

Bringing Choices to Light

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GE Lighting Teacher's Kit Introduction

Bringing Choices to Light.

Welcome to "Bringing Choices to Light," *free*, national standards-based lesson plans from GE, designed to help students learn about lighting choices and energy conservation. All of our plans were created to engage beginner to intermediate and advanced students with in-school and at-home projects.

To help students learn about lighting choices and energy conservation, we've included a home audit worksheet in an Excel® format (for ease of use) and a Supplemental Reference Material section.

What's So Smart About Compact Fluorescent Light (CFL) Bulbs?

One of the most important things your students will learn is the energy and money savings involved in using CFLs instead of standard incandescent bulbs. Our line of CFLs are called GE Energy Smart® bulbs, and we're a leader in bulb life—our longest-lasting Energy Smart® bulb is rated for 15,000 hours.



Energy Savings

In general, GE Energy Smart® bulbs use 70–75% less energy than standard incandescent light bulbs. Saving energy is better for the environment. Less energy used in the home means less air pollution from power generation.



GE Energy Smart® bulb



Standard incandescent bulb

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GE Lighting Teacher's Kit Introduction (cont.)

Money Savings Consumers will save money by using GE Energy Smart® bulbs vs. standard incandescent light bulbs. Taking into consideration initial purchase price, replacement cost and energy cost, GE Energy Smart® bulbs are much less expensive. They cost less than one-third as much to operate annually as standard incandescent bulbs.

Longer Life GE Energy Smart® bulbs last up to 10 times longer than standard incandescent light bulbs. This means less time and effort spent changing out light bulbs; perfect application for hard-to-reach fixtures.

The Same Light as Standard Incandescent Bulbs Most GE Energy Smart® bulbs provide the same amount of light (lumens) as their standard incandescent counterparts, while consuming 1/3 to 1/4 of the energy.

The Same Application GE Energy Smart® bulbs can be used in almost all the same fixtures and in the same way regular light bulbs are used.

Excellent Color Rendering Most GE Energy Smart® bulbs offer brightness and color rendition that is comparable to standard incandescent lights.

ENERGY STAR® Qualified 91% of GE Energy Smart® bulbs are ENERGY STAR® qualified, and the percentage keeps growing.

GE Energy Smart® bulbs are available in a variety of different shapes and sizes to fit different fixtures and applications.



Reduction Cycle

Switch to a CFL



Reduce the amount of electricity used in your home



Help curb the amount of greenhouse gases given off by power plants



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Lighting and Energy Conservation Lesson Plans

These lessons reinforce the academic content standards for “Nature of Energy” and utilize national standards for Language Arts and Science.

Lesson 1:

Introducing students to lighting and energy conservation through home electricity audits.

Activity Summary: Students collect data in their own homes. In the classroom, they work on science and math problems directly related to the project, share their findings from their home energy survey, and learn how much money can be saved simply by switching to CFLs. Students will create tables, graphs and summaries of this data to be shared in a classroom presentation.

Benefits: After completing the activity, students will be able to:

- Observe, record and interpret data
- Use charts, tables and graphs
- Sharpen computer skills (Microsoft® Word and Excel®)
- Communicate ways that changes in behavior can affect energy consumption
- Present findings to an audience

Science goal: Observe, use numbers, collect and interpret data, communicate, see cause and effect.

Language arts goal: Writing, gathering information for research purposes, rhetoric.

Time required: Two 40 minute sessions of in-class time with additional work outside the classroom.

Materials required: Writing materials and lined paper, GE standard incandescent and Energy Smart® bulbs (CFLs), graph paper, home audit worksheet, possibly computer graphic software and/or art supplies. Note: The Excel® home audit is a live document with formulas in place. Print out if you prefer students to do the calculations themselves.

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Lighting and Energy Conservation Lesson Plan 1 (cont.)

Level: Beginner

Activity 1: Home Energy Audit

Benefits: Students take an inventory of the light bulbs used inside (and outside) their homes. Using the downloadable Excel® home audit worksheet, they will be able to compare standard incandescent light bulbs to the comparable wattage of CFLs and share their cost-saving findings with the class. This exercise leads to an understanding that energy efficiency/resource conservation is a role all of us can assume (students, parents and communities).

