Types of Lights

Grade 8

Topic: Energy
Grade: 8
Duration: 2 x 45 minutes

Students will examine the types of lighting used at school. They will create a spreadsheet of this information to determine how costs could be reduced at the school if energy efficient lights were used wherever possible. They will also look at current practices for timing devices at the school and board level for automatically turning lights on and off. They will examine: inside lighting, emergency lighting, exit lighting, outdoor lighting and floodlights.

Curriculum Expectations

- 8s62: Demonstrate an understanding of the properties of visible light and the properties of other types of electromagnetic radiation, including infrared and ultraviolet rays, X-rays, microwaves, and radio waves
- 8s64: Describe ways in which different sources of visible light and the properties of light, both natural and artificial, are used by humans for different purposes
- 8s67: Describe how incandescent, fluorescent, and phosphorescent sources produce light
- 8s77: Use appropriate vocabulary, including correct science and technology terminology, to communicate ideas, procedures, and results
- 8s78: Compile qualitative and quantitative data gathered through investigation in order to record and present results, using diagrams, flow charts, frequency tables, graphs, and stem-and-leaf plots by hand or with a computer
- 8s85: Evaluate the effectiveness of energy transfer systems
- 8e1: Communicate ideas and information for a variety of purposes (to evaluate information, to compare points of view) and to specific audiences, using forms appropriate for their purpose (e.g., a survey soliciting opinions on an environmental issue) and features appropriate to the form (e.g., focused questions)
- 8e3: Organize information and ideas creatively as well as logically, using paragraph structures appropriate for their purpose (e.g., paragraphs structured to develop a comparison or establish a cause-and-effect relationship)
- 8e6: Produce media texts using writing and materials from other media
- 8e62: Contribute collaboratively in group situations by asking questions and building on the ideas of others
- 8e63: Work with members of their group to establish clear purposes and procedures for solving problems and completing projects
- 8e67: Create media works of some technical complexity
- 8m16: Perform multi-step calculations involving whole numbers and decimals in real-life situations, using calculators
- 8m91: Systematically collect, organize, and analyse primary data
- 8m92: Use computer applications to examine and interpret data in a variety of ways
- 8m94: Evaluate data and draw conclusions from the analysis of data
- 8m100: Manipulate and present data using spreadsheets, and use the quantitative data to solve problems

Background Information

There are two basic ways to produce artificial light. One method is to heat something until it is so hot that it glows. The flame of a candle or oil lamp contains particles of carbon that are made white-hot by the combustion of the wax or oil. In a light bulb, the filament is heated so much that it glows. The second method is to pass an electric current through a gas or vapour so that the gas or vapour lights up. Both methods cause electrons to emit energy in the form of light rays.

A fluorescent light is a glass tube filled with a mixture of gases. There are two filaments at each end of the tube. When the light is turned on, there is a jolt of electricity that sparks through the length of the tube. The spark completes the circuit. The gases allow current to flow through the tube. Light is produced by the current flow, only it is "invisible light" – this is the same ultraviolet light that can cause sunburns. To produce 'Visible" light, the ultraviolet light causes a coating on the inside of the glass tube to glow. The conversion of one kind of light into another is called fluorescence.

Compact fluorescent bulbs are about 10 times the price of incandescent bulbs. They last up to 10 to 20 times as long. They also use about 25% of the energy. A 9-watt fluorescent can replace a 60-watt incandescent bulb; a 10-watt fluorescent gives the same light as a 75-watt incandescent. These compact fluorescents come in a variety of colours imitating warm incandescent light or daylight.

An electric light bulb is made up of a filament of tungsten wire wound in a tight coil. The passage of electricity through the filament heats the coil to a temperature of about 2500 degree Celsius. Tungsten is used because it has a very high melting point and does not melt as it heat up. The bulb contains an inert gas such as argon to prevent the metal combining with oxygen in the air that would cause the filament to burn out. The gas is under extreme pressure. In modern light bulbs, each coil of the filament is often made up of very tiny coils that increase its light output. Incandescent light uses most of its energy to create heat, not light, and therefore, they are less inefficient.

Newer energy-efficient light bubs are available and will save energy. For example, a tungsten halogen bulb can cut power consumption by 50% over conventional ones and will last up to 2 _ times longer. In these bulbs, the tungsten filament is contained within a small quartz capsule filled with halogen gas, similar to a car headlamp. This gas enables the tungsten, which evaporates from the filament, to be redeposited back onto the filament instead of onto the surface of the bulb (the black you see on regular light bulbs). Tungsten halogen bulbs last longer and have a greater strength.

Accountability

Students will appreciate how much energy can be saved by using more efficient forms of lighting.

Teacher Notes

1. Use this scenario approach:

   > Your school is involved in a project to retrofit its lighting system to create a more energy efficient environment. Your organization has been asked to create a feasibility study on the cost effectiveness of this plan. You will need to consider how much energy the lighting at the school is currently using and what it would cost to replace the current fixtures with newer, more efficient lighting systems. You will present your final report to the EC team.

2. Discuss the different types of lights that are in common use. Make a list of these types.
3. Find out where the lights are located in the school and make a chart of the types of lights. This should include: inside lighting, emergency lighting, exit lighting, outdoor lighting and floodlights.

4. As part of the EarthCARE program, your goal is to reduce energy consumption, so the class will want to determine how efficient the lighting is in the school. They will conduct simple experiments to determine how much electricity the different types of lights are using.
5. Explain that a watt is used to measure the amount of electricity consumed. A kilowatt is a thousand watts. A watt-hour measures one watt used over a period of one hour. A kilowatt-hour is a thousand watts used in one hour. Electrical energy is usually measured in kilowatt-hours.
6. You may want to work with an expert from the utility company, an electrician or the custodian. You will need an assortment of dimmer switches and timers that are used to control lights and an electric meter.
7. Demonstrate how dimmer switches work and ask students to think about where these are currently being used and where they could be used at school.
8. In the next experiment, students will use an electric meter to determine what kind of light bulb uses the least amount of energy.
9. Plug a lamp into an electric meter. Record how much electricity is used over one minute. Change light bulbs to see how different lights affect consumption. Include different wattage bulbs as well as "energy-efficient" bulbs. Have student calculate how many watt-hours of electricity were used during the experiments.
10. Now attach a dimmer switch to the lamp. Experiment with different degrees of light. Record how much electricity is used in one minute on the meter. Discuss how the dimmer switch is used to save electricity.
11. Have students create an experiment to determine how much electricity the different lights at the school use:
    - Calculate how much electricity is used by one incandescent light in one year
    - Multiply wattage of light bulb X hours used per day X 365 days
    - Divide this by 1000 to get the kWh
    - Multiply this by the current price per kWh of electricity (from electricity bill) to determine the average cost of running an ordinary incandescent light per year (or ask your custodian)
    - Do this for all the lights that are on for more than 3 hours per day to determine total energy for these lights
    - Calculate the same costs if fluorescent lights were used – divide the total cost by 4
    - Determine the cost savings by switching to more energy efficient lights
12. Talk to the custodians and find out if there are any devices in the school for automatically turning lights on and off at certain times of the day. Look at lights in the playground area – are they on all night? Are any lights left on all the time? Why would this be?
13. Make a list of ways that energy can be saved through the use of ordinary lighting.
14. Create your final report on the feasibility of changing to newer types of lights. Include some type of media in the presentation.

Home Extension

1. Conduct a similar experiment at home to determine the costs of lighting.
2. Look at the different devices at home that are currently used to save energy and see if there are other things that can be done.

Lesson Comments

Teachers, feel free to add in your own comments for this lesson.