Energy Awareness:

A consumer approach

What is energy?

Why is it important?

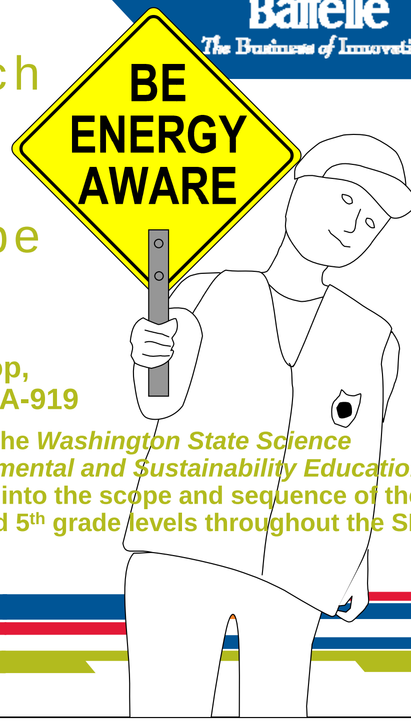
Why should energy be conserved?

Lesson Plan for grades 4-5

Post-Nov 18 ESD123/LASER Workshop,
ERICA Information Release #PNWD-SA-919

These lessons were designed to align with the *Washington State Science Learning Standards* and *Integrated Environmental and Sustainability Education Learning Standards*. These lessons also fit into the scope and sequence of the STC *Electric Circuits* Unit used at the 4th and 5th grade levels throughout the SE LASER Alliance

Battelle
The Business of Innovation



VERSION DATE: 1/6/11

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Version 1-6-11
TK added slides 19, 20, and 21.
JH corrected decimal place on "Home_Energy_Awareness_Survey.doc" and on image of it in these slides.

Workshop Overview & Schedule

- *See schedule slide in the Workshop PowerPoint file for Grades 2-3.*

Funding & Strategic Mission

- The Washington State Attorney General Office (AGO) funded Battelle to investigate ways to increase energy efficiency awareness in the K-12 student community.
- Based on guidance from several teachers and curriculum developers/organizations, we developed energy efficiency lesson plans to support the Washington State Science Learning Standards and the Washington State Integrated Environmental and Sustainability Education Learning Standards.

Overview of Student Instruction

- About 30 minutes a day for 4 days (not necessarily in a row).
- Day 1:
  - Pre/Post Energy Survey (10-15 minutes)
  - Energy Name Game (10-15 minutes)
- Day 2: “What Keeps Me Warmer?” (thermometers) (30 minutes)
- Day 3: “How Much Does It Save?” (“EZ Watt” meters) (30 minutes)
- Day 4: Home Energy Survey - homework. (5-10 minutes).
- Day 5:
  - Follow-up on the Home Energy Survey. (15 minutes)
  - Post-survey: redo the Energy Survey (15 minutes)

Teacher's Options

- Designed into two grade-groupings (2-3 and 4-5) per state curriculum standards – but teachers pick which components of this lesson plan to use in classroom.
- Download Battelle's PowerPoint slides to modify as desired. (Note our Disclaimer slide.) http://buildingefficiency-labworks.pnl.gov/education_k-12.stm
- Ask your district, LASER, or ESD science curriculum leaders about additional training on this lesson plan, on this general subject, or about finding an energy scientist/engineer to visit your class.

Science Standards - Grades 4-5

Washington State Science Learning Standards: Note: *also addresses some standards from math, social studies, &economics*

EALR 4: Physical Science

Big Idea: Energy: Transfer, Transformation, and Conservation (PS3)

Core Content: Heat, Light, Sound, and Electricity

Time: about 60 minutes a day for 5-6 days or adaptable to class time

Washington State Integrated Environmental and Sustainability Education Learning Standards: Standard 3: Sustainability and Civic Responsibility *Students develop and apply the knowledge, perspective, vision, skills, and habits of mind necessary to make personal and collective decisions and take actions that promote sustainability.*

National Science Standards:

- *Sun is main source of energy*
- *Energy comes in many forms: fossil fuels, oil & coal*
  - *Such fuels come from plants that grew a long time ago*
- *Cost effectiveness and pollution issues with energy, which sources cost more and which sources pollute*
- *How do we conserve energy?*

State Content Standard & Performance Expectation, Grades 4-5

- Energy has many forms, such as heat, light, sound, motion, and electricity.
  - Identify different forms of energy in a system.
- Energy can be transferred from one place to another.
  - Draw and label diagrams showing several ways that energy can be transferred.
- Heat energy can be generated in many ways. Heat moves from warmer things to colder.
  - Identify several ways to generate heat energy.
  - Give examples of two ways that heat energy can move.
- Sound energy can be generated by making things vibrate.
  - Demonstrate how sound can be generated by vibrations as it moves to your ear.
- Electrical energy in circuits can be changed to other forms of energy.
  - Describe how electrical energy is transferred and converted.

Content Standard & Performance Expectation

Energy has many forms, such as heat, light, sound, motion, and electricity.

Identify different forms of energy (e.g., heat, light, sound, motion, and electricity) in a system.

Energy can be transferred from one place to another.

Draw and label diagrams showing several ways that energy can be transferred from one place to another (e.g., sound energy passing through air, electrical energy through a wire, heat energy conducted through a frying pan, light energy through space).

Heat energy can be generated a number of ways and can move (transfer) from one place to another. Heat energy is transferred from warmer things to colder things.

Identify several ways to generate heat energy (e.g., lighting a match, rubbing hands together, or mixing different kinds of chemicals together).

Give examples of two different ways that heat energy can move from one place to another, and explain which direction the heat moves (e.g., when placing a pot on the stove, heat moves from the hot burner to the cooler pot).

Sound energy can be generated by making things vibrate.

