TOWNGREEN2025
Middle School Climate-Change Curriculum

Lesson 11

Carbon Cycles through Ecosystems

Unit Title: **Carbon Cycles through Ecosystems**	
Theme: **Ecosystems & Cycles**	Grade Level: **7**
# of sessions for the unit: **2**	Session #11: **Why does it matter which types of light bulbs we use?**
Date created: **Summer 2017**	Author: **B. Allia, C. McWilliams**

CC Climate Change Curriculum

Unit Description

Focusing on systems and cycles, students use their understanding of climate-change and how carbon and thermal energy interact with Earth's land and atmosphere. Students practice skills such as argumentation and collecting and analyzing data. Students gain experience with the interactions of humans and Earth processes with ecosystem dynamics, and with developing solutions to complex climate-change issues. The lessons generally follow this order:

- Introduce unit and culminating event: climate-change's effect upon fauna
- analyze global temperature and carbon dioxide trends
- understand personal climate-change experiences, such as weather, matter and energy uses
- collect wetland and upland forest soil carbon-stores
- sample atmospheric carbon-store
- analyze land and atmospheric carbon-stores
- understand the carbon cycle, pre-human and human era
- describe personal experiences with solid forms of carbon changing into atmospheric carbon
- develop and present solutions to save a fauna from climate-change issues

Standard(s)

Based upon the 2016 MA Science & Technology/Engineering Curriculum Framework

MA LS2 Ecosystems: Interactions, Energy, and Dynamics

MA 7.MS-LS2-3 Develop a model to demonstrate how matter and energy are transferred among living and nonliving parts of an ecosystem and that both matter and energy are conserved through these processes

Unit Goals

1. Create an action plan to decrease carbon in the atmosphere, increase carbon stored by the land, and preserve natural carbon-stores in the ground
2. Build background knowledge of how carbon cycles within a local ecosystem
3. Understand relevant climate-change issues in order to make informed decisions
4. Identify authentic scientific processes, such as sampling, gathering, and analyzing land and atmospheric carbon-content data, in order to validate evidence regarding climate-change

Unit Objectives

Students will be able to

understand that:

1. Carbon cycles through the atmosphere and land
2. Human activities increases atmospheric carbon by burning fossil fuel
3. Atmospheric carbon is a "greenhouse gas"
4. Greenhouse gases increase global temperatures
5. Wetlands and uplands store different amounts of carbon above and below ground

and to:

1. Sample, collect, and analyze primary-source data
2. Collect and analyze secondary data as a means to validate causes of climate-change

Lesson Objectives

Students will understand how human-interaction increases atmospheric carbon when they turn on a lightbulb

Note any potential barriers to the lesson — consider variability

Student challenges

- challenges reading the thermometers
- anxiety about preparing and presenting finding of lab report
- Vocabulary, reading, written expression

Teacher challenges

- supplies needed for lab
- enough stations to spread students out

Evaluation/Assessment

(directly linked to the goals, i.e., Formative/Ongoing Assessment or Summative/End of Lesson Assessment)

Light Bulb lab report *(see lab report below)*

Vocabulary

- incandescent
- CFL
- fluorescent
- LED

NOTE: Consider the UDL Guidelines in selecting methods and materials to ensure that you provide options for engagement, representation, and action and expression.

Methods

(e.g., Anticipatory Set, Introduce and Model New Knowledge, Provide Guided Practice, Provide Independent Practice)

Day 1: Hook: Light bulbs — does it matter which type?

1. Prep work
   - **A.** Before class begins, have 3 or more stations set up for the lab; you will have to divide up the students into the number of set-ups you have, so plan accordingly.
   - **B.** Materials
     - 2 lamps with bendable lights (set up with a power strip or near an outlet so both can be plugged in)
     - 2 shoe boxes (similar in size, with white paper in the bottom)
     - 2 thermometers (can be digital or regular thermometers, and you will need time in-between classes/labs to have the thermometer's temperature return to room temperature)
     - 2 different types of light bulbs; bulbs should be equal in light output in lumens, one should always be an incandescent (in the lamp on the left of the work station) and the other one can be a CFL or an LED (in the right lamp in the work station)
     - a timer and a copy of the lab report for each student
     - The lamps should be bent so the bulb is even with the edge of the shoe box, in the middle of it, directly over the thermometer.
   - **C.** A copy of a sample lab report is below.
   - **D.** Begin the class by showing the 3 different types of light bulbs that will be used in this lab.
     - Do not give too much information about how each bulb works until reviewing the lab report students have completed.
   - **E.** As you begin class, ask students to identify the bulbs.
     - First show the students the incandescent bulb, the standard bulb used since the end of the 1800s — most will not know its type but may have some in their houses.
     - Secondly, show them the CFL (compact florescent light bulb) — some may know it is an energy-saving bulb and may have some in their houses.
   - **F.** First show the students the incandescent bulb, the standard bulb used since the end of the 1800s.
     - most will not know its type but may have some in their houses.
     - Secondly, show them the CFL (compact florescent light bulb).
     - some may know it is an energy saving bulb and may have some in their houses.
     - Lastly, show them the LED (light emitting diode).
     - some may know it is energy saving or may know it is like the little lights on many electronic devices to show if it is on or not.
   - **G.** To begin, briefly describe the lab to the students.
     - Explain that you will split them up into groups and each group will go to one work station as assigned.
     - Inform them that the lights are off and should remain off until you tell them to turn them on.

