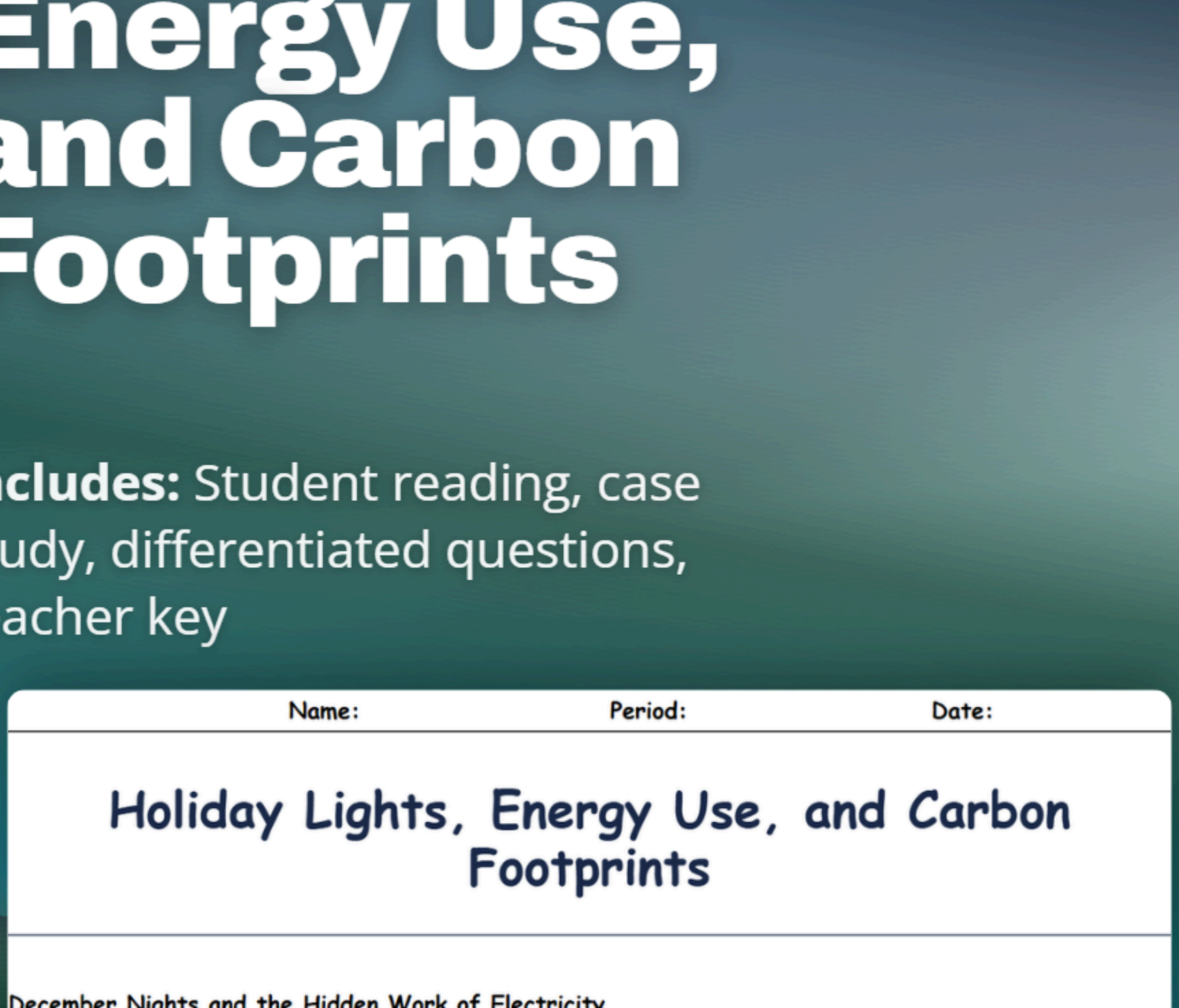
NO PREP

Holiday Lights, Energy Use, and Carbon Footprints

MORE LESSONS LESS PLANNING · MLLP · FREE TODAY · FREE TOMORROW · FREE FOREVER

Includes: Student reading, case study, differentiated questions, teacher key



Name: Period: Date:

Holiday Lights, Energy Use, and Carbon Footprints

December Nights and the Hidden Work of Electricity

Name: **Period:** **Date:**

Holiday Lights, Energy Use, and Carbon Footprints

December Nights and the Hidden Work of Electricity

When you walk through a neighborhood in December, it can feel like the whole world is glowing. Houses are outlined with holiday lights, trees sparkle in living room windows, and front yards blink in red and green. It looks magical. What you don't see is the quiet, constant work of the electric grid that keeps all those bulbs shining. Power plants, transmission lines, and transformers are all part of a system that must respond moment by moment to changes in electricity demand. In many regions, December evenings are a mini "energy rush hour." Families are home from work and school, heating systems are running, ovens are baking, and extra decorations are plugged in. One single string of lights doesn't use much energy, but millions of households adding decorations for several weeks can create a noticeable bump in regional electricity use. Utilities track this in kilowatts (kW) and kilowatt-hours (kWh), which measure how much power is being used and how much energy is used over time. From an environmental science perspective, the important question is not, "Should we cancel the fun?" but, "Where does this electricity come from?" In many places, it is still generated by burning fossil fuels such as coal and natural gas. When these fuels are burned, they release carbon dioxide (CO_2) and other greenhouse gases into the atmosphere, contributing to climate change. That means turning on more lights for longer hours slightly increases the carbon footprint of the holiday season. Understanding this connection helps us make choices that keep the sparkle while shrinking the impact.

Incandescent vs. LED: How Much Energy Do Holiday Lights Really Use?

Not all holiday lights are equally hungry for energy. Older incandescent bulbs work by heating a thin metal filament until it glows. This process wastes a lot of energy as heat, so only a small portion becomes visible light. Newer LED (light-emitting diode)

lights use semiconductors to produce light much more efficiently, with very little wasted heat. To your eyes, both kinds look festive. To the power plant, they are completely different stories. To compare them, it helps to think in watts and kilowatt-hours. Power (watts) tells you how fast energy is being used at a given moment. Energy (kilowatt-hours) tells you how much is used over time. If a 100-watt strand of lights runs for 6 hours, that is 600 watt-hours, or 0.6 kWh. If your electricity costs $0.15 per kWh, that's about nine cents. But multiply that by many strands, many hours, and many days, and the total grows quickly. Here is a simplified comparison for one month of decorations (about 30 days), assuming lights are on for 6 hours each evening: The exact numbers depend on the products you buy and how long you leave them on, but the pattern is clear: LEDs use far less energy than incandescent lights for the same amount of decoration. Switching from old strings to efficient LEDs can dramatically cut the electricity use—and therefore the carbon footprint—of your display without making your house look dark or boring.

From Kilowatt-Hours to Carbon Footprints

So how do we turn these kilowatt-hours into a carbon footprint? Power plants that burn fossil fuels release CO_2 for every unit of energy they produce. The exact amount varies by fuel type and technology, but a common classroom estimate is that one kilowatt-hour of electricity from a fossil-fuel-heavy grid might produce roughly half a kilogram of CO_2 (this is just a ballpark, not a universal rule). That means the 38 kWh used by those three incandescent strands could be linked to nearly 19 kilograms of CO_2, while the LED strands might be responsible for only about 2 kilograms over the same period. It's important to remember that not all electricity is the same. In regions with lots of renewable energy—such as wind, solar, or hydroelectric power—the CO_2 emissions per kWh are much lower. In areas that still rely heavily on coal, they are higher. This is why scientists and policymakers talk about "decarbonizing the grid": if the electricity becomes cleaner, then everything plugged into it, from phone chargers to holiday lights, automatically becomes cleaner too. For individual households, focusing on energy efficiency can make a surprisingly big difference. Swapping incandescent lights for LEDs, using timers so lights are not on all night, and turning off unneeded indoor lighting can all reduce demand without ruining the mood. These actions might feel small, but they add up across millions of homes. Just as importantly, they help students see that climate science is not just

an abstract topic—it shows up in the little choices you make about how you light up a dark winter evening.