Demonstrate how sound can be generated by vibrations, and explain how sound energy is transferred through the air from a source to an observer.

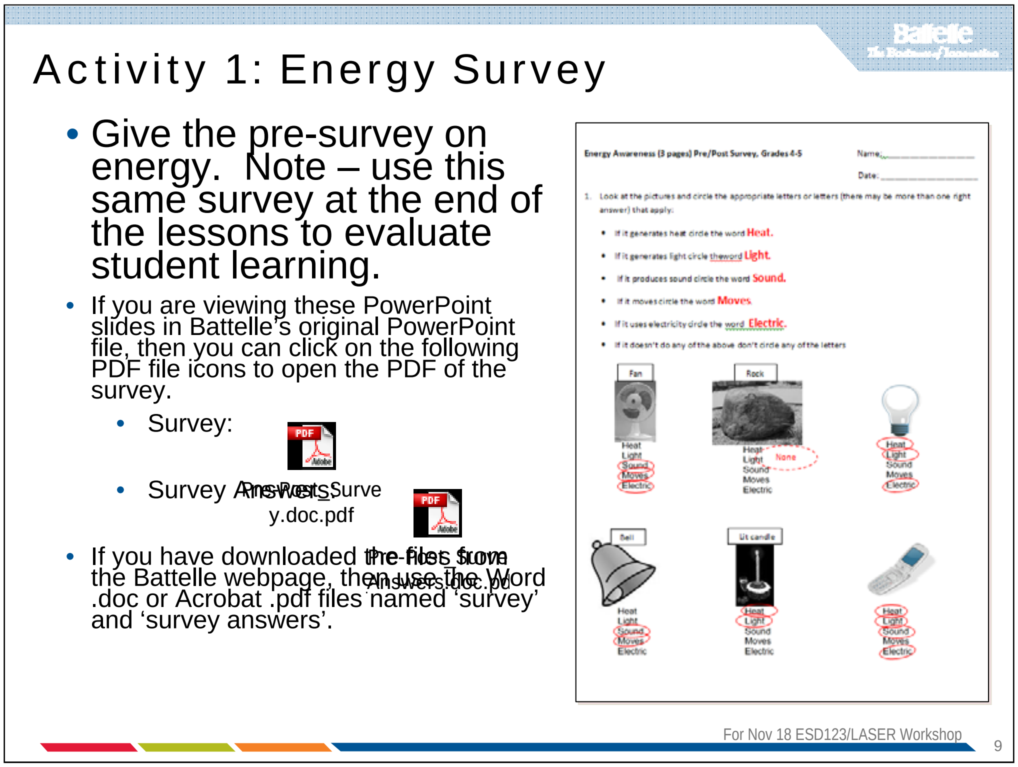
Electrical energy in circuits can be changed to other forms of energy, including light, heat, sound, and motion. Electric circuits require a complete loop through conducting materials in which an electric current can pass.

Connect wires to produce a complete circuit involving a battery and at least one other electrical component to produce observable change (e.g., light a bulb, sound a buzzer, and make a bell ring).

Repair an electric circuit by completing a closed loop.

Describe how electrical energy is transferred from one place to another, and how it is transformed from electrical energy to different kinds of energy in the circuit above.

Classroom Activities



The survey can also be reviewed with the class as a whole, to generate discussion about the topics, while learning what the knowledge base is in the class.

Vocabulary/Spelling List of Learning: these are the energy related terms that accompany the lessons. Use these as desired.

appliance	battery
Celsius	electric circuit
conserve	consumer
electricity	energy
Fahrenheit	fluorescent
generates	graph
heat	incandescent
infrared	kilo
kilowatt	light
motion	sound
temperature	watt

Activity 2: Name Game

"They Call Me Mr./Miss Energy"

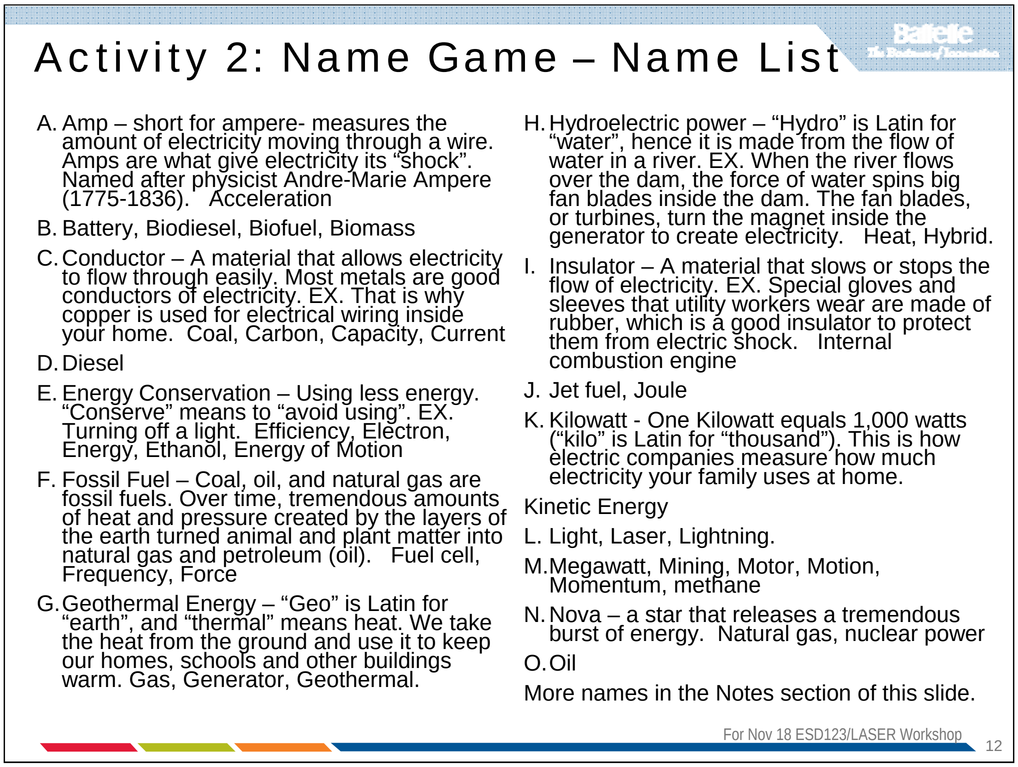
- Play this group game to get the students thinking about energy.
- See suggestions and flow of game in the Notes section of this slide in the PowerPoint file.
- Student "A" picks an energy name for himself and the student to the left recites that Student A's name and then picks a energy name.
- The following slide show possible names in the slides and Notes section of the slide. The slide includes background information on some of the energy names and concepts.