- Explain there is a thermometer in each shoe box and the first thing they need to do when they get to their work station is to take a reading of the temperature in each box and record it in the table on the back of their lab report.
- Remind them they are not to touch the thermometers, as that can alter the temperature.
- Then inform them that when everyone has the starting temperature recorded, the teacher will have a timer ready and tell the students to turn on both lamps.
- Then, they will take temperature readings every 2 minutes for 10 minutes, after which they will turn the lamps off.
- Students should also be observing the light — how bright, similar colors, etc.

H. Hand out a lab report to each student.

- Students write their names and other information needed on the lab report.
- Students think about what they will be doing; have them write their claim as to what they think will happen (previously known as the hypothesis).
- Teacher assigns students to go to their work station and get the initial temperature (they should share the temperature readings).
- Once all the students have the initial temperature recorded, have the timer ready and tell students to turn on the lamps while starting the timer.
- Every 2 minutes tell students to record the different temperatures.
- After 10 minutes, have students turn off the lamps after they record the final temperature reading.
- Students can go back to their seats now.
- Ask what the independent variable was (turning on the light bulbs) and the dependent variable (the shoe box heats up).
- Then students can begin working on the lab report as time allows.

2. Day 1 Homework

A. Students answer lab questions, to prepare for next class.

Day 2: Review the conclusion reports written by students at the end of the lab report

1. Hopefully students saw that the incandescent bulb got a lot hotter than the CFL or the LED and should be the choice to use at home.

A. Ask students why they think the bulbs all had different temperatures.

B. Now, use a Kill-A-Watt meter, with one lamp plugged into it, and switch through all 3 light bulbs to see how much energy each one uses.

- The incandescent bulb will use the most by far, which is why it got so hot.
- The energy used was going toward heating the filament and not just to making the bulbs bright.
- The CFL and the LED light bulbs use a lot less.

C. Then explain how each type of bulb works. (see materials below for this info)

D. So why should students care how much energy they use?

- They do not see the pollution from a power plant (unless you have one near your school). This is a good time to inquire with students how much they know about where their electricity comes from.
- Solicit their ideas, then give an update based on your area.
- Explain how power is generated at a power station, which could use coal, natural gas, or oil (or other fuel) to generate the electricity. If you have a plant near you, reference that.
- Then explain that the electricity then needs to be distributed across the state, cities, and towns to their houses. The students may have seen power lines on their street, or larger numbers of power lines they

may see while driving on a highway. But most methods of generating electricity produces carbon dioxide, so conserving energy helps reduce how much carbon dioxide there is in the air. It also means lower electric bills at their homes.

- For more detailed information, go to *https://www.eia.gov/energyexplained/index.cfm?page=electricity_delivery*.

2. Homework options

A. Students use this website to take notes on note-taking graphic organizer: *https://energy.gov/articles/history-light-bulb*

OR

B. Students watch this video and take notes on video note-taking graphic organizer

Materials

For the lab:

2 lamps with bendable necks per work station (recommend at least 3 work stations) and plugs/power strips to plug into; 2 shoeboxes and white paper to line the bottom of the boxes;
2 light bulbs per work station — 1 incandescent and one either CFL or LED,
2 thermometers — digital or regular; timer or watch with a seconds hand.

You need a **Kill-A-Watt meter** to measure how many watts of energy the device that is plugged into it uses. These are available at Home Depot or on *Amazon* for $20.

Light bulb info:

From *http://www.bulbs.com/learning/incandescent.aspx*

How do incandescent bulbs work?

An incandescent bulb typically consists of a glass enclosure containing a tungsten filament. An electric current passes through the filament, heating it to a temperature that produces light.

Incandescent light bulbs usually contain a stem or glass mount attached to the bulb's base which allows the electrical contacts to run through the envelope without gas/air leaks. Small wires embedded in the stem support the filament and/or its lead wires.

The glass enclosure contains either a vacuum or an inert gas to preserve the filament and protect it from evaporating.

How Do CFLs Work?

CFLs produce light differently than incandescent bulbs. In an incandescent, electric current runs through a wire *filament* and heats the filament until it starts to glow. In a CFL, an electric current is driven through a tube containing *argon* and a small amount of *mercury* vapor. This generates invisible *ultraviolet* light that excites a fluorescent coating (called phosphor) on the inside of the tube, which then emits visible light.

