

Lesson: Lots of Watts!

Environmental Literacy Question: How have humans affected the Chesapeake Bay and its watershed?



Topic/Essential Question: How is the earth's climate changing?

Unit/Lesson Sequence: This is one of two lessons in the 'Concerning Climate' module based at Arlington Echo.

Content Standards:

Environmental Literacy Quarter 3

- 3.B.1.d. Explain and diagram how greenhouse gasses increase thermal energy in the atmosphere and its effect on earth's temperature and systems.
- 6.A.1. Identify and describe natural changes in the environment that may affect the health of human populations and individuals.

Science

- 3.4.F.1.a. Identify and describe the interactions of organisms present in a habitat.
- 6.4.B.1. Recognize and describe that people in Maryland depend on, change, and are affected by the environment.

Common Core Standards for English Language Arts Standards- Speaking and Listening-4th Grade

Comprehension and Collaboration

- CCSS.ELA-Literacy.SL.4.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 4 topics and texts*, building on others' ideas and expressing their own clearly.

Length of lesson: 35 minutes

Student Outcomes:

- Use background knowledge of climate change and the carbon cycle to estimate their carbon footprint.
- Investigate how humans can reduce their greenhouse emissions and carbon footprint.
- Determine the amount of energy their household electronics use.
- Record examples of human reduction for carbon footprints in their journals.

Knowledge of the Learner:

- Prerequisite knowledge, skills and processes: weather effects and greenhouse gasses; beginning knowledge of the carbon cycle.
- Student needs, interests, previous learning: These will be identified in the pre-assessment.

- Conceptual difficulties: Understanding that the everyday things we do impact our carbon footprint and climate change.
- Differentiation: Students are at the fourth grade level with a diversity of backgrounds and skill levels.

Knowledge of Content:

- Content knowledge for instructor: Provided in the text of the lesson.

- Vocabulary:

Carbon Dioxide	Oxygen	Watt
Carbon Footprint	Photosynthesis	Kilowatt
Carbon Cycle	Atmosphere	Fossil Fuels
Renewable Resources	Energy	Vampire Energy

- Resources:

Dry erase markers	Electronics/chargers	1 Blue hula hoop
Chairs	Carbon Cycle poster	1 Green hula hoop
Clipboards	Kilowatt Meter	
data sheets	Rope	

Instructional Delivery

Lesson setup:

- Set up stations with various household electronics at each. Set all meters to read watts (see instructions in Supplement B). Make sure Carbon Cycle poster is set up and ready to use with students. Chairs should be in a semi-circle facing the poster with clip boards, data sheets, and pens attached under each one.
- Set up Carbon Game- Make a large circle with rope, and put hula hoops in the center of the circle.
- Set out Debrief game- Put poly spots in a circle, with one less spot than the number of students.

Pre-Assessment: At the beginning of the lesson invite students to share what they know about human impacts on the environment.

Activity:

Motivation/Warm-Up:

Meet students in the main field. Play the carbon Game.

- 1) Introduction: Explain how the game works by asking the students a series of questions.
 - Ask students if all living things are made of Carbon? (Yes)

- Is this tree made of carbon?
- How about the leaves? (Yes), and what about you? (Yes)
- What planet they think is represented by the blue and green hula hoops (Earth).
- What do you think the rope you are standing on represents (The Earth's atmosphere)
- What star in the sky shines down on earth giving earth energy and making it possible for life on this planet? Since Carbon attracts heat.

2) First Round

- a) Pick a volunteer to be a carbon molecule. Explain that carbon attracts heat. Tell everyone else that they will be sunrays. Explain that the carbon molecule will walk around the earth (between the rope and the hula hoops). The sun rays (all the other students) will walk from the edge of the atmosphere touch the earth and then back out to the edge of the atmosphere. The carbon molecule will try to tag any sunrays as they leave the earth and head back to the edge of the atmosphere. Tell sun rays that their goal is to make it through the atmosphere and touch the "Earth" without getting tagged by Carbon molecule also known as CO₂. If tagged inside the atmosphere, sun rays stay and float around as heat with the CO₂.
- b) Ask students what they are seeing. What is happening to heat when it is tagged by CO₂?
- c) Ask student if it is bad to have this heat inside the atmosphere? (No without this heat the earth would get to cold at night)

3) Second Round

- a) Have all sun rays and the CO₂ step back on the rope. Tell them that a great discovery was made in which we found that we could use the carbon that had decomposed in the ground to power cars, electronics, and to heat our house. Now there is a lot more carbon being released. For this reason this time pick more people to be CO₂ (About 1/3 of the group). Play the game again this time more sunrays should be tagged.
- b) Ask what happened? (More heat was trapped in the atmosphere.) Tell them this heat can change the climate of different areas which is called global climate change.