For Nov 18 ESD123/LASER Workshop 11

Explain the game to the entire class. The game is similar to the "telephone" game, they may have played.

- Each student will be choosing new last names. Their new last names should begin with the same letter as their first names and be energy-related—a source of energy, an energy consuming or producing device, or energy term. For example: Bob Biomass, Martha Microwave, Gina Generator, etc.
- No relatives are allowed, in other words, there can't be both Bob and Barbara Biomass.
- Ask if anyone in the group is having a problem thinking of an energy last name, and have the group brainstorm several last names for them.
- If, during the game, someone in the group has a problem remembering a person's first or last name, members of the group can give that person a hint. For example: If the person's name is Tim Toaster, someone in the group could say "you put your bread in it in the morning and it uses energy." If the person's name is Peter Petroleum, a group member could say "you make gasoline from it."

1. Divide the students into groups of 10-12 or smaller. (the smaller groups help this to go faster, reduce the number of energy names to develop and remember) Also, it is best is the students have varying different first name letters together to minimize problems with coming up with energy names. E.g. have students with first names of A or B, etc. in each group.
2. Each group should choose a group leader, that starts by saying, "Hi, my name is…" and then his/her first name, followed by his/her new energy last name.
3. Then the person to the left of the leader says the first person's first and last name, and then his/her own new energy name. The third person continues by giving the first two names, then his/her own energy name.
4. The game continues until the final person, sitting to the right of the group leader, gives everyone's name and then his/her own.



P. Pollution, Power, Potential Energy, Power plant

Q. (None.)

R. Renewable Energy – Coming from environmentally-friendly resources that are naturally replaced by Mother Nature. EX. Wind, water or solar power. Reactor, Renewable, reservoir

S. Solar panel, static electricity, steam, sunlight, specific heat

T. Turbo – connotations of speed and great energy. Temperature, Turbine

U. Utilities, Uranium

V. Volt – Also referred to as voltage, is the pressure that pushes the electricity through the wires. EX. This is how electricity gets from the power plant to your house. The fist electric battery was invented by Professor Alessandro Volta (1745 – 1827). Velocity.

W. Watt – How electric use is measured or the amount of power a device consumes. Discovered by James Watt, an engineer from Scotland who lived during the 1800s.

Waste, Wind, Windmill, Work, Wave

X. Yottajoule

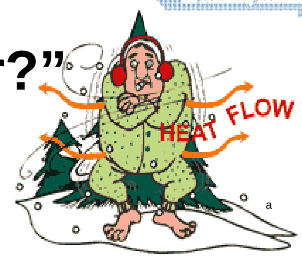
Y. Zettajoule

Sources include:

- http://www.alliantenergykids.com/EnergyBasics/EnergyWords/index.htm
- http://www.enchantedlearning.com/wordlist/energy.shtml

Activity 3:

"What keeps me warmer?"



Materials per group (total of 2 groups):
- 3 thermometers (6 total)
- 1 small bag with denim material in it (2 total)
- 1 small bag with fleece material in it (2 total)
- 1 instant ice pack (2 total)
- 1 record sheet (2 total)

Figure 1: Bags with Insulation placed over thermometers

Figure 2: Cold pack placed over insulation and thermometers

Note: This can also be done with a thermo probe, which needs a computer or with hand thermometers. To set up the experiment with thermometers, proceed as follows:

Teachers' discussion:
- Why do you wear gloves/mittens? … (answer), to keep your hands warm or on other words try to keep or body heat from transferring or to the environment.
- Humans eat food and their bodies use that food (metabolize it), to create their own body heat (energy). Also, our bodies are affected by our surroundings. So when you go outside and it is cold (winter), our body heat is transferred (heat flows out of our body) to the environment. Heat always travels from a hotter area to a colder area and the bigger the difference between the hot and cold areas the faster the transfer takes place. If heat is leaving your body faster than your body cannot create heat, you will be cold. This is why you wear a warm coat in the winter (and shorts in the summer) to help adjust your body temperature…because just like "Goldilocks' porridge" your body temperature has to be just right-not too cold and not too hot.

Concept question:
Where does the earth get it's heat from or what (big yellow thing in the sky) transfers heat to the earth? Of course, the sun…it is a major example of heat flow (in nature).

Begin the Activity:
1. Separate the students into groups; about 3 students per group
2. Provide each group with 2 thermometers
3. Provide each group with 2 labeled baggies with insulating materials; can have extra materials to try if some groups get done faster, or after the activity they can try their own mittens if they have them.
4. Ask the students to decide which material that they think will keep their hands warmer?
5. Let the students feel the materials if that helps them decide
6. Ask each group to record the initial temperatures on each thermometer. Note, they should both be about the same-at room temperature.
7. Place the two thermometers on the table
8. Get an ice pack or an instant cold pack from the teacher (the teacher or delegate may want to break the cold packs for the students)
9. Place the insulating materials on top of the thermometers (just below the 30 degree F line-see figure 1)

Activity 3 Cont'd: Record/Log Sheet Print out for each student's recording…

Table 1: Activity

Material	Initial temperature (temperatures should be the about the same)	Final temperature

Table 2: Example Record/Log Sheet

Material	Initial temperature (temperatures should be the about the same)	Final temperature
Denim	72	52
Fleece	72	47

For Nov 18 ESD123/LASER Workshop 14

1. In table 1, record the name shown on the label in the first column "material".
2. After 3 minutes, record the temperature of the two thermometers in table 1 above for the appropriate material. (Can use a timer that can be set to alarm/ring when time is up)
3. Discuss the results, and the fact that the thicker material- the fleece, was the better insulator
4. Discuss that is why gloves and blankets are made of fleece. (bring in some glove examples?)