Key Information

Setup	Approx. Power Draw	Monthly Energy Use (kWh)	Notes
3 strands incandescent mini-lights	~210 W total	~38 kWh	Warm glow, uses the most energy
3 strands LED mini-lights	~21 W total	~3.8 kWh	Similar brightness, far less energy
No outdoor lights, only small window set	~5 W total	~0.9 kWh	Much smaller display, very low use

Case Study – Maya's "Operation Cozy Glow"

When Maya's parents pulled three boxes of old incandescent holiday lights out of the garage, she saw more than decorations—she saw a science project. In environmental science class, she had just learned about energy efficiency and carbon footprints. She asked if they could try an experiment: compare the family's old lights to a box of LED strings on sale at the hardware store. With a watt meter borrowed from school, Maya measured one incandescent strand at about 70 watts and one LED strand at about 7 watts. The glow on the house looked almost the same; the numbers on the meter did not. At the kitchen table, Maya helped her parents estimate that running three incandescent strands for 6 hours a night for 30 days would use around 38 kWh, while three LED strands would use less than 4 kWh. When her dad saw the difference in both energy and cost on the next electric bill, he joked that the LEDs were paying for part of the pizza. Maya's mom pointed out something else: if the whole street switched, the neighborhood's seasonal carbon emissions would drop, and no one would have to give up the cozy glow they loved.

1. What evidence did Maya collect to convince her family that LED lights were more efficient than their old incandescent strands?

_____

_____

2. How did Maya connect a small household decision (which lights to buy) to a larger environmental impact in the neighborhood?

_____

_____

Multiple Choice

1. According to the reading, the main environmental concern about holiday lights is that they:

    a) Increase electricity use, which can raise CO_2 emissions when power comes from fossil fuels

    b) Work only with renewable energy sources

    c) Cannot be measured in kilowatt-hours like other devices and have no measurable energy use

    d) Always cause power outages in every neighborhood

2. One major advantage of LED holiday lights compared to incandescent lights is that they:

    a) Always cost more to operate, even if they are efficient

    b) Use much less energy for a similar amount of light

    c) Work only for one year and must be replaced

    d) Cannot be used outdoors in cold weather

3. A carbon footprint is best described as:

a) The pattern of footprints left in fresh snow

b) A measure of how bright holiday decorations look from orbiting weather satellites

c) The number of light bulbs in a house

d) The total amount of greenhouse gases released by an activity, person, or product

Matching

Write the letter of the correct definition on the line next to each term.

Term	Definition
1. ___ Kilowatt-hour (kWh)	A) System of power plants and lines that delivers electricity
2. ___ LED (light-emitting diode)	B) Total greenhouse gases linked to an activity or product
3. ___ Power grid	C) Fuel like coal or natural gas formed from ancient organic matter
4. ___ Fossil fuel	D) Type of light that produces the same brightness with far less energy
5. ___ Carbon footprint	E) Unit that measures energy use over time

Fill-in-the-Blank

1. Old-style holiday lights that heat a filament to produce light are called _____ bulbs.

2. A small difference in watts becomes a much larger difference in total energy use when lights are left on for many hours, measured in kilowatt-_____.

3. When electricity is generated by burning coal or natural gas, carbon _____ is released into the atmosphere and contributes to climate change.

Short Answer

Answer each question in 2-4 complete sentences.

1. Using the table in the reading, explain how switching from three incandescent strands to three LED strands changes both energy use and carbon footprint over a month.

2. Describe two practical steps a family could take to enjoy holiday lights while reducing their environmental impact, based on the reading.

3. Some people say individual actions "don't matter" for climate change. Using Maya's case study or the neighborhood example, explain how small choices about holiday lighting can still be meaningful.