Procedure:

1. The class is introduced to the ENERGY STAR® label, the national symbol for efficiency, administered by the Environmental Protection Agency (EPA) in partnership with the Department of Energy (DOE).
2. Students are shown a selection of standard incandescent bulbs and CFLs and asked to talk about the differences in shapes and sizes, design, price, expected life span, merits and drawbacks. To minimize the risk of injury, avoid having the students handle the light bulbs.
3. Students are instructed to look around their own homes and record on a chart all of the different bulbs used inside and outside the home. Instruct students not to handle or touch the light bulbs while they perform this activity.
4. Students then compare the bulbs that are currently used in their homes with comparable CFLs and calculate the energy and money savings for each fixture. (They could also do the cost savings for an individual room instead of each fixture.)
5. Students report their findings to the class.

Level: Intermediate

In addition to the home audit, students can write an action plan for their family and include tips for energy savings. Plans could include: actions, time frames for completion, and who is responsible for each task. Students could give an oral report in class about their action plans and share their tips. All of the students' work could be put together to make an "Energy Savings Booklet" that each student could take home to share with their family. Or, the class could create a website to house their work.

Lesson plan courtesy of Rantin' Raven Educational Consulting.



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Lighting and Energy Conservation Lesson Plan 1 (cont.)

Level: Advanced

In addition to the home audit, students also conduct an audit of their school's lighting. They could also take it one step further and find out from the school's finance or maintenance departments how much electricity is being used and how much it is costing the school. The students could then calculate how much money their school could save by switching to CFLs. They could present their findings to the class, or to the school board in a formal presentation.

Lesson plan courtesy of www.energynet.com

Alternate Activities:

- Students can draw up a chart or table for their family's energy use and savings. These can be posted in the classroom.
- Working together, students create a chart showing how much their school could save in energy and energy costs. The chart could be posted in a prominent place in the school.
- Hold a contest: Which student was able to save the most energy and money for their family? (Alternatively, an entire grade could compete to save the most energy in their homes).
- If the school is networked, different classes and grade levels could share their findings on the school intranet.
- Take a field trip to a business that has overhauled its energy conservation programs or lighting options.
- Have a guest speaker from the local energy company talk to the class.

Other Resources:

Interactive online home audit source:

<http://hes.lbl.gov>

ENERGY STAR®

Most ENERGY STAR® qualified CFLs provide the same amount of light (lumens) as standard incandescent bulbs, but use fewer watts. This means they use less energy and can result in less pollution. If you are unfamiliar with the best CFL wattage to use for your lighting needs, always refer to the lumen, or light output on the product packaging as your guide. Look for the ENERGY STAR® label on GE CFLs.

Additional resources for facts about lighting and electricity:

www.gelighting.com

www.geprojectplantabulb.com

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Lighting and Energy Conservation Lesson Plans

These lessons reinforce the academic content standards for “Nature of Energy” and utilize national standards for Language Arts and Science.

Lesson 2:

Students learn about lighting and energy conservation by making smart buying decisions and behavior changes.

Activity Summary: Students are assigned to “Energy Teams” in the classroom. Students collect data in their own homes. They meet in their Energy Teams to work on science and math problems directly related to the project, and to share their findings from their home energy survey. Students will create tables, graphs and summaries of this data to be shared in a classroom presentation. Students will evaluate other Energy Teams for valid data and effective presentation.

Benefits: After completing the activity, students will be able to:

- Observe, record and interpret data
- Use charts, tables and graphs
- Sharpen computer skills (Microsoft® Word and Excel®)
- Communicate ways that changes in behavior can affect energy consumption
- Present findings to an audience

Science goal: Observe, use numbers, collect and interpret data, communicate, see cause and effect.

Language arts goal: Writing, gathering information for research purposes, rhetoric.

Time required: 40 minutes (except Advanced Level, which has an at-home component).