INSTRUCTORS NOTES:

- *Do this in Celsius and Fahrenheit? Can mention that Celsius is used in science and other countries-and as can see on thermometers has a different scale, zero in Celsius is 32 in Fahrenheit. So in other countries if it is 40 degrees celsius-it is very hot…look at your thermometers.*
- *I tried it with making mittens and shoving the insulation inside the paper mitten (stapled together)-denim and fleece, and results: The instant cold pad was not as cold-after ~2 hrs…but fleece (68 deg) and denim (65) after 15 mins*
- *Can also suggest that the teacher include the book, "the mitten" written by Jan Brett and discuss why the animals that are also warm blooded (as humans) want to snuggle inside the mitten?*

Image provided by the Flying Turtle Company: http://www.ftexploring.com/energy/heatflow.htm

Activity 4: How Much Does It Save?

Materials:
- 2 lamps
- 1 incandescent bulb
- 1 compact fluorescent bulb
- 2 Kill-a-watt TM EZ meters
- 1 outlet plug strip
- Post it notes and ruler (not provided)

Set-up:
1. Place lamps on floor/table.
2. Screw in the incandescent (IC) bulb into a lamp.
3. Plug that lamp into one of the Kill-a-watt TM EZ meters and label that meter "IC".
4. Screw in the compact fluorescent bulb (CFL) into the other lamp.
5. Plug the lamp with the compact fluorescent bulb into the remaining Kill-a-watt TM EZ meter and label that meter "CFL"
6. Adjust height of each lamp ~8" off floor/table.

Activity 4 Cont'd :

Light meter reading and comparison

Set-up cont'd:

7. Reset the Kill-a-watt ™ EZ meters
8. Turn on each bulb at the same time
9. The meters will start taking readings immediately
10. Unscrew the cap off the light meter
11. Set the light meter under the IC lamp
12. Set meter to Range "B"
14. Turn meter to on and observe reading
15. Set the light meter under the CFL lamp
16. Turn the meter on and observe reading
17. Notice that the readings are about the same (results will vary depending on height of lamps off floor and meter placement.
18. The packaging of the two bulbs can be compared (foot candles should be about the same, these lamps showed 548 and 560.)

For Nov 18 ESD123/LASER Workshop 16

Before starting: Plug in the Kill A Watt™ EZ meter in the outlet. Select the menu button and scroll through until you see the "rate" in the top right corner. The rate should be displayed as "$0.057" (5.7 cents/kilowatt-hour) based on the Benton County PUD rate as of June 2010. If this needs to be changed, refer to the instructions for how to use the device (Reference Appendix A, at end of the lesson plan). To begin a new measurement, select the "reset" button down until you see the words, "rEST" on the display, now all the accumulated measurements including KWH, elapsed time, and actual total cost in the unit should be set to zero. You can check this by scrolling through the menu again and make sure all the totals such as "elapsed time" are zeroed out. WHEN PLUGGED IN STARTS time immediately

1.Check that the supplied cfl bulb is in one lamp and a IC is in the other, or place one of each bulb into the lamps.
2.Plug in each lamp into the Kill A Watt™ EZ meter, and plug the Kill A Watt™EZ into an outlet.
3.You can label with a post it note which meter is the connected to the lamp with the IC bulb and which is connected to the lamp with the CFL bulb for easier identification.
4.Turn on the lamps.
5.The meters will begin taking measurements. Note that some items, such as "initial cost per hour" being displayed, may need to be left on for a short time before they are accurate.
6.Push the "menu" button until each meter reads "elapsed time", and leave on that time, until approximately one hour. These could be left to run overnight or over a weekend.
7.When you have ended the activity, push the "menu" button until you see "kwh" on the right side of the screen, (it is the unit listed after the "rate" which should be saved as a constant at $0.057)-record the kwh off both meters-see table on next slide.
8.Push the "menu" button again, and you can record the "elapsed time" (if desired) off each meter.
9.Generate discussion as to which type of bulb is the better bulb.

Extension: Have students decide if the extra cost for the fluorescent bulbs outweighs the benefits/savings of using them versus the incandescent bulbs. Fluorescent bulbs typically cost more to buy; but boast a longer life.

Activity 4 Cont'd:

"How much does it save?"

- Record the energy (kWh) off the each IC meter and put the value in column #1
- Record the energy (kWh) off the each CFL meter and put the value in column #2
- Subtract column #1 from column #2, record in column #3
- Show savings in column #4; Multiply fixed rate ($0.057/kWh*4380 hrs/y)

Energy measured Lamp with IC Bulb (kWh)	**Energy measured Lamp with CFL Bulb (kWh)**	**Energy difference (0.04-0.01, kWh)**	**Annual Savings ($) ($0.057 * 4380 hrs/year) if assume lamp is "on" 12 hours per day)**
0.01	0.04	0.03	$ 7.5

For Nov 18 ESD123/LASER Workshop 17

NOTE: The electric EZ meter can also extrapolate costs out assuming that lamp will pull the same power and the electrical rate that was input was correct-to check the extrapolated costs:

1. Hit the "menu" button,
2. Stop at "cost", and the cost shown should be "total" accumulated which unless you run it a long time, this will be zero.
3. Stay at 'cost", and hit the "up" button to toggle thru the costs offered: the first one should be, "day",
4. Hit "up" again and the cost per "week" is shown
5. Hit "up" again and the cost per "month" is shown
6. Hit "up" again and the cost per "year" is shown

•The students may want to feel the heat the radiated heat from the bulbs to compare which gets hotter (without touching the bulbs or lamps which can get very hot

•Discuss that energy is being lost or wasted by the bulb that is heating (radiating heat to) the surroundings. The other bulb is using less total energy and using it's energy only on light and not heating.

