Teaching Guide

Lighting Mobile Learning Lab

Purpose

Exploring lighting alternatives and learn how to purchase bulbs

Learning Objectives

- Compare and contrast types of lighting lamps
  - Demonstrate differences in electrical consumption and heat output in lamps
  - Demonstrate differences in light color and intensity between lamps
  - Gain understanding of electrical power strips

Handouts

- E^{3}A Home Energy Fact Sheet "Lighting" (E3A-EMH.14)
- E3A Evaluation Form
- E3A Sign-In Sheet

Demonstration Plan

The following plan is provided as a sample of how you might incorporate the materials in this mobile learning laboratory in a demonstration workshop. Modifications to meet local market and learner needs are encouraged.

Demonstration 1: Understanding Electrical Consumption

Time: 8-15 Minutes

Est. Time	*Materials*	*Actions*
2-5 Minutes	– Power Analyzer Instruction Sheet	Begin with watt's up PRO device plugged directly to the wall outlet. Connect the utility meter to the watt's up PRO. Screw in an incandescent bulb, but do not turn it on. Show the watt's up PRO meter – demonstrate that there is a small amount of electricity consumption even though the bulb is not on. Turn the bulb on. Show the various functions of the watt's up PRO device.
3-5 Minutes	– Smart Strip Instruction Sheet	Turn the bulb off. Unplug the utility meter from the wall and plug in the power strip. Demonstrate that when the power strip is "off" the watt's up PRO meter does not register a draw when the bulb is off. Turn power strip "on". Demonstrate the functions of the smart strip by plugging various items (preferably items that given an obvious indication they are powered up – light up, make noise, etc.) in the strip and using the bulb/meter in the "control outlet. When you turn on the bulb the other items will power up.
3-5	– Electrical Meter	Turn on the bulb – point out the spinning of the electrical

Minutes	Instruction Sheet	meter and the readings on the watt's up PRO. Discuss how to read the meter. Show the blue dot and show the disc rotate as the bulb is one. Turn the bulb off and show the disc slowing. Explain that a "watt" is an instantaneous measure of energy. A "watt hour" is a measure of power – energy over time. A 60-watt bulb will consume 60 watt-hours of power if left on for an hour. The electrical meter measures our power consumption.

Demonstration 2: Understanding Changes in Bulbs

Time: 10-20 Minutes

Est. Time	*Materials*	*Actions*
3-5 Minutes	– 60 watt incandescent bulb – CFL lamp(bulb) with a 13-15 watt rating (60 W replacement)	Screw the incandescent bulb into one side of the meter and the CFL into the other side. Turn off the CFL and turn on the incandescent. Use the watt's up PRO to measure the power being used. Observe the spinning of the meter. Turn off of the incandescent bulb and turn on the CFL. Use the watt's up PRO to measure the power being used. Observe the spinning of the meter. Compare and contrast the readings.
2-5 Minutes	– As above	Turn on both bulbs. Explain that incandescent bulbs are inefficient in that they produce more heat than light. Have participants hold their hands over (but do not touch) the two illuminated bulbs. Note differences in heat output.
5-10 Minutes	– Light Bulb Comparison Sheet	Explain the two bulbs are both rated as 60 watt bulbs, but their power consumption is different. Use the light bulb comparison sheet to explain the differences in cost. Replace the incandescent bulb with a 60 watt LED. Use the watt's up PRO meter to compare/contrast the power consumption.

Demonstration 3: Purchasing a Bulb

Time: 24-30 Minutes

Est. Time	*Materials*	*Actions*
3-5 Minutes	– Purchasing Lighting Information Sheet	Review the Top 5 considerations when purchasing lighting.
3-5 Minutes	– 60 W Incandescent Bulb – 13-15 W CFL	Screw both bulbs into the meter. Use the watt's up PRO to compare and contrast the power usage of the two bulbs. Show on the packaging that they are similar lumens, but different in the power they use. Use the light meter to

			illustrate that they are similar lumens.
3-5 Minutes	–	Any two bulbs with different K scale (color) ratings (ie- - 2700 K and a 5000K)	Use any two bulbs with different Kelvin-scale color to demonstrate differences in white light.
15 Minutes	–	Variety of packages	Have participants look through various packaging samples for information on watts, lumens, color, and other features. Point out that even though packaging is different, you can usually find watts, lumens, and color. Be aware that some inexpensive lamps have shorter life expectancy. Energy Star bulbs are tested to meet life, watt and color standards.

