Light Pollution and Energy

Energy Waste
- All the light you see in the images is wasted. About 30% of all outdoor light is being wasted by shining upward.
- Energy is a precious resource. Most electricity is produced by burning fossil fuels, which are non-renewable and are quickly being depleted.
- How can we keep the light from going up, and instead, keep it down where we need it?

Carbon Footprint
- A carbon footprint is the amount of greenhouse gases emitted due to burning fossil fuels. Greenhouse gases (like carbon dioxide) contribute to climate change by trapping heat that would otherwise escape into space.
- Most electricity in the United States is produced by burning fossil fuels (39% by coal, 27% by natural gas, and 1% by petroleum). Fossil fuels are the fossilized remains of plants that lived hundreds of millions of years ago.
- For each kilowatt-hour of energy produced, 0.84 kg (1.85 lbs) of greenhouse gases are released into the atmosphere.
- An estimated 875 million trees would have to be planted every year to offset all the carbon dioxide released.

Cost
- Lighting accounts for 11% of the total energy usage in the United States by all sectors (residential, commercial, industrial, and transportation).
- In 2012, each person in the United States spent over $3000 on energy usage.
- The United States accounts for 18% of the world’s energy consumption.
- An estimated $3.3 billion is spent on wasted energy in the United States.
- How can individuals and families reduce their energy costs? How can cities and countries reduce costs?

Efficient Bulbs
- One way to reduce energy waste, cost, and carbon footprint is to use energy efficient light bulbs.
- Efficiency is an output over an input, or how much light you get out for the amount of energy you put in.
- See the “Types of Lights” handout for more information.

Now Try This!
- Examine the International Space Station (ISS) aerial photograph of Houston, Texas, United States found in your group’s folder. Notice the grid of squares superimposed on the city; there are 1,344 squares total. Each square of the grid is 3 km (1.8 miles) on a side.
- There are three different colors of lights on the map: white, yellow, and brown. The white lights are usually in lines following the roads, the yellow lights are blobs of densely packed lights, and the brown lights are spread all over.
- Count the number of squares of each color, marking the squares with a different colored marker or pencil. You’ll probably want to make a key. When counting squares, count any square that is more than half lit. If there is more than one type of light in one square, pick whichever light takes up more of the square. Do not double count squares!
- The white lights are 250 Watt (W) Metal Halide lights, the yellow are 150 W High Pressure Sodium lights, and the brown are 250 W High Pressure Sodium lights.
- Refer to the “Energy Calculation Mat – First Side” to see how to calculate energy, cost & carbon footprint from these lights for one night. Discuss your results with your group.
- Using the “Types of Lights” handout, reduce the energy, cost, and carbon footprint by changing the types of lights, number of lights, length of time the lights are on, etc. Then calculate the energy, cost and carbon footprint for the improved situation using the “Energy Calculation Mat – Second Side”. What do you get when you difference the resulting energy, cost and carbon footprint from both sides?
- Based on your results, make general recommendations about the changes that went into recalculating the second side. Consider whether there are some places or cases in the city where the general recommendations may not work. What would work better in those cases?
- Create a powerpoint, a video, or a poster in which the case study and your resulting recommendations are presented to the Mayor.

Shielding
- Another way to help reduce energy cost is to cover the light bulb, so that the light does not go up (where it is wasted). Concentrating all light downward (where needed) allows for the bulb’s wattage to be reduced.
- Shielded lights should be task-oriented, designed for people to see the effect (lit footprint on the ground) but not the bulb.

Key Ideas
- Energy efficient light bulbs
- Carbon footprint
- Energy for lighting
- Energy waste

The pictures above show the urban area of Houston, Texas, USA (left) and the province of Santiago, Chile at night from space. The populations of urban Houston and the province of Santiago each have roughly 4.9 million people, but the area of the province of Santiago is twice as large as urban Houston. The brightnesses are on the same scale. How do these brightnesses compare?