Per the calculations above the savings are:

•Lamp Savings per year (0.03kWh x.$057/kWh)= $7.5/year

•Explain that the savings may not seem like much, but consider if you have 10 lamps on, and each is on for your lifetime-say 8 years, so 7.5* 10 lamps * 8 years=$600

Activity 4 Cont'd: Record/Log Sheet

Energy measured Lamp with IC Bulb (kWh)	Energy measured Lamp with CFL Bulb (kWh)	Energy difference (kWh)	Annual Savings ($) ($0.057 * 4380 hrs/year) if assume lamp is "on" 12 hours per day)

NOTE: The electric EZ meter can also extrapolate costs out assuming that lamp will pull the same power and the electrical rate that was input was correct-to check the extrapolated costs:
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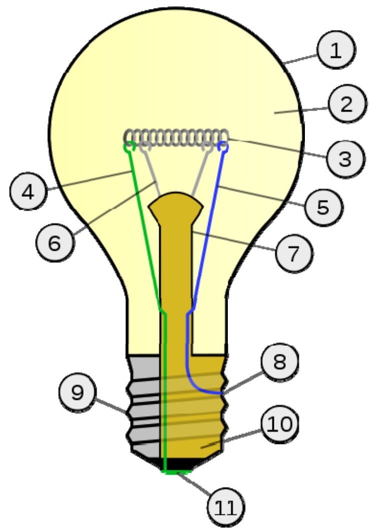
•Discuss that energy is being lost or wasted by the bulb that is heating (radiating heat to) the surroundings. The other bulb is using less total energy and using it's energy only on light and not heating.

Per the calculations above the savings are:
•Lamp Savings per year (0.03kWh x.$057/kWh)= $7.5/year
•Explain that the savings may not seem like much, but consider if you have 10 lamps on, and each is on for your lifetime-say 8 years, so 7.5* 10 lamps * 8 years=$600

Activity 4 Cont'd: Additional Information Incandescent Light Bulb Technology



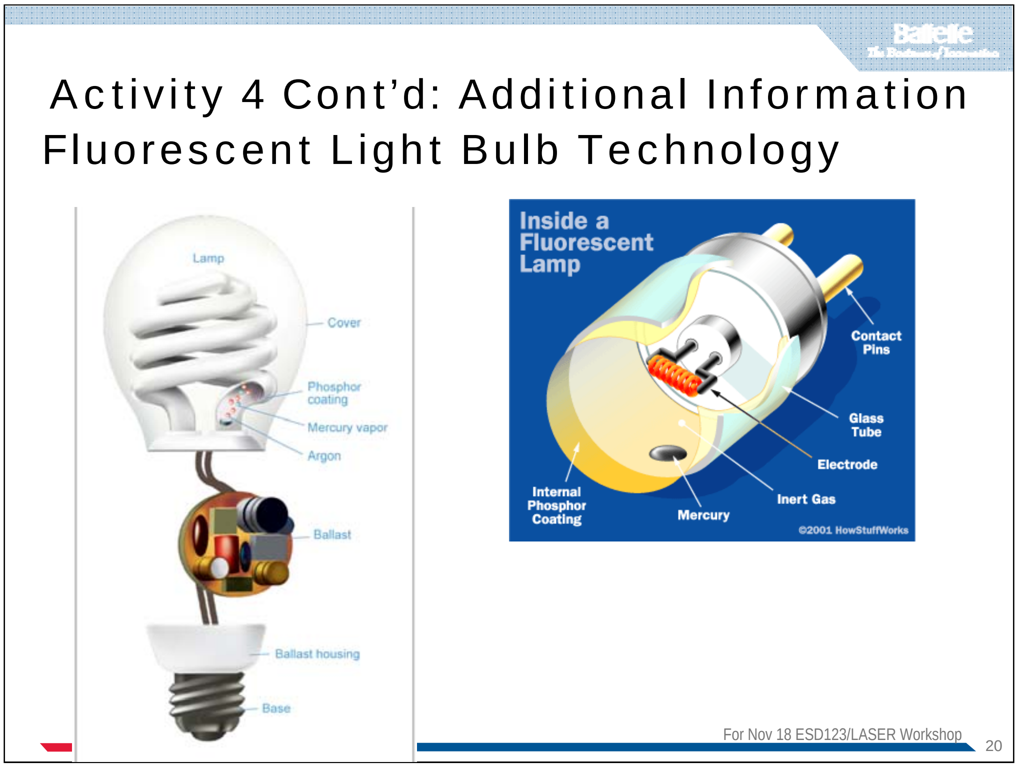
1. Outline of Glass bulb
2. Low pressure inert gas (argon, neon, nitrogen)
3. Tungsten filament
4. Contact wire (goes out of stem)
5. Contact wire (goes into stem)
6. Support wires
7. Stem (glass mount)
8. Contact wire (goes out of stem)
9. Cap (sleeve)
10. Insulation
11. Electrical contact

For Nov 18 ESD123/LASER Workshop 19

•Slide #19 was added (based on feedback from the initial presentation of this material), to provide the instructors with additional information. This slide provides background information on the lighting technology.