** If you are new to lighting, review or use www.WxTVonline.org episode "Lighting 101". This episode discusses differences between incandescent and CFL lamps, with emphasis on explaining lumens, watts, color rendition, layering light, and reading labels.*

Purchasing Lighting

Information Sheet

Purchasing a light bulb can be a real task given all of the options on the market today. Understanding a few things about light bulbs can simplify the process.

Top 5 Things to Know When Buying a Light Bulb

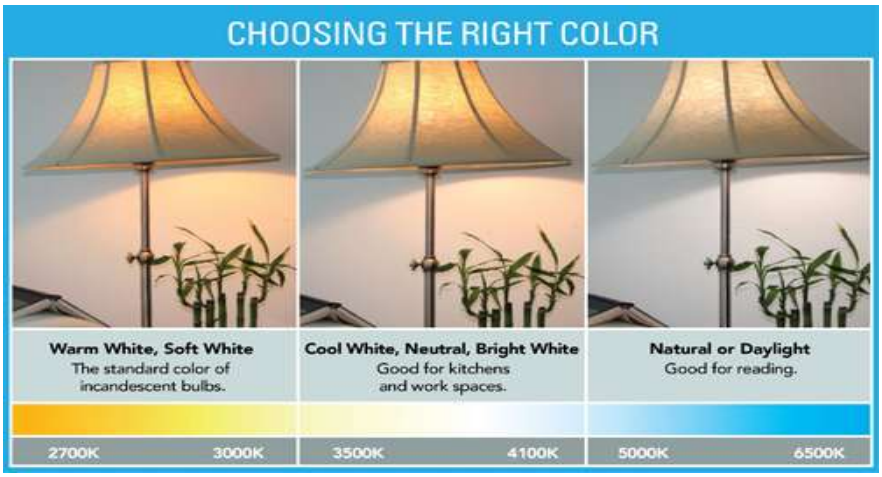
1. They are no longer called "light bulbs". "Light bulb" tends to refer only to incandescent or pear-shaped bulbs. In many stores, the term used to reference all types of "bulbs" is "lamps".

2. When replacing an incandescent bulb with another kind of lamp (CFL, halogen, or LED), the watts will be different. For example, if you are replacing a 60-watt bulb with a CFL, the CFL may be 13-15 watts. Most packaging will provide information such as "60W Replacement".

Incandescent Bulb (Watts)	Lumens	Energy Star Qualified Bulbs (Watts)
40	450	9 to 13
60	800	13 to 15
75	1,100	18 to 25
100	1,600	23 to 30
150	2,600	30 to 52

3. You are shopping for lumens, not watts. When shopping for incandescent bulbs, you shopped for watts. Now you need to shop for lumens – a measure of light output. Most lighting packaging will provide you with the information you need.

4. The color of the white light is measured on a Kelvin scale. Lower numbers (2600-3200K) means the light appears more yellow and warm. Higher numbers mean the light is more white or blue.