Materials required: Writing materials and lined paper, GE standard incandescent and Energy Smart® bulbs (CFLs), graph paper, a home audit worksheet, possibly computer graphic software and/or art supplies.



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Lighting and Energy Conservation Lesson Plan 2 (cont.)

Level: Beginner

Activity 1: How can smart buying behavior make you and your family energy savers?

Benefits: Students will be able to understand and describe hidden costs when buying electrical products. This exercise leads to an understanding that energy efficiency/resource conservation is a role for all (students, parents and communities).

Procedure:

1. The class creates a definition of the term “hidden costs” and gives examples (i.e., remote-control car that requires batteries, coat that requires dry cleaning, clothes that require special detergent, cars that require oil changes and replacement tires, pools that require cleaning and chemicals, lamps that require bulbs, tennis racquet that needs restringing).
2. Ask the class to determine: Which hidden costs in the examples are also normal maintenance? Which can be unusually costly?
3. The class then narrows the focus to examples of electrical products that have hidden costs. Introduce and explain the ENERGY STAR® label, the national symbol for energy efficiency, administered by the Environmental Protection Agency (EPA) in partnership with the Department of Energy (DOE).
4. Display and discuss standard incandescent bulbs and CFLs. The class is divided into Energy Teams to compare standard incandescent bulbs and CFLs in design differences, price, cost to run (hidden costs), expected life span, merits and drawbacks. (They can also do a home audit to make the exercise more relevant.)
5. Each Energy Team makes a poster to illustrate their findings and gives a presentation to the class.
6. Ask the class to list examples of places they would likely use standard incandescent bulbs and CFLs. Call on individuals to read lists and explain reasoning.

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Lighting and Energy Conservation Lesson Plan 2 (cont.)

Level: Intermediate

Have Energy Teams participate in a debate to determine whether human behavior or energy-efficient products achieve greater energy savings. (Once a panel has argued one side of the question, they must also debate supporting side of the question.)

Behavior Viewpoint:

To get the most efficiency from electricity, we should put the most time, money and effort into teaching people about energy conservation.

Product Viewpoint:

To get the most efficiency from electricity, we should put the most time, money and effort into developing energy-efficient products for people to buy.

Level: Advanced

Invite an educator from a local utility company to the classroom to explain to students how electricity and natural gas are measured in kilowatts and BTU/cubic feet. Students will see a Watt-Rate Meter demonstration showing how much energy different appliances use. A lesson on reading power meters will be done in class. Students will be given a handout to record the reading of their home meter every day at the same time for one week—they make a graph of the daily home meter readings. The goal is to have the students learn how to read their home electric bill, and determine the amount of electricity used comparing the data and their graphs.

Lesson plans courtesy of Tamara Lindemann and Becky Clark.



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Lighting and Energy Conservation Lesson Plan 2 (cont.)

Alternate Activities:

- Different Energy Teams could demonstrate the differences between standard incandescent bulbs and CFLs to the class (instead of the teacher explaining them).
- Students could implement a “turn out the lights when you leave the room” campaign in school and create their own collateral pieces: door hangers, posters, brochures and flyers. They could also put all of this information on the school’s website to save paper.
- For more advanced students, organize a public facility energy audit and have students share their findings with the class and the facility.

Other Resources:

Have students complete the ENERGY STAR® lighting quiz found at:
http://www.energystar.gov/index.cfm?c=ilg.pr_lighting_quiz_index

ENERGY STAR®

Most ENERGY STAR® qualified CFLs provide the same amount of light (lumens) as standard incandescent bulbs, but use fewer watts. This means they use less energy and can result in less pollution. If you are unfamiliar with the best CFL wattage to use for your lighting needs, always refer to the lumen, or light output on the product packaging as your guide. Look for the ENERGY STAR® label on GE CFLs.

Additional resources for facts about lighting and electricity:

www.gelighting.com

www.geprojectplantabulb.com

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Lighting and Energy Conservation Reference Materials

Supplement 1

Did you know?