•Incandescent bulbs are the most common and least expensive bulb commercially available today. An incandescent bulb contains a tungsten filament that is protected from air by a glass bulb that is filled with an inert gas (such as argon or halogen) or evacuated. The inert gas or evacuated enclosure reduces evaporation and prevents oxidation of the filament. The glass bulb has a screw-in type base and contains small wires embedded in the base to support the filament and/or its lead wires. The light is produced when an electric current heats the tungsten filament to high temperatures to produce a glow (visible light), while releasing heat.

Picture downloaded 1-6-11 from:
http://en.wikipedia.org/wiki/Incandescent_light_bulb



•Slide #20 was added (based on feedback from the initial presentation of this material), to provide the instructors with additional information. This slide provides background information on the lighting technology.

This is a schematic of a compact fluorescent light bulb which is one type of fluorescent lighting product. This bulb is similar to an incandescent bulb that also has a screw-in type base with an integrated ballast. Another type of fluorescent lighting product used in commercial applications is the pin-based fluorescent lamp tube, often without integrated ballasts. Both operate based on the same technology.

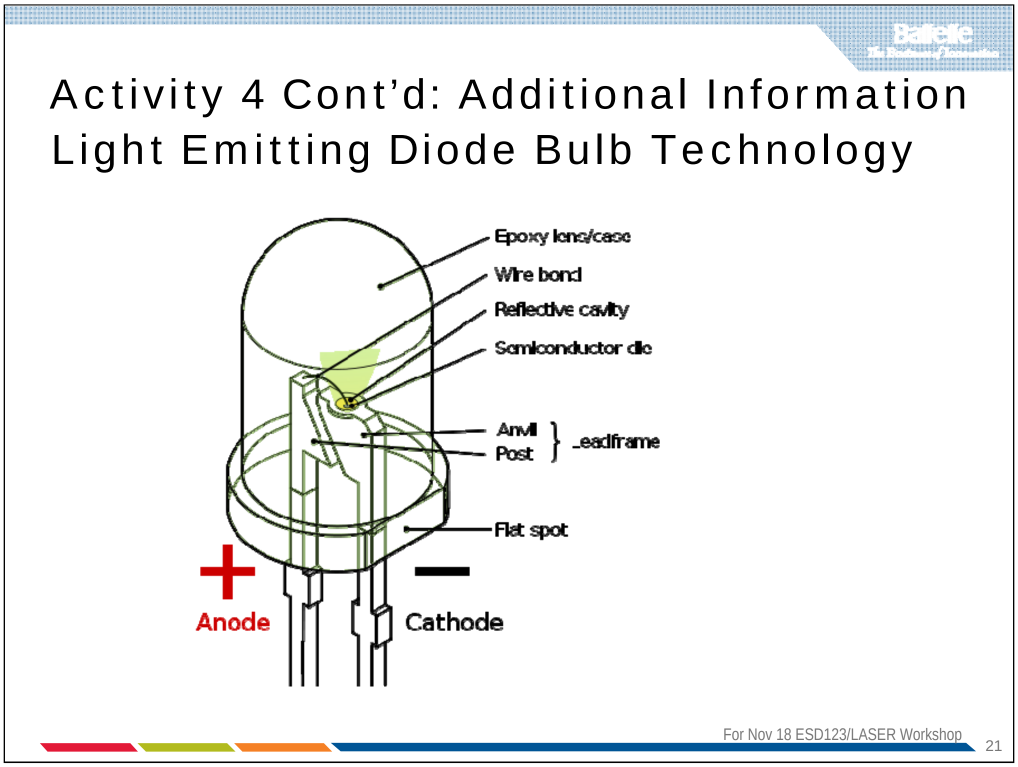
A fluorescent light bulb/lamp is filled with a gas containing low pressure mercury vapor and another gas such as argon. They produce light when an electric current flows through electrodes and reacts with the fill gases. This generates invisible ultraviolet light that excites a fluorescent coating (called phosphor) on the inside of the tube, which then emits visible light.

According to one manufacturer, certain types of compact fluorescent light bulbs work best if they are left on for over 15 minutes each time they are turned on because they can take up to 3 minutes to warm-up. Warm-up will probably not be noticeable from a user stand point, but the lamp needs to warm-up in order to reach the point of most efficient operation. Switching them on and off may shorten the life of the product. In addition, the variation in color often observed with this type of lamp is due to the different combinations of phosphor that is used to coat the inside of the bulb producing slightly different color effects. Moreover, since the bulbs contain mercury, they should be properly disposed of through a local recycler.

Pictures downloaded 1-6-11, from :

http://www.energystar.gov/index.cfm?c=cfls.pr_cfls_about#how_work

http://www.howstuffworks.com/fluorescent-lamp.htm



Slide #21 was added (based on feedback from the initial presentation of this material), to provide the instructors with additional information. This slide provides background information on the lighting technology.

A newer technology is the light emitting diode (LED) bulb. It is a solid-state lamp that uses light-emitting diodes (LEDs) as the source of light; most commonly available is the semiconductor light-emitting diodes. They technology is similar to an incandescent bulb; yet they do not have a filament. Instead of a filament, an LED bulb generates light as electrons flow along the path of its semiconductor.

LEDs offer advantages over incandescent and fluorescent bulbs, including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability. Moreover, they do not contain mercury (unlike a compact fluorescent lamp or CFL). However, currently available LED bulbs are much smaller than incandescent and fluorescent bulbs, and are often clustered or grouped to be powerful enough to adequately light a room. Commercially available LED bulbs are relatively expensive and require more precise current and heat management than compact fluorescents lamp sources of comparable output.