CFLs need a little more energy when they are first turned on, but once the electricity starts moving, CFLs use about 70% less energy

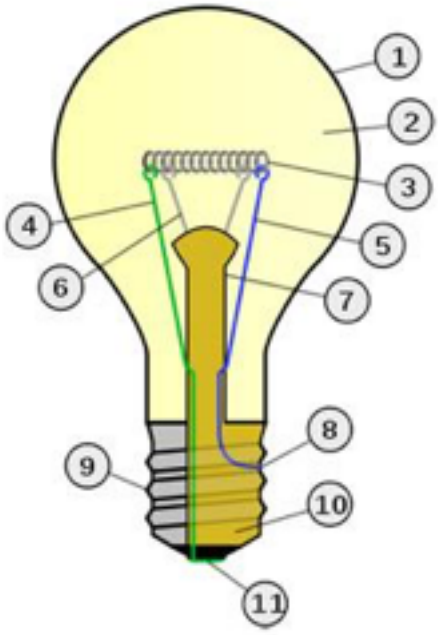

Diagram showing the major parts of a modern incandescent light bulb.

1. Glass bulb
2. Inert gas
3. Tungsten filament
4. Contact wire (goes to foot)
5. Contact wire (goes to base)
6. Support wires
7. Glass mount/support
8. Base contact wire
9. Screw threads
10. Insulation
11. Electrical foot contact

from: https://www.energystar.gov/products/lighting_fans/light_bulbs/learn_about_cfls

than incandescent bulbs. A CFL's *ballast* helps "kick start" the CFL and then regulates the current once the electricity starts flowing.

This entire process typically takes 30 seconds to 3 minutes to complete, which is why CFLs take longer than other lights to become fully lit. CFLs with decorative covers like globe or reflector shapes have a unique design challenge that results in the tradeoff of a slower warm-up time, which is why these CFLs take longer than bare spirals to reach full brightness.

From: *http://www.toptenreviews.com/home/articles/how-do-LED-light-bulbs-work/*

How do LEDs work?

Light-emitting diodes (LED) are semiconductors. As electrons pass through this type of semiconductor, it turns into light. Compared to incandescent and CFL bulbs, LED lights are more efficient at turning energy into light. Therefore, less of the energy radiates from the bulb as heat. This is why LED bulbs are cooler during operation than incandescent and CFL bulbs.

As the light-emitting diodes create light, they warm up quite a bit for their size. LEDs are heat sensitive, so it's important that the heat move away so that it doesn't damage the semiconductors. In order to do this, these lights need a system to keep cool. Most LED lights have a heat-sink plate that moves the heat away from the light-emitting diodes. Manufacturers make the heat-sink plate out of a variety of materials, but it's commonly made from aluminum. Frequently, the heat sink becomes part of the design of the bulb.

Name: Block: Date:

Lab Report

Carbon Cycles through Ecosystems

Title: Why are different amounts of energy used?

Problem: Where does the energy go when using an incandescent light bulb, a compact fluorescent light bulb, and an LED lightbulb?

Claim: What do you think will happen? State it in a sentence.

Independent Variables: What do you change as you do the experiment?

Dependent Variables: What changes as a result of the independent variable?

Controls: What does not change?

Materials: What will you use for the lab? List materials

Procedure: Check and document the temperature in both shoeboxes.

Set up the lamp with the incandescent bulb and the one with the compact fluorescent lamp so the bulbs are 10 cm above the respective shoebox. Document the temperature before you begin. Turn the lamps on at the same time. Check and document the temperature in each box every 2 minutes for 10 minutes. At the end of 10 minutes, turn off the lamps.

Quantitative Data/Results: Graph each bulb's changes over time

Timing in minutes	Incandescent bulb Temperature	CFL bulb Temperature
Before = 0 minutes		
2 minutes		
4 minutes		
6 minutes		
8 minutes		
10 minutes		

Quantitative Analysis: Make a bar graph of the 2 sets of temperature readings, labeling each type of bulb

Qualitative Data/Result: Describe what happens — include colors, textures, smells, (tastes), appearance — data that can be observed but not measured.)

Conclusion

1. Start with an introductory sentence briefly explaining how you did this lab experiment.
2. Use your bar graph to answer questions.
3. Then answer this question: Why should someone switch the type of light bulb they use in their house?
4. Include evidence about each type of bulb and reasons why the bulb you chose is better for a household.
5. Use the questions (on page 7 of 8) when writing this conclusion.
6. Use these questions when writing your conclusion.
7. Did your results support your claim? Explain.
8. Explain why the temperature readings were different or the same for each type of bulb during the experiment.
9. Where does the energy go when using an incandescent light bulb?
10. Where does the energy go when using a compact fluorescent light bulb?
11. What scientific concepts did you learn from the experiment?
12. How does this experiment apply to the real world?
13. What further experimentation could you do?
14. Write any other thoughts about what you think happened and why.

Notes and Comments

For this lesson, check out *http://energyblog.nationalgeographic.com/2013/12/31/u-s-phase-out-of-incandescent-light-bulbs-continues-in-2014-with-40-60-watt-varieties/* for background information on the phase-out of incandescent bulbs.