FRESNO CHAFFEE

Learning with Fresno Chaffee Zoo

Sea Lion Cove: Conserving Energy

Objective

After this activity, students will be able to express why LED bulbs are more energy efficient than incandescent light bulbs.

Standards

MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Materials

Energy and Conservation Worksheet

Lesson

Using the chart on the worksheet, students can build equations to answer questions comparing the efficiency of LED and incandescent bulbs in a zoological setting.

For question #1, a LED bulb uses 12 watts to produce 1,200 lumens, giving a ratio of 100 lumens per watt. An incandescent bulb uses 75 watts to produce 1,200 lumens, giving a ratio of 16 lumens per watt.

In question #2, students should recall information from the Cart Lab and apply information from their calculation to form some idea about the comparative energy use of LED and incandescent bulbs.

For question #3, students should refer to the chart in in question #1 to determine a LED bulb uses 6 watts to produce 450 lumens, and an incandescent bulb uses 40 watts. They should then use the given percentages to find the number of watts that are not used for producing visible light (85% or 5.1 watts for LED, 95% or 38 watts for incandescent).

For question #4, students should include the cost of purchasing 5,000 new LED bulbs ($5.12*5,000=$25,600) as well as the cost of operating all 5,000 bulbs for one year ($6.00*5,000=$30,000). For the existing incandescent bulbs, they only need to calculate the cost of operating 5,000 bulbs for one year ($59.99*5,000=$299,950).

Extension Ideas

Ask students to rate the value of switching to LEDs from incandescent bulbs for lighting spaces at the zoo.

Ask the students to think of a case at the zoo where the energy "lost" as heat from a lightbulb would be an intended outcome (i.e. heating lamps for animals, especially reptiles and smaller ani-mals not able to adapt to the cold).

In what case would light from a lightbulb be an unintended or "negative" outcome at a zoo (i.e. Animal needs heat but is nocturnal so light is not desired).

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Lumens	LED Bulb	Incandescent Bulb
450	6 watts	40 watts
700	7 watts	60 watts
1200	12 watts	75 watts
1600	14 watts	100 watts
2700+	25 watts	150 watts

1. The energy used by lightbulbs is measured in watts. The amount of visible light a bulb produces is measured in lumens. Here are some comparisons in the number of watts is takes for LED and incandescent light bulbs to produce the same amount of light.

Calculate the lumens per watt difference between an incandescent and LED bulb which both produce 1200 lumens of light.

2. How might lumens per watt affect the energy efficiency of a lightbulb?

3. The energy consumed by a 100-watt incandescent bulb produces around 12% heat, 83% Infrared Radiation (invisible light& heat) and only 5% visible light. In contrast, a typical LED might pro-duce 15% visible light and 85% heat.

Calculate the number of watts lost as invisible light and heat for an LED bulb and an incandescent bulb that both produce 450 lumens of light.

4. If the zoo switched out 5,000 incandescent light bulbs for new LED bulbs, would they save money or lose money in one year? How much? Assume the light bulbs are on for twelve hours every day of the year. Don't forget to include the cost of purchasing new LED bulbs.

Light Bulb Type	Cost to Buy (1 bulb)	Cost to Operate for 1 year @ 12 hours/day
Incandescent	$1.38	$59.99
LED	$5.12	$6.00