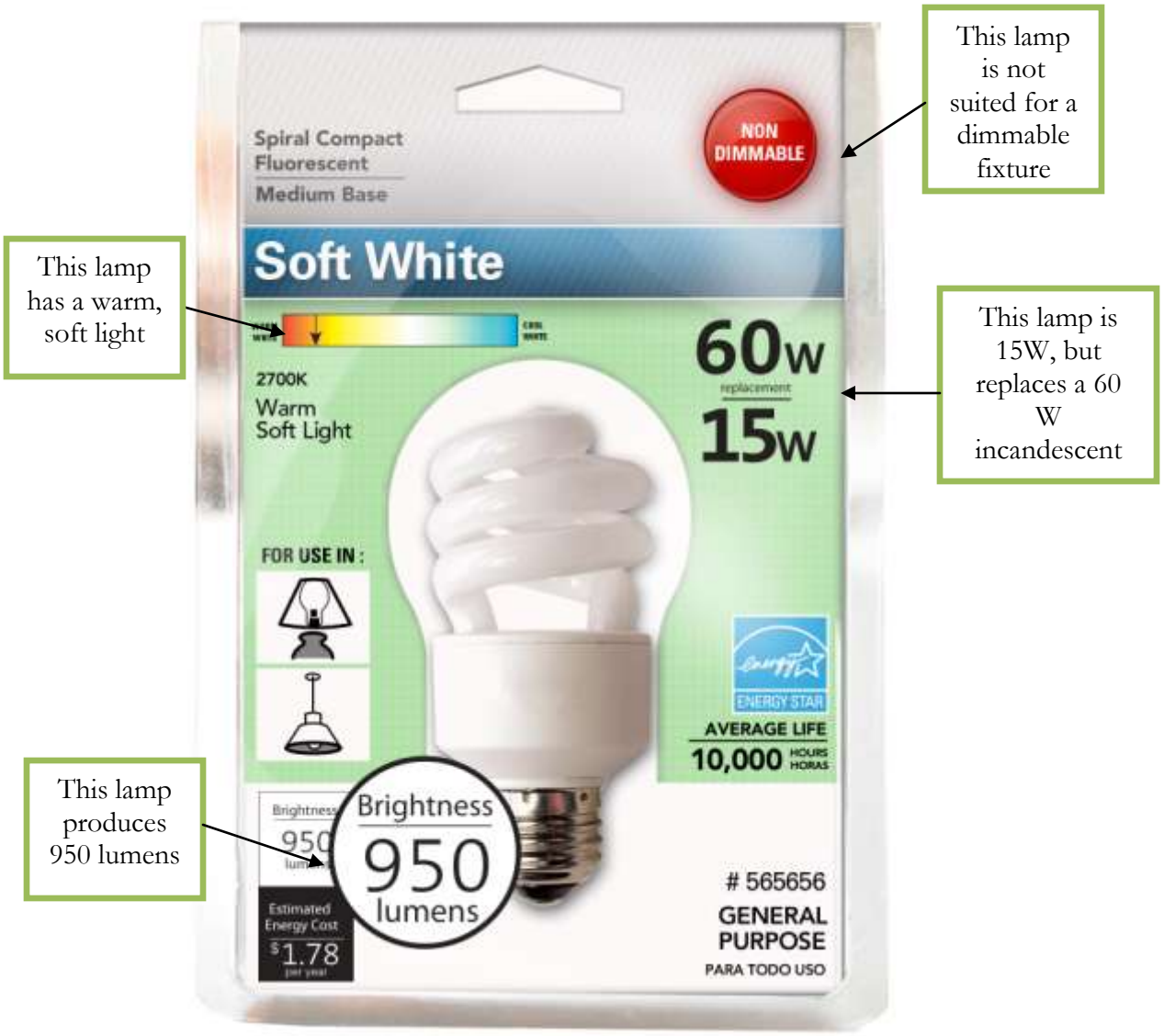


http://www.energystar.gov/index.cfm?c=cfls.pr_cfls_color

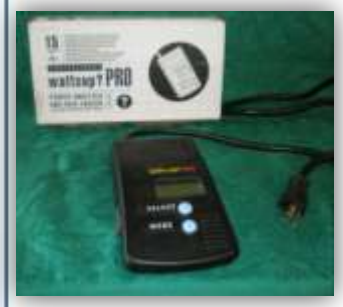
Purchasing Lighting

Information Sheet

5. BE AWARE: If your fixture is dimmable, in a three-way socket, on an electronic control (motion sensor, etc.), ore exterior to your home you need to bulbs that are labeled for that purpose!



