing energy efficiency, schools can save as much as 30% on their energy costs. This reduction can be accomplished through personal actions and easy choices that schools and facility personnel can make.

Reduce lighting costs:

- Turn off lights when not in use (and/or install occupancy sensors). Hang "save energy" signs near light switches and doors to remind everyone to turn off the lights when leaving the room.
- Turn off unneeded lights. Some rooms have lights near windows that can be turned off, or sometimes the total number of lights in a room can be reduced without negatively influencing the light level.
- Replace incandescent bulbs with compact fluorescent or LED lights, and older tube fluorescents with T8 bulbs. Students can calculate the savings that can be achieved by these retrofits and submit the information to the administration.

Reduce heating and cooling costs:

- Raise the thermostat a couple of degrees in the summer (78 degrees) and lower it a few degrees in the winter (68 degrees).
- Don't block airflow around vents.
- Keep exterior doors and windows closed.
- Stop air leaks. Students can help locate leaks (see the Further Research section).
- Install programmable thermostats or energy management systems that include thermostat control and timing.
- Clean/replace filters regularly.

Reduce computer and appliance use:

- Use surge protectors on computers and turn them off when the computers are not in use.
- Turn off the monitor of computers that will not be used during the next class period.
- Encourage the administration and school board to purchase energy star appliances, and properly maintain existing appliances.
- Install controllers on vending machines so the machines don't run 24 hours a day.

Reduce water heating and water usage:

- Fix dripping faucets, running toilets and water fountains that don't completely turn off.
- Hang posters/signs about water conservation near sinks and fountains.

Implement an energy program:

- Measure and track school energy usage.
- Conduct an energy audit.
- Form an energy patrol (see Further Research section).
- Involve the whole school in an energy saving initiative.

One energy efficient measure, natural daylighting can also positively affect student performance. According to a study done by the California Board for Energy Efficiency, students who study with natural light perform on average 20% faster on math tests and 26% faster on reading tests.

Procedure (prior to class)

1. If possible, find out how much electricity your school uses during a school day. If that is not possible, find out how much electricity the school uses in a month and calculate an approximate daily usage.
2. Using 12 cents per kilowatt hour, calculate the approximate cost of the school's daily electric usage.
3. Figure out the approximate percentage of the total electrical usage that your classroom uses. If possible, use the school's total square footage and your classroom's square footage to calculate this. If this method is not possible, count the number of classrooms and offices in your school, add in an approximate room equivalences for the larger spaces (cafeteria, auditorium, gym, library, etc). Then divide the total electricity in kWhr and the total cost by this number.

Procedure (during class)

1. Ask the students where their electricity comes from. If they answer "the outlet" (or something similar), ask where the electricity came from before that. Try to get them to go all the way back to the fuel that is used at the power plant, and the mining/collecting of that fuel. The students should realize that there is an environmental as well as monetary cost to electricity–it doesn't just magically occur!
2. If your students seem unclear on where their electricity comes from, lead a mini review/discussion. You may wish to show the video *Where Does Electricity Come From?* (link is in the Internet Link section)
3. Tell the students that they will be thinking about how their classroom and school uses electricity, and ways that they can help save on the amount of electricity the school uses.
4. Write your classroom's approximate daily electricity usage (in kWhrs) and the cost on the board. Explain what the numbers represent.
5. Ask the students what items in the classroom use electricity, and write them on the board as they list them.
6. Ask them which items on the list they think use the most electricity and number them according to their suggestions. *(Note: Air conditioning/heating and lights are typically 1st and 2nd in total usage)*
7. Using the Kill-o-watt meter, measure some of the devices in the classroom (computer, desk lamp, aquarium pump, etc). Write their measurements on the board next to the item. Make sure to put the unit of time in the measurement (i.e. kWhr, watts per minute, etc.).
8. Have the students fill out the first two pages of their Science Journal. You will probably need to help them with the name(s) of the types of lighting and lightbulbs in the classroom.
9. Divide the students into groups. Tell them they are going to look at the items on their chart of things in the classroom that use electricity and come up with a plan to reduce the electricity usage of as many of them as they can.
10. After the students have discussed in their group ways to reduce electricity usage, lead a discussion and have the groups share their ideas.
11. Have the class make a Classroom Action Plan of 5 - 6 items to implement.
12. Assign each group (or have them pick) an action item from the list and make a poster for it.

13. Hang the posters around the room (or near the item) as a reminder of the plan.

Key Words and Definitions

- **compact fluorescent** – a fluorescent tube that has been compressed into a small size that will fit into a standard light socket. The compact fluorescent is more energy efficient and produces less heat than a old-style incandescent bulb.
- **electricity** – the movement of electrons on a wire
- **fluorescent** – a tubular bulb that discharges a gas at one end that strikes a coating inside the bulb causing it to fluoresce (glow).
- **incandescent lightbulb** – the old standard lightbulb which is being replaced for more energy efficient varieties
- **kilowatt hour (kWhr)** – a measure of electrical energy equivalent to 1,000 watts for one hour
- **LED lightbulb** – a bulb that uses light emitting (semi-conductor) diodes. These bulbs are currently the most energy efficient on the market.
- **power plant** – a facility that turns a fuel into electricity.

