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Lesson Plan - How Do Humans Impact the Production of Greenhouse Gases?

Center for Urban Resilience

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LESSON 5: HOW DO HUMANS IMPACT THE PRODUCTION OF GREENHOUSE GASES?

OVERVIEW:

The purpose of this lesson is for students to consider where they currently obtain their energy from and their subsequent impact on the carbon cycle. The goal is to help students understand that humans extract energy from a variety of sources including carbon based resources (e.g. wood, coal and petroleum). Many of the activities and decisions that humans make everyday impact the amount of greenhouses gases (particularly carbon dioxide) that they produce. The lesson begins by having students compare the energy usage and subsequent carbon dioxide production from an incandescent light bulb and a compact fluorescent light (CFL) bulb. Then students use a carbon emissions calculator to estimate how much carbon dioxide they contribute to the atmosphere and how they can make decisions to decrease their carbon emissions.

SUB-QUESTION:

How do humans impact the production of greenhouse gases?

WAYS OF KNOWING URBAN ECOLOGY:

	Students will…
Understand	• Recognize the impact of human activities on the carbon cycle (*forces and drivers* and *human impact*). • Understand that as more carbon is released into the carbon cycle, the amount of greenhouse gasses in the atmosphere increases (*ecosystem change* and *ecosystem state and structure*).
Talk	*No specific goals connected with talking urban ecology in this lesson.*
Do	• Calculate the difference in carbon dioxide production between an incandescent light bulb and a compact fluorescent light (CFL) bulb. • Model their own carbon emissions based on daily activities.
Act	• Examine how daily decisions can alter their personal carbon dioxide production.

SAFETY GUIDELINES

- No specific safety issues are associated with this lesson.

PREPARATION:

Time:

1 class period

Materials:

Activity 5.1

1- 100 watt incandescent light bulb
1- 20-25 watt CFL bulb
2- thermometers

2- lamps into which the bulbs can be placed
For each student – copy of student handout
Calculators

Activity 5.2

Computers for students with either online access or the excel sheet (Alternative Teacher Demonstration – one computer and projector OR transparencies of screen shots for a couple of different scenarios.)

INSTRUCTIONAL SEQUENCE

Introducing the Lesson

- Either as a "Do Now" for students to complete individually or as a discussion among the entire class, show the diagram from the previous lesson about how humans impact the carbon cycle.
- Ask students to list activities that they have already completed that morning/day that they think contributed greenhouse gases to the atmosphere. Have students explain how they think each activity contributed to the increase or decrease in greenhouse gases in the atmosphere.
    - If done as a "Do Now," provide an opportunity for yours students to share their responses in a discussion with the entire class.
    - List students' ideas on the board or an overhead. You could make a t-chart with the activities on the left hand side and how they contribute greenhouse gases on the right hand side.
    - *The purpose here is just to have students brainstorm a variety of ideas. Any activity that they completed this morning that required electricity (e.g. turning on lights, alarm clock, radio, toaster oven), gasoline (e.g. car) or other energy source (e.g. heating of house – energy source could be electric, gas, oil).*

Activity 5.1 Comparing Incandescent and CFL Light bulbs

1. Light bulb demonstration

- Tell your students that they will now be examining the differences between two different types of typical light bulbs, *incandescent* and *compact fluorescent light* (CFL).
- Place two lamps in front of the classroom, one with an incandescent light bulb (100 watts) and the other with a compact fluorescent light (CFL) bulb (25 watts), but do not tell the students the wattage. Since CFL light bulbs can take a couple of minutes to build to their full brightness, you may want to turn these on a few minutes before class starts.
- Place a thermometer about 5 cm away from each bulb. Ask students what they think will happen to the temperature of both thermometers and why they think this.

- *Students may say that the temperature will increase. Since the light bulbs have similar brightness, they may not expect there to be a difference in temperature.*

- Tell the students the temperatures associated with each light bulb. (The incandescent will be a higher temperature). Ask students which light bulb (Incandescent or CFL) they think uses more energy.
    - *The incandescent is using more energy, because not only is it producing light, but it also producing a lot of heat.*

Teacher Background Knowledge

An incandescent bulb works by passing an electrical current through the bulb's filament. This current heats the filament. Once a threshold temperature is reached, the filament emits light.

In a compact fluorescent light (CFL) bulb, an electrical current is driven through a chamber of argon and mercury vapor. When these gaseous particles are excited by electricity, invisible ultraviolet light is produced which in turn excites a fluorescent coating of phosphor on the inside of the chamber. This phosphor coating is what produces the light we see by.