Picture downloaded 1-6-11 from:
http://en.wikipedia.org/wiki/Light-emitting_diode

Activity 5: Home Energy Awareness Survey

- **Homework or in the class**
  - **math calculations with a calculator or by long hand**
  - **A graph can also be made.**
  - **See Word file "Home_Energy_Awareness_Survey.doc"**

Name:__________________________

Home Energy Awareness Survey ("Given" kilowatts data from Benton PUD, June 2010)

	Column A	Column B	Column C	Column D
Appliance Type	Given: Kilowatts (1,000 watts)	Enter Hours Used per Day	Calculate Total Kilowatts Used (Col A x Col B = kW-hours)	Calculate Total Cost per Day* (Col C x $0.06)
Incandescent Lights 60W (or 0.06 kW)	.060	Example: 10	.06 x 10 = 0.6	0.6 x $0.06 kWh = $0.036 (3.6 cents)
Fluorescent Lights 18W	.018			
Television (42" LCD)	.210			

Incandescent bulb

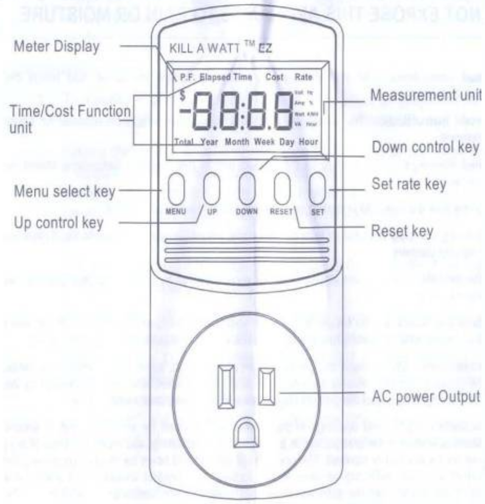
Compact Fluorescent bulb

1. Hand out the sheet above to the students
2. This is to take home and fill out based on what they find when they survey
3. Column A lists the "typical" appliances in a home, so the students should first walk around and see if they can find one in their house. If there is more than one, just fill out the form for one appliance.
4. Column B, (shaded column), is the "hours used per day" which is to be filled out by the student. For example, in the first two rows, you are looking for light bulbs. If you find a light bulb then check if it is a incandescent or a fluorescent light bulb. (you can ask your parents or refer to the pictures provided if not sure), then ask your family-if it is on all day or only a few hours of the day. If it is not in a main area, you can put "6" in column B row 1 or row 2 as appropriate, if it is in a garage, only used in the morning, put "2" in the row. Repeat this to fill out column B as best you can. Put "don't have" if you don't have that appliance at home.
5. Column C is a calculation, "kilowatt hours per day" found by multiplying column A * column B.
6. Column D is a calculation, "cost per day", " found by multiplying column C * $0.06 per kilowatt hour (an estimated cost of electricity based on Benton PUD cost rate-November 2010).

Activity 1 - Retake Survey

- Return each student's pre-survey and state the answers to each question. Ask students to mark their sheet with the correct answer.
- Encourage discussion and plan for how they will improve energy conservation in their lives.
- Each student or group of students could prepare a poster explaining their plan for being more energy aware at home/school/community
- present it to the class Or…
- start a project such as a school wide energy audit/conservation
  - a recycling program
  - or a community awareness science project presentation.

Appendix A: Kill-a-Watt Meter Instruction sheet



Quick Start Guide:

Use these quick start instructions to get up and running in just a few minutes. Be sure to review all the operating instructions later to ensure full enjoyment of the product.

1. Connect the Kill A Watt™ **EZ** unit to the outlet and the appliance to the unit
2. Press and hold the RESET key on the unit until "rESt" appears.
3. Press and hold the SET rate key until "Rate" is displayed and the currently set rate flashes.
4. Press the UP and DOWN key to set your desired rate. For example, if your utility charges you 10.6 cents per KWH, set the rate until the unit displays $0.106.
5. Press the SET key again. "SAVE" will appear briefly in the display.
6. To display the actual cost of power consumed or projected cost, press the MENU key until "Cost" is displayed in the LCD.
7. Pressing the UP and DOWN key will cycle through the cost projection periods. For example if the display indicates $2.34 and "Month", the unit is projecting that the attached appliance will consume $2.34 worth of electricity in one month.
8. To display the power measurements press the MENU key until "Volt" is displayed on the LCD.
9. To cycle through the various measurements press the UP and DOWN key as desired. The measurement unit currently selected will be indicated in the display.
10. To display the total consumed power in Kilowatt-Hours, press the MENU key until "KWH" is indicated in the display.
11. Review the complete operating instructions to familiarize yourself with all features.

Washington State
Science & Sustainability
Curriculum Standards
Related to Energy and Efficiency

Essential Academic Learning Requirements (EALR)

Science:
http://www.k12.wa.us/Science/Standards.aspx

State Standards – Sustainability

- Washington State Integrated Environmental and Sustainability Education Learning Standards, Standard 3 - Sustainability and Civic Responsibility:
  - Students develop and apply the knowledge, perspective, vision, skills, and habits of mind necessary to make personal and collective decisions and take actions that promote sustainability
- Battelle's lesson plan supports sustainability by increasing students' awareness of energy and energy efficiency.
  - Shows the effort and cost to make/use electricity.
  - Promotes thinking about turning things off, insulating (color choices), and buying energy efficient (more sustainable) products.