Procedure:

Take students to the Bee Room, and have them to sit in a semi-circle facing the poster.

1. Introduce the concept of the carbon cycle to students. Explain why the carbon cycle is so important and what it has to do with humans and our changing climate (Supplement D).

2. Present felt board with carbon cycle pieces to students while they are seated, and have them come up one at a time to create a carbon cycle. Use carbon cycle key (Supplement A) for guidance.
 3. Remind them that when fossil fuels are burned to produce electricity, extra carbon dioxide is released into the atmosphere.
1. Have students brainstorm some things around their homes that require electricity. Tell them that they will be testing some of those items to determine how much energy each of them uses in order to operate.
 2. Inform students they will be using a kilowatt meter to read how many watts each item uses. Inform them that a “watt” is a measurement of how fast energy is used (“just like an inch is a measurement of length, a watt is a measurement of energy”).
 3. Show them how to use the meters. Turn on item and read the meter in Watts and record. Turn off read the meter in watts record. Never plug anything in or unplug anything.
 4. Have students get the clipboard, pen and data sheet that is under their chair to record results at the stations. They should fill in the table as they go through each station (see Supplement C).
 5. Have students work in pairs or groups of three as they go to each station.
 6. Discuss safety rules with students before they begin. Do not unplug devices. If the electrical device needs to be measured when it is unplugged, switch the power strip off.
 7. Walk around and oversee each group. Help with meter use when needed. Have students record the information they find on the data sheets.
 - Guide students to test items powered on and powered off.
 8. After groups have gone to each station, have students return to their chairs. Discuss their findings (students can talk about things they already know about energy use, and what they learned at the different stations):
 - Which item uses the most energy?
 - Which item uses the least?
 - Was energy still being used when electronics were powered off? This is called vampire energy.

Assessment:

1. Discuss the importance of conserving energy. We now know how much energy many of the things we use require, but *where* does that energy come from?
 - *By using fossil fuels (coal, oil, natural gas). We use these fuels to produce the electricity we need. By burning these fuels, CO₂ is generated and released back into*

the atmosphere.

2. Conclude with a brief discussion on renewable energy sources. Not only are fossil fuels adding excess CO₂ into our atmosphere, they are also in limited supply.
 - *We cannot make more fossil fuels if we run out because they are non renewable. This means they take millions of years to form. Instead we are learning alternative energy sources that are 'renewable,' meaning (wind, solar, water). These sources are not only renewable, but also much cleaner – they do not release CO₂ into the atmosphere.*
3. Have students discuss the questions. “How can I help to reduce my carbon footprint at home?” Discuss some ideas with them
 - *Plant trees, replace regular light bulbs with energy efficient ones, turn off lights/fan/TV when not in use, unplug chargers when not in use, keep heaters at lower levels, etc.*
4. Play the game “Carbon is not released for those who”
 - Tell students that in this game we will think of ways that we can help reduce the amount of carbon being released into the atmosphere.
 - Have all but one student stand on one of the poly spots in the circle. This student should stand in the middle of the circle.
 - Have the student in the middle think of something they do to reduce carbon from being released into the air. They should then say “Carbon is not released for those who...”
 - If the statement applies to them, students will run to another poly spot, as long as it is not right next to them.
 - One student will again be without a poly spot, so this student will go in the middle and give another statement.
 - Continue the game until time runs out or all students have had a chance to be in the middle.
 - If students have a hard time generating questions, use the suggestions in supplement E