If every American home replaced just one standard incandescent light bulb with an ENERGY STAR® qualified bulb, we would:

- Save enough energy to light more than 3 million homes for a year
- Eliminate more than \$600 million in annual energy costs
- Prevent greenhouse gases equivalent to the emissions of more than 800,000 cars

By replacing your home's five most frequently used light bulbs with ENERGY STAR® qualified models, you can save as much as \$70 per year.

In the average U.S. home, lighting accounts for about 20% of the electric bill.



Source: http://www.energystar.gov/index.cfm?c=lighting.pr_lighting



Lighting and Energy Conservation Reference Materials

Supplement 2

FAQs about CFLs:

Will a CFL give the same amount of light as a standard incandescent?

Most CFLs will provide the same amount of light as the standard incandescent equivalent shown on the package. A GE Energy Smart® 13-watt CFL will provide the same light output as a 60-watt standard incandescent bulb.

Why do they last for such a long time? CFLs use fluorescent technology to operate. Fluorescent bulbs are much more efficient and last much longer than standard incandescent bulbs.

Why do they cost so much? The products are more complex, require a ballast and use advanced fluorescent technology. However, retail prices have been reduced substantially in the past few years.

Do they really save money? Yes. Considering replacement cost and the cost of electricity they are actually much less expensive than standard incandescent lighting. They last up to 10 times longer and use 1/3 to 1/4 of the electricity.

Why are they shaped that way? Manufacturers have developed numerous shapes to increase energy efficiency and reduce the overall size. There are different shapes for different applications.

Where can they be installed? In most cases, anywhere standard incandescent light bulbs are used.

Will they fit standard lamps, fan fixtures, and bathroom vanity fixtures? CFLs are much smaller today than just a few years ago and fit most applications.

Can they be used for outside lights? Yes. However, they should be used in a fixture that does not expose the light bulb to low temperature or directly to moisture.

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Lighting and Energy Conservation Reference Materials Supplement 2 (cont.)

Do they make candelabra type lights? Yes. There are CFLs with candelabra bases.

Does GE make 3-way bulbs? Yes.

How long will it take to get to “full light”? They will light within 1 second and will reach full brightness in about 30 seconds.

Can they be used in a refrigerator? No. This is not a recommended application due to cold temperature, short operating time and frequent starting.

Can they be used in a stove hood? Not recommended, due to heat and moisture from cooking.

Can they be used in recessed lighting? Yes. Some of the newer CFL Reflector bulbs are even dimmable.

What are these lights made of? They use fluorescent technology. They are essentially made out of the same material as a 4' fluorescent bulb plus some electronics in the base.

Can they be used in a motion sensor outside? The motion sensor needs to be compatible with fluorescent light bulbs.

Do they come in different shapes other than corkscrew? Yes. They are available in many different shapes and sizes.

Biax® (multi-tube) vs. Spiral® CFLs? Biax (multi-tube) last longer than corkscrew shapes.

How does a CFL bulb work? CFLs are more energy efficient than regular bulbs because of the different method they use to produce light. Standard bulbs create light by heating a filament inside the bulb; the heat makes the filament white-hot, producing the light that you see. A lot of the energy used to create the heat that lights an standard incandescent bulb is wasted. A CFL contains a gas that produces invisible ultraviolet light (UV) when the gas is excited by electricity. The UV light hits the white coating inside the fluorescent bulb and the coating changes it into light you can see. Because CFLs don't primarily use heat to create light, they are far more energy efficient than standard incandescent bulbs.



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Lighting and Energy Conservation Reference Materials Supplement 2 (cont.)

What's the difference between CFLs and fluorescent bulbs? The primary difference is in size. CFLs are made in special shapes to fit in standard household light sockets, like table lamps and ceiling fixtures. In addition, most CFLs have an "integral" ballast that is built into the light bulb, whereas most fluorescent tubes require a separate ballast independent of the bulb. Both types offer energy-efficient light.