Resources

Battelle Resources – Grades 4-5

- Battelle's energy awareness lesson plans and supporting files: http://buildingefficiency-labworks.pnl.gov/education_k-12.stm
  - This PowerPoint file, including the Notes sections,
    - "Grade_4-5_Lesson_Plan_Current.ppt"
  - A PowerPoint file of just the key Activities slides for showing in the classroom to students.
    - "Grade_4-5_Lesson_Plan_Current_Classroom.ppt"
  - The pre and post Energy Survey, and Answer Sheet files:
    - "Pre-Post_Survey.doc" and in a pdf file also.
    - "Pre-Post_Survey_Answers.doc" and in a pdf file also.
  - The Home Energy Awareness Survey.
  - Kit inventory/purchase list for others' purchase of additional parts.
  - Teacher Feedback Form on the lesson plans
    - "Feedback_on_the_Energy_Awareness_Lesson_Plan.doc"
- Contacts
  - John Hail, 509-372-4799, John.Hail@pnl.gov, and
  - Theresa Koehler, 509-375-2415, Theresa.Koehler@pnl.gov

Energy Efficiency Awareness Lesson Plan, Grades 2-3 For Nov 18 ESD123/LASER Workshop 28

Many Resources Online … Some:

- US Department of Energy, http://www.loseyourexcuse.gov
- Cool School Challenge (upper grades), http://www.coolschoolchallenge.org
- US Energy Information (EIA) Energy Kids, http://www.eia.doe.gov/kids
- Washington State OSPI grade level standards and resources, http://standards.ospi.k12.wa.us
- Arbor Scientific – lessons for grades 5-12 Student Lab Act. In Physics and Physical Science, http://www.arborsci.com/ArborLabs/ASLabs_Home.aspx
- The National Science Digital Library (NSDL) Literacy maps of the national standards, http://strandmaps.nsdl.org
- Beyond Penguins and Polar Bears – energy awareness, http://beyondpenguins.nsdl.org
- Science Net Links – Absolutely amazing site nearly limitless resources, http://sciencenetlinks.com
- Energy Quest – California, http://www.energyquest.ca.gov
- Classroom Energy K-12, http://www.classroom-energy.org
- National Energy Foundation for educators, http://www.nef1.org/educators.html

Energy Efficiency Awareness Lesson Plan, Grades 2-3

For Nov 18 ESD123/LASER Workshop

29

Resources, National Standards

(Thank you Kathy Fisk)

- Science Matters: Achieving Scientific Literacy, Hazen and Trefil.
- Science for All Americans, American Association for the Advancement of Science, Project 2061. Online viewing: http://www.project2061.org/publications/sfaa/online/sfaatoc.htm?txtRef=&txtURIOld=%2Ftools%2Fsfaaol%2Fsfaatoc.htm
- Benchmarks for Science Literacy, American Association for the Advancement of Science, Project 2061. Online viewing: http://www.project2061.org/publications/bsl/online/index.php
- National Science Education Standards, Center for Science, Mathematics, and Engineering Education. Some online viewing: http://www.nap.edu/openbook.php?record_id=4962
- Curriculum Topic Study, National Science Foundation. www.curriculumtopicstudy.org

Videos – Energy Basics

- **Bill Nye The Science Guy on Energy – kinetic energy, then electricity generation, (http://www.youtube.com/watch?v=0ASLLiuejAo&feature=related**
- **Potential Energy: Wile E Coyote & Roadrunner, http://www.youtube.com/watch?v=Jnj8mc04r9E&feature=related**
- **What is Energy? – Energy basics put to song, http://www.youtube.com/watch?v=o_5oYuDY2qM&feature=related**

Energy Efficiency Awareness Lesson Plan, Grades 2-3

For Nov 18 ESD123/LASER Workshop

31

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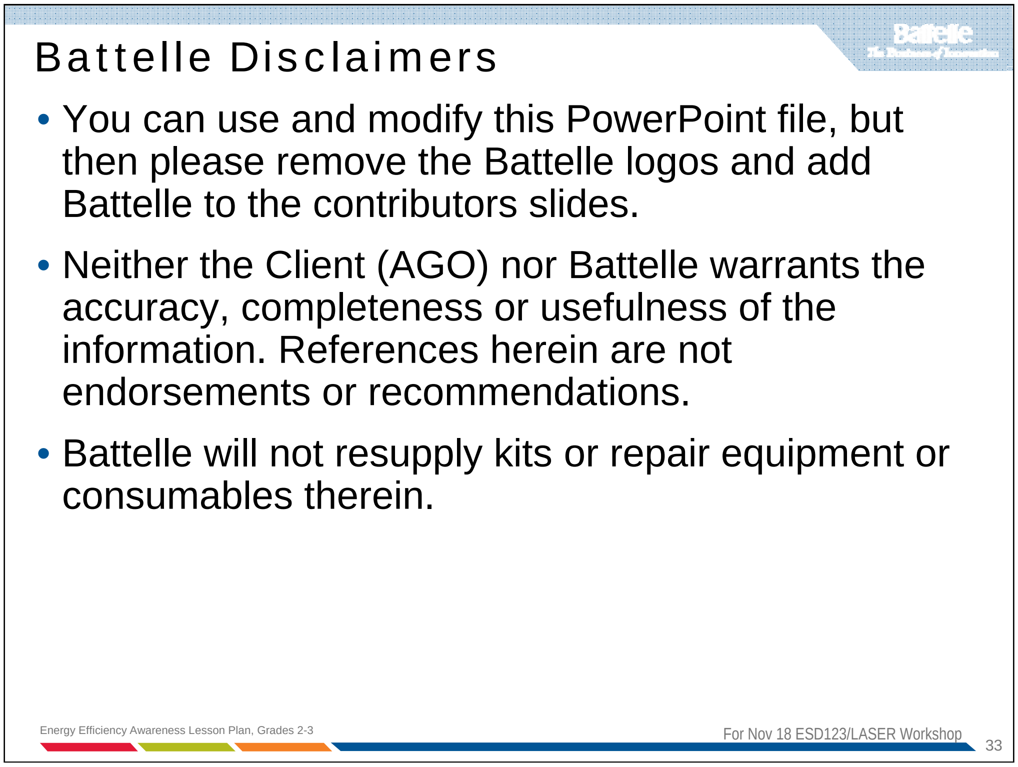
Energy Efficiency Awareness Lesson Plan, Grades 2-3

For Nov 18 ESD123/LASER Workshop

32



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