Further Research

1. Have the students form Energy Patrols that spread the conservation effort throughout the school. Some of the things the students could do include:
    - Make posters and hang them around the school encouraging others to reduce their energy use, recycle, etc.
    - Make 'turn off the light' mini signs to put above light switches in the classrooms.
    - Put hang-tag reminders on door knobs of vacant classrooms that have not turned off their lights.
    - Check cafeterias, auditoriums and other periodically used rooms to make sure that the lights are turned off when they are not in use.
    - Assist in building shut-down during holidays, breaks and before summer.
    - Have an Energy Assembly for the school. Create skits and songs to promote a school-wide energy action plan.
2. Take one or two of your school-wide or facility recommendations to the administration (i.e. replacing old light bulbs with more efficient varieties, changes to the temperature settings, etc). If possible, estimate the amount of money that could be saved with the new energy efficient measure.
3. Have students determine areas of energy loss in leaky windows and doors by using "draftmeters" made from a strip of plastic wrap attached to the end of a pencil. These draftmeters can be held close to the door or window frame to see if air is leaking. In some cases, students could then work with facility staff to install permanent weather stripping, caulking, and insulation.
4. Implement (or widen) a school recycling program. Look into ways to collect recycled materials from the classrooms and offices as well as ways to reduce the lunchroom waste.
5. Use a Flicker Checker to check the fluorescent bulbs. (See the Internet Links section for a link to a Flicker Checker phone app). If older fluorescents are discovered, submit a

recommendation to the administration to replace the older bulbs. Include the cost of installation plus the savings that will be realized with the installation of the new bulbs.

Related Reading

- ***Catch the Wind, Harness the Sun: 22 Super-Charged Projects for Kids*** by Michael Caduto (Storey Publishing, 2011)
  Twenty-two projects plus stories, background information, cartoons and photos covering solar thermal, photovoltaics, solar cooking, climate change, energy production and energy conservations–plus wind energy!
- ***Charged Up: The Story of Electricity*** by Jacqui Bailey (Science Works, 2004)
  This book presents an introduction to the operation of a hydroelectric plant and the transportation and transformation of electricity, as well as its many uses in our homes.
- ***DK Eyewitness Books: Electricity*** by Steve Parker (DK Eyewitness Books, 2013)
  This book presents the story of electricity from the earliest discoveries to today's technologies with many photos of old equipment used by the pioneers of electricity to test their inventions.
- ***Electrical Wizard: How Nikola Tesla Lit Up the World*** by Elizabeth Rusch (Candlewick, 2013)
  Rusch's picture-book biography follows Tesla's lifelong fascination with electricity from childhood experiments, through his college training, designing the alternating current (AC) system, his bitter rivalry with Edison, and on to his achievements at Niagara Falls and the Chicago World's Fair.
- ***The Magic School Bus and the Electric Field Trip*** by Joanna Cole and Bruce Degan (Scholastic Paperbacks, 1999)
  Ms. Frizzle and her science class take a trip through the town's power lines and discover how electricity works. Readers learn about how electricity is made in power plants, how transformers function and how electricity makes heat and light.

Internet Sites

http://www.eia.gov/kids/

Department of Energy, Energy Information Administration's student webpage, includes kid friendly information on various energy sources and how to save energy as well as games and activities.

http://www.energystar.gov/ia/partners/publications/pubdocs/LORAX_ENERGY%20STAR_Poster.pdf

Environmental Protection Agency, Join the Lorax poster for classroom use, allows students to record their energy saving pledge and efforts.

http://www.energystar.gov/index.cfm?c=kids.lorax

Environmental Protection Agency's *Join the Lorax* kids site, includes interactive games, coloring and hidden word puzzles with an energy saving theme. The print version can be downloaded here:
http://www.energystar.gov/ia/partners/publications/pubdocs/Lorax Activity Book 6 pages.pdf

https://itunes.apple.com/us/app/flicker-tester/id893931726?mt=8

Flicker Tester app for Apple devices that can test the flicker (curves, index, frequency and percentage) on a light source.

https://www.youtube.com/watch?v=20Vb6hlLQSg

Energy 101: Electricity Generation, Energy Now's video on electricity production, transmission and usage.

https://www.youtube.com/watch?v=duVhnEfbTP0

Where Does Electricity Come From, short video created by a teacher as a quick review of electricity from nonrenewable sources and its drawbacks.

https://www.youtube.com/watch?v=H5s1ia50-aw

Wall Street Journal video news interview with Bill Nye on how he made his home energy efficient.