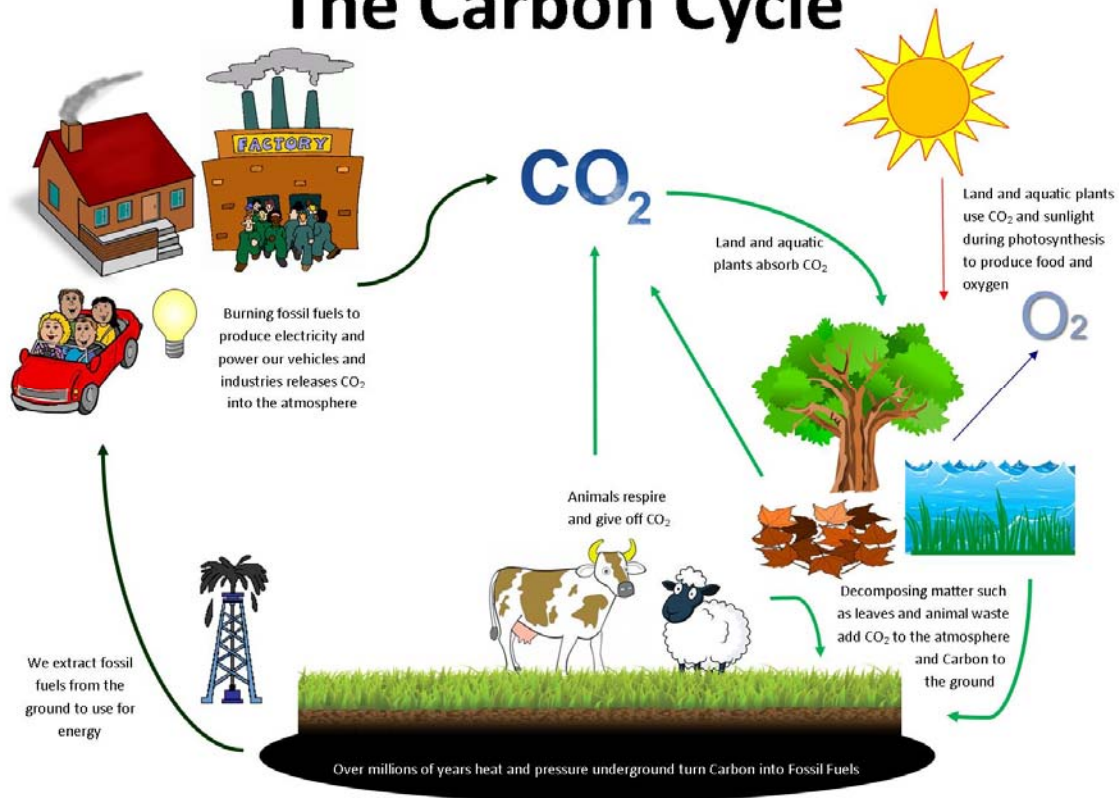
After the lesson is finished, students will move to their next activity, or back to the module introduction location for a debriefing activity led by an Arlington Echo staff member.

Notes for Clean up:

Please clean, organize and return the lesson materials to their proper locations at the end of each day of instruction. Remember to inform the Arlington Echo staff if you need assistance or if any materials are damaged or missing.

Supplement A

The Carbon Cycle



Carbon is one of the most common elements found on Earth and is the main ingredient of every plant and animal (even humans). Over time, carbon moves between many places and forms—this movement is known as the Carbon Cycle. The Carbon Cycle is made up of sources and sinks. **Sources** are things that add carbon to the atmosphere. **Sinks** are things that remove carbon from the atmosphere.

Explain the carbon cycle using the steps below; for each step ask a student to place the corresponding pieces and arrows on the board:

1. In the atmosphere, carbon reacts with oxygen to form a gas known as carbon dioxide (CO₂).
2. Land and aquatic plants absorb CO₂ and sunlight to photosynthesize and produce oxygen—this makes plants a carbon **sink**.
3. Animals and humans need oxygen to breathe. As animals and humans breathe, or respire, they give off CO₂—this makes human and animal respiration a carbon **source**.
4. As plants, animals, and other organic matter die, they decompose. During decomposition, carbon is released into the atmosphere (**source**) and carbon enters the ground beneath the land and oceans (**sink**).
5. After millions of years, heat and pressure turn the underground carbon into fossil fuels. Since the 1800s, humans have been extracting fossil fuels from deep underground on a large scale.
6. We burn these fossil fuels in order to power our buildings, vehicles, and factories; which releases the carbon that has been trapped underground for millions of years into the atmosphere. Through the burning of fossil fuels, humans have created a new **source** of carbon into the atmosphere.

Supplement A continued

Carbon Cycle Discussion Questions and Information

a. What happened in the natural cycle (lighter arrows on the right)?

- The level of carbon dioxide in the atmosphere was stable because the sources (that add carbon to the atmosphere) and sinks (that remove carbon from the atmosphere) were in balance.

b. What happened when humans began extracting and burning the fossil fuels for energy (darker arrows on the left)?