What CFLs do I buy to replace a 60-, 75-, 100- or 150-watt standard bulb? How are the watts calculated? While an standard incandescent light bulb uses heat to produce light, a fluorescent bulb creates light using an entirely different method that is far more energy efficient — in fact, 3–6 times more efficient. This means a 15-watt CFL produces the same amount of light as a 60-watt standard incandescent bulb. Here are the watts needed by standard incandescent bulbs and CFLs to produce the same amount of light:

| | |
|-------------------------------------|------------------------|
| 60 watts incandescent = | 13–15 watts CFL |
| 75 watts incandescent = | 20 watts CFL |
| 100 watts incandescent = | 26–29 watts CFL |
| 150 watts incandescent = | 38–42 watts CFL |
| 250–300 watts incandescent = | 55 watts CFL |

Can CFLs be used with dimmer switches? There are bulbs specifically made to work with dimmers (check the package). GE makes a CFL that is specially designed for use with dimming switches. We don't recommend using regular CFLs with dimming switches, since this can shorten bulb life. (Using a regular CFL with a dimmer will also nullify the bulb's warranty.)

Why do CFLs flicker or appear dim when turned on? The first CFLs flickered when they were turned on because it took a few seconds for the ballast to produce enough electricity to excite the gas inside the bulb. Thanks to the refined technology in our new GE Energy Smart® bulbs, there is now no significant flicker (less than 1 second). However, these bulbs do require a short warm-up period before they reach full brightness, which is why they may appear dim when first turned on. CFLs are best used in fixtures that are left on for longer periods of time, rather than in fixtures that are turned off and on frequently.

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Lighting and Energy Conservation Reference Materials Supplement 2 (cont.)

Can a CFL be used in an enclosed light fixture? CFLs may generally be used in enclosed fixtures as long as the enclosed fixture is not recessed. Totally enclosed recessed fixtures create temperatures that are too high to allow the use of a CFL.

Can CFLs create interference with electronic equipment, such as radios? Many electronic devices, such as radios, televisions, wireless telephones, and remote controls, use infrared light to transmit signals. Infrequently, these types of electronic devices accidentally interpret the infrared light coming from a CFL as a signal, causing the electronic device to temporarily malfunction or stop working. Fortunately, this only happens when light is produced at the same wavelength as the electronic device signals, which is rare. To reduce the chance of interference, avoid placing CFLs near these kinds of electronic devices. If interference occurs, move the bulb away from the electronic device, or plug either the light fixture or the electronic device into a different outlet.

Can a CFL be used with an electronic timer or photocell (AKA electric eye)? Some electronic timers and photocells contain parts that are incompatible with CFLs. Using these bulbs in incompatible products will result in a shorter light bulb life. To find out if an electronic timer or photocell is compatible with CFLs, check with the manufacturer of the timer or photocell.

Do light bulbs (such as CFLs) give off hazardous amounts of ultraviolet (UV) light? Most light sources, including fluorescent bulbs, emit a small amount of UV, but the UV produced by fluorescent light bulbs is far less than the amount produced by natural daylight. (Ultraviolet light rays are the light wavelengths that can cause sunburn and skin damage.) Your safety is important to us. That's why for all of our light bulbs designed for general public use, we strive to minimize the amount of UV light emitted.

http://www.gelighting.com/na/home_lighting/ask_us/faq_compact.htm



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Lighting and Energy Conservation Reference Materials Supplement 2 (cont.)

How much heat (or infrared radiation) is emitted by standard incandescent bulbs and CFLs? Standard incandescent bulbs create light by heating a filament inside the bulb. The heat makes the filament white-hot, producing the light that you see. Because standard incandescent bulbs create light through heat, about 90% of the energy they emit is in the form of heat (also called infrared radiation). To reduce the heat emitted by standard incandescents, use a lower watt bulb (like 60 watts instead of 100). Fluorescent light bulbs use an entirely different method to create light. CFLs contain a gas that, when excited by electricity, hits a coating inside the bulb and emits light. (This makes them far more energy efficient than standard incandescent bulbs.) The fluorescent bulbs used in your home emit only around 30% of their energy in heat, making them far cooler.