Power Analyzer
Instruction and Information Sheet

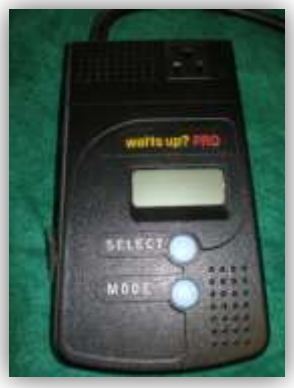


The enclosed **watts up? PRO** device can provide basic wattage information and more for any appliance or device that can be plugged into a standard electrical outlet.

Follow the steps listed to the right to simply determine the watts used.

The Basics: Wattage

1. Plug the device into a standard, 3-prong, 120-volt wall outlet.
2. Press and hold down the SELECT button for 1 second to clear any stored data from past use.
3. Find a device and plug it into the top socket of the watts up? PRO
4. The display will show the amount of electricity in watts being drawn from the electrical outlet through to your device.



Expand the Lesson: Want To Learn More?

After completing Steps 1 - 4 above, press the MODE button repeatedly and notice the display also shows:

- Watt-hours
- Elapsed time
- Cost to use (The default setting is 8 cents/kWh. This can be changed. The average cost per kWh in Montana is 9 cents.)
- Volts
- Amps

Take It One Step Further

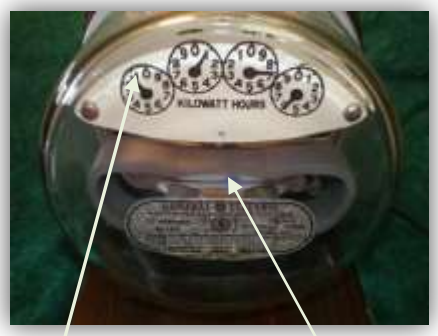
For each MODE selection, the SELECT button will show additional information such as minimum and maximum values and averages.

There are a variety of power analyzers available at many stores and on-line.

Electrical Meter

Instruction and Information Sheet

The Lighting Kit's retrofitted electric meter can be used to explain how an electric meter is read and to visually compare the amount of electricity used by various light bulb types.



Reading an Electric Meter

As electricity flows from the utility grid and is used, the meter's internal gears track the amount. The gears spin the disc and turn the dial hands. Think of each dial as a clock that is read from left to right representing a four-digit number. In the picture on the left, the dials show 1,176 kilowatt hours (kWh) have been used.

kWh = the units used to measure electricity use.

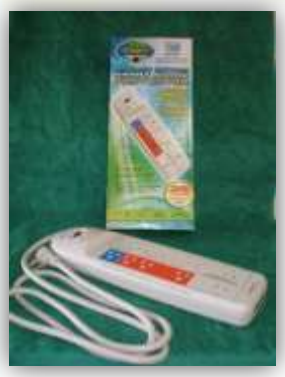
Some electrical meters are digital

Bulb Electricity Use Comparison

Place different types of bulbs of equal light output (lumens) to compare electricity use. For example, a 100-watt incandescent will have the same lumens as a 23 -25 watt compact fluorescent (CFL). Turn only one on and watch the meter's disc spin (watch the blue dots). Turn the first bulb off, then turn on the other bulb and compare the speed at which the disc spins. The faster the disc spins, the more electricity being used to produce the same amount of light.

Use the enclosed Light Meter to determine the footcandle light level of the bulbs.

"Smart" Power Strip
Instruction and Information Sheet



Today's surge protectors can do more than protect devices from power surges! They can help us save money and reduce energy consumption by eliminating phantom loads. A phantom load (also known as a vampire load) is when electricity is being used even when a device is "off." This stand-by use can be as high as 15-20 watts.