CFLs are much more efficient than incandescent bulbs as more light energy and less heat energy is produced by CFLs. They are not, however, without their drawbacks (see, for example, the sections beginning with http://www.wikimedia.org/wikipedia/en/wiki/Compact_fluorescent_lamp#Health_issues). However, with proper precautions and disposal procedures, the widespread use of CFLs can greatly reduce the amount carbon in the carbon cycle.

Incandescent Bulb

http://www.flickr.com/photos/jamesrbowe/3338776771/

CFL Bulb

http://www.flickr.com/photos/loomitz/3548031837/

2. Students Complete Activity Sheet

- Distribute the student activity sheet for this lesson and discuss the comparison of incandescent light bulbs to compact fluorescent light (CFL) bulbs.
- Have students work individually or in pairs to calculate the carbon dioxide emissions associated with each bulb.

3. Discuss Results from Activity 5.1

- Have students share their results from calculating the different carbon dioxide emissions for the two types of light bulbs.
- Remind students that the emission of that carbon dioxide actually occurs at the power plant that produces the electricity we are using in the school and in our homes. The electricity just travels to their homes through electrical wires. Ask students to think about the following – What if there was an exhaust pipe from their home that the emission came out of? Or what if carbon dioxide emissions were like trash that you had to take out to the curb for a garbage truck or to a dumpster every week. How many pounds of carbon dioxide do they think their home produces every week? What would that look like if carbon dioxide were in pounds of garbage in garbage bags? How many pounds do they think are in a typical garbage bag that their family throws away (This varies depending on the garbage in the bag, but probably between 10-25 pounds). How many bags of carbon dioxide would they have in a week?
- Ask students if people could observe the amount of carbon dioxide they were producing each week and had to dispose of it like we do garbage, do you think this would impact their actions? Why or why not?

Activity 5.2: Carbon Footprint

1. Students Calculate their Personal Emissions

- Tell students that they are now going to use an online personal emissions calculator to estimate how many pounds of carbon dioxide they add to the atmosphere each year.
- Have each student or group of students work at a computer and go to the Cool Climate Network website (http://coolclimate.berkeley.edu/) and determine their personal emissions. Have them record their results on the student activity sheet.

Teaching Alternative

- If you have computers students can use, but no internet access there is an excel sheet students can use from the EPA to estimate their personal emissions from http://www.epa.gov/climatechange/emissions/ind_calculator.html.
- If you do not have access to computers for students to calculate their own emissions, you can complete this activity as a demonstration. If you have one computer connected to a projector, you can project the web site or the spreadsheet and complete it as a whole class. If you do not have access to a computer, you can print out a couple of screen shots with different alternatives (E.g. changing the amount of energy an individual uses). You can either use these as overheads and discuss them with the class or hand out paper copies and have students analyze the different scenarios. The Cool Climate Network provides opportunities to create different scenarios based on location and activity.

2. Discuss Student Results

- Have students share how many pounds of carbon dioxide they produce each year before considering the reductions. You may want to ask for a couple of volunteers or survey the whole class through a show of hands (e.g. below 30,000

lbs, between 30,000 – 35,000, etc.). Discuss any differences that arose in the estimates and have students suggest possible reasons why those differences exist.
- Discuss the conclusion questions at the end of the activity sheet.

Teacher Background Knowledge

In this case, the carbon dioxide released by human activity is a form of *human impact* on the environment. The impact of increased carbon dioxide in the atmosphere is a *driver* in *ecosystem change*. From an *ecosystems services* perspective, these changes brought on by increased carbon dioxide negatively impacts *ecosystem state and structure* by the increase of greenhouse gases in the atmosphere and the subsequent changes to the global climate. Rapid climate change caused by unchecked human activity (such as leaving lights on when they are not being used, using inefficient light bulbs) in the end, has a negative effect on human sustainability as a species.

Concluding the Lesson

1. As an end of the class reflection, have students consider the following question:
   - The average American generates about 20,000 pounds of carbon dioxide a year while the average individual in England produces 9,500 pounds/year, in Japan produces 9,4000 pounds/year and in France 6,800 pounds/year.
   - Ask your students why they think Americans on average produce more carbon dioxide per year than individuals living in other countries?

Teacher Background Knowledge

While lower efficiency is an issue (using incandescent rather than CFL bulbs, for example) for Americans, excess consumption of energy is the biggest contributor to Americans' carbon footprints across the board. This is especially true in terms of products and food that have a high carbon cost in terms of manufacturing and shipping. Even a homeless man who sleeps in shelters and eats in food kitchens typically has a carbon footprint of 8.5 tons. See "Carbon Footprint of Best Conserving Americans Is Still Double Global Average" (http://www.sciencedaily.com/releases/2008/04/080428120658.htm) for further information.

- Tell your students that in the next lesson they will be looking at the impact of the production and transportation of food on the carbon cycle.