What is the white powder inside my fluorescent bulb? The white powder inside a fluorescent bulb is called phosphor, which is a substance that emits white, visible light whenever it absorbs light waves. Both CFLs and fluorescent tubes contain a gas that gives off invisible light when excited by electricity. This invisible light travels to the phosphor coating on the bulb, where it is transformed into light visible to the human eye.

What should I do with a CFL when it burns out? The EPA recommends that consumers take advantage of available local recycling options for CFLs. The EPA is working with CFL manufacturers and major U.S. retailers to expand recycling and disposal options. Consumers can contact their local municipal solid waste agency directly, or go to www.epa.gov/bulbrecycling or www.earth911.org to identify local recycling options.

If your state permits you to put used or broken CFLs in the garbage, seal the bulb in two plastic bags and put it into the outside trash, or other protected outside location, for the next normal trash collection. CFLs should not be disposed of in an incinerator.

For more information on disposal, mercury and CFLs, visit http://www.energystar.gov/index.cfm?c=cfls.pr_cfls



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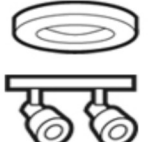












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Spiral® is a registered trademark of General Electric Company.
ENERGY STAR® and the ENERGY STAR® logo are registered U.S. marks.
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| Room | Fixture Type | Type of Bulb | Current Wattage of Bulbs | Number of Light Bulbs | CFL Equivalent Wattage | Wattage Savings | Number of Light Bulbs | Total Savings in Watts | Total Savings in kW | Standard Hours (life) of a CFL | Total Savings in kWh | Electric Rate (per kWh) | Total Energy Cost Savings |
|----------------------------------|-----------------------------------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 1) List the rooms in your house. | 2) Record the types of fixtures in the rooms. | 3) Record the types of light bulbs in each fixture. | 4) Record the wattage of each existing bulb by turning off the light and looking at the wattage listed on the glass. | 5) Record the number of light bulbs in each fixture type. | 6) List the CFL equivalent wattage from the chart below. | 7) Subtract the CFL wattage from the current wattage to calculate the difference or savings of watts. | 8) Use the same number recorded in step 5. | 9) Calculate the total savings in watts by multiplying the number of light bulbs by the wattage savings. | 10) Convert the total savings in watts to kilowatts by dividing by 1,000. | 11) Use 8,000 as the life of a CFL unless otherwise noted. | 12) Calculate the total savings from kilowatts (kW) to kilowatt hours (kWh) by multiplying the kW and 8,000 hours. | 13) Use .10 as the electric rate per kWh unless otherwise noted. | 14) Calculate the total energy savings in dollars over the life of the bulbs by multiplying .10 per kWh by total kWh savings. |
| Example: Kitchen | Pendant | Globe | 60 | 5 | 13 | 47 | 5 | 235 | 0.235 | 8,000 | 1880 | \$ 0.10 | \$ 188.00 |
| | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | |

*PLEASE ADVISE STUDENTS TO USE PARENTAL SUPERVISION WHEN HANDLING LIGHT BULBS.

Rooms: Include all rooms in the home, such as bedrooms, living room, dining room, bathrooms, hallways, den/family room, laundry room and basement.

| Fixture Types | Pendants | Track and Recessed | Table Lamp | Floor Lamp | Ceiling Fan | Chandelier | Vanity Strip | Enclosed Ceiling Fixture | Sconce | Fixture-Socket | |
|---------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--|
| |  |  |  |  |  |  |  |  |  |  | |
| Bulb Types | Reflector | Standard | Decorative | Globe | | | | | | | |
| |  |  |  |  | | | | | | | |

Note: There may be fixtures in the student's home that aren't compatible with CFL bulbs. See gelighting.com for more information.

| Watt Conversion Chart | | | | | |
|-----------------------|----------|---------|---------|---------|---------|
| Incandescent Bulb | 100 Watt | 75 Watt | 65 Watt | 60 Watt | 40 Watt |
| CFL Bulb | 26 Watt | 20 Watt | 15 Watt | 13 Watt | 10 Watt |

If there is no bulb in the fixture, look at the light socket on the fixture. It will tell you standard wattage for that fixture.