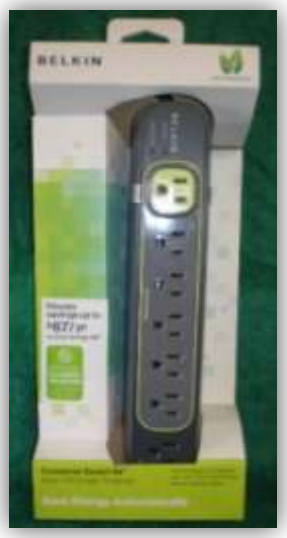
Basic surge protectors and power strips can be turned off to completely eliminate phantom loads. They must be manually turned on for the devices plugged into them to be turned back on. "Smart" strips are a different type of surge protector that could help to make eliminating phantom loads easier for you.

One use for the enclosed "Smart" surge protector could be for TV-related devices:

- Plug the TV into the blue "Control Outlet."
- Plug the DVD player and cable box into the "Automatically Switched Outlets."

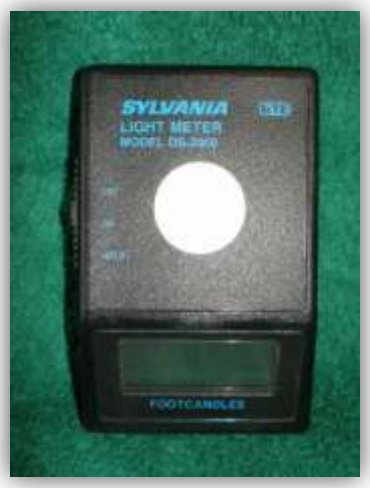
When the TV is turned off, the "Smart" surge protector detects the reduced electricity use and will completely turn off the TV, DVD player and cable box to eliminate all phantom loads. When you want to watch TV, simply turn it on and the DVD player and cable box will automatically turn on as well.

Any device that needs to remain on at all times can be plugged into the red "Constant Hot Outlets."



Varieties of smart surge protectors are available at stores and on-line.

Light Meter
Instruction and Information Sheet



A light meter measures the amount of light that falls upon any surface in units of footcandles (lumens per square foot). Design and lighting industry professionals use footcandle measurements to provide adequate lighting levels for everything from outdoor lighting along pathways to indoor light levels for workspaces and museums. The lighting standard is established by the Illuminating Engineering Society (IES). If taken outside, the meter may read up to 10,000 footcandles on a bright sunny day and around 1,000 on a cloudy day.

Use this Light Meter to detect the footcandle light output of the bulbs used in the Electric Meter. Turn the light meter on and place it on a surface near the light source, then away from that source and read the numbers on the display.

Did You Know?

There are different types of light meters used to measure light levels for photography, film, television and greenhouses.

Light Bulb Comparison Sheet

There are two price tags to any device that uses energy. The first is what you pay for the device. The second is what you pay for maintenance and operation. Operation includes the cost of the energy required to operate the device whether it's gas for a car or electricity for a light bulb. Use the table below to compare the total cost of buying and operating different light bulbs.

EXAMPLE: Compact Fluorescent Lamp (CFL) & Incandescent Cost and Energy Use Comparison			**Conduct your comparison in these columns.**	
Bulb Type	 CFL	 Incandescent		
Equivalent Light Output Wattage (**same Lumens**)	23 watts	100 watts		
Bulb Cost	$7.00	$0.25		
Bulb Lifespan	10,000 hours	1,000 hours		
Bulb Cost for 10,000 Hours	**$7.00**	$0.25 x 10 **= $2.50** (takes 10 bulbs to get 10,000 hours)		
Energy Used in kWh	10,000 hours of light at 23 watts = 230,000 watt-hours. 230,000 ÷ 1,000 watts = **230 kilowatt-hours (kWh)**	10,000 hours of light at 100 watts = 1,000,000 watt-hours. 1,000,000 ÷ 1,000 watts = **1,000 kilowatt-hours (kWh)**		
Utility Electricity Cost for 10,000 hours of light at $0.08 / kWh	230 kWh x $0.08 = **$18.40**	1,000 kWh x $0.08 = **$80.00**		
Store Purchase Cost + Electricity/Operation Cost **= Total Cost**	$7.00 + $18.40 = **$25.40**	$2.50 + $80.00 = **$82.50**		
	That's a savings of over $ 57			