Our Energy Smart School

Florida NGSS Standards & Related Subject Common Core

			.1	.2	.3	.4	.5	.6	.7	.8
Grade 3										
Forms of Energy	**Big Idea 10**	**SC.3.P.10**	**X**							
Grade 4										
Earth Structures	**Big Idea 6**	**SC.4.E.6**			**X**					
Forms of Energy	**Big Idea 10**	**SC.4.P.10**	**X**							
Grade 5										
Forms of Energy	**Big Idea 10**	**SC.5.P.10**	**X**			**X**				
Energy Transfer & Transformations	**Big Idea 11**	**SC.5.P.11**	**X**							
Language Arts	**Third Grade:** LAFS.3.SL.1.1, LAFS.3.SL.1.3, LAFS.3.L.3.6 **Fourth Grade:** LAFS.4.SL.1.1, LAFS.4.L.3.6 **Fifth Grade:** LAFS.5.SL.1.1, LAFS.5.L.3.6									
Visual Arts	**Third Grade:** VA.3.F.3.1 **Fourth Grade:** VA.4.F.3.1, VA.4.F.3.2 **Fifth Grade:** VA.5.F.3.1, VA.5.F.3.3									

Third Grade Benchmarks

Science–Big Idea 10: Forms of Energy

- SC.3.P.10.1 - Identify some basic forms of energy such as light, heat, sound, electrical, and mechanical.

Language Arts–Comprehension and Collaboration

- LAFS.3.SL.1.1 - Engage effectively in a range of collaborative discussions with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.
- LAFS.3.SL.1.3 - Ask and answer questions about information from a speaker, offering appropriate elaboration and detail.

Language Arts–Vocabulary Acquisition and Use

- LAFS.3.L.3.6 - Acquire and use accurately conversations, general academic, and domain specific words and phrases as found in grade appropriate texts.

Visual Arts–Innovation, Technology, and the Future

- VA.3.F.3.1 - Create artwork that communicates an awareness of events within the

community.

Fourth Grade Benchmarks

Science–Big Idea 6: Earth Structures

- SC.4.E.6.3 - Recognize that humans need resources found on Earth and that these are either renewable or nonrenewable.

Science–Big Idea 10: Forms of Energy

- SC.4.P.10.1 - Observe and describe some basic forms of energy, including light, heat, sound, electrical, and the energy of motion.

Language Arts–Comprehension and Collaboration

- LAFS.4.SL.1.1 - Engage effectively in a range of collaborative discussions with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

Language Arts–Vocabulary Acquisition and Use

- LAFS.4.L.3.6 - Acquire and use accurately general academic and domain-specific words and phrases as found in grade level appropriate texts.

Visual Arts–Innovation, Technology, and the Future

- VA.4.F.3.1 - Create art to promote awareness of school and/or community concerns.
- VA.4.F.3.2 - Collaborate with peers in the art room to achieve a common art goal.

Fifth Grade Benchmarks

Science–Big Idea 10: Forms of Energy

- SC.5.P.10.1 - Investigate and describe some basic forms of energy, including light, heat, sound, electrical, chemical, and mechanical.

Science–Big Idea 11: Energy Transfer and Transformations

- SC.5.P.11.1 - Investigate and illustrate the fact that the flow of electricity requires a closed circuit.

Language Arts–Comprehension and Collaboration

- LAFS.5.SL.1.1 - Engage effectively in a range of collaborative discussions with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.

Language Arts–Vocabulary Acquisition and Use

- LAFS.5.L.3.6 - Acquire and use accurately general academic and domain-specific words and phrases as found in grade level appropriate texts.

Visual Arts–Innovation, Technology, and the Future

- VA.5.F.3.1 - Create artwork to promote public awareness of community and/or global concerns.
- VA.5.F.3.3 - Work collaboratively with others to complete a task in art and show leadership skills.

National Next Generation Science and National Visual Arts Standards

Third Grade Standards

Note: Related Common Core Language Arts Standards are listed in the Florida section above.

Fourth Grade Standards

Science–Earth and Human Activity

- 4-ESS3-1 - Obtain and combine information to describe that energy and fuels are derived

from natural resources and their use affects the environment.

Visual Arts–Innovation, Technology, and the Future

- VA.3.F.3.1 - Create artwork that communicates an awareness of events within the community.

Note: Related Common Core Language Arts Standards are listed in the Florida section above.

Fifth Grade Standards

Note: Related Common Core Language Arts Standards are listed in the Florida section above.

Our Energy Smart School

Classroom Energy Use Survey

1. Who sets the temperature of the heating and air conditioning? _____

_____

Is it usually too hot, too cold, or just about right in your classroom? _____

_____

2. Does your classroom have windows? _____

How many? _____ Do they open up? _____

When you are standing close to the windows does it feel hotter, colder, or about the same as the rest of the room? _____

3. Who controls the lights in the classroom? _____

What kind of lightbulbs do you have? _____

_____

4. How many computers are in the classroom? _____

Are the computers turned off when they are not being used? _____

Who turns them off? _____

5. List below the other things in the classroom that use energy, whether they are turned off, and who turns them off.

Energy using item	Turned on and off?	Who turns it off?

6. Looking at your list above, what could be done to decrease the energy use in your classroom? Write your suggestions below.

In the list above, circle those suggestions that can be done by you and your classmates.