- The level of carbon dioxide in the atmosphere increased because the sources and sinks became unbalanced—carbon was added to the atmosphere from burning fossil fuels (source) much faster than any natural sinks could remove it.

c. Why is this increase important and how does it relate to humans and climate change?

- Carbon Dioxide (the gaseous form carbon takes when it reacts with oxygen in the atmosphere) is one of the **Greenhouse Gasses**, meaning that it holds heat and traps it in the atmosphere, like a greenhouse. Greenhouse gasses exist naturally in the atmosphere and are important for keeping Earth warm enough for organisms to live.
- When humans burn fossil fuels (source) and remove natural sinks such as forests and wetlands, carbon dioxide is added to the atmosphere faster than it can be removed.
- This results in an overload of carbon dioxide in the atmosphere, and because carbon dioxide is a heat-trapping greenhouse gas, this increase causes the atmosphere to warm up.
- The atmosphere's temperature cycles between warm and cool naturally over time, which is what creates periods like Ice Ages. The recent increase in carbon and other greenhouse gasses, however, has caused the atmosphere to warm and change much more quickly and significantly than has ever been observed in history.

d. Do you know any effects of climate change?

- Higher temperatures overall
- Increased droughts in dry areas and floods in wet areas
- More extreme, changing, and unpredictable weather patterns
- Ice, snowpack, and glacier melt in the arctic regions
- Warmer ocean temperatures
- Sea level rise
- Ocean acidification

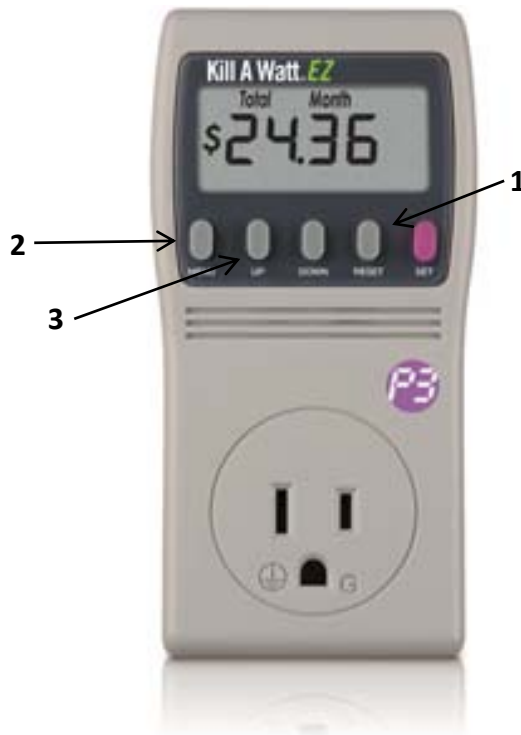
e. Is there anything you can do to help?

- Reduce your **Carbon Footprint** (the amount of carbon released into the atmosphere as a result of an individual's activities)

Sources: U.S. Environmental Protection Agency (EPA), 2015; U.S. National Aeronautics and Space Administration (NASA), 2015

Supplement B

1. Plug Kill A Watt meter into any outlet.
2. Connect appliance to be tested directly into plug on meter.
3. Reset meter by holding down RESET button (1) until “rEST” appears on screen.
4. Press MENU button (2) repeatedly until “Volt” is displayed on screen.
5. Press UP button (3) repeatedly until “Watt” is displayed on screen. This is the correct unit of measurement students will be taking.
6. Reset meter before testing each appliance.



Supplement C

Lots of Watts!



Item Tested	Watts Used	
	On	Off

Which item uses the most energy?

Which item uses the least energy?

How can I help to reduce my carbon footprint at home?

Supplement D

Vocabulary

Oxygen- The life supporting component of air.

Carbon Dioxide- gas produced by burning carbon and respiration.

Carbon Cycle – the process and movement of carbon as it is recycled and reused throughout the biosphere (the total of all ecosystems)

Carbon Footprint – the amount of carbon released into the atmosphere as the result of an individual's activities

Watt – a unit of power that expresses the rate at which electric energy is being used

Kilowatt – 1000 watts of electrical power

Photosynthesis – the process of plants using energy from sunlight, carbon dioxide and water to produce energy

Atmosphere – the mass of air surrounding the earth; it is held in place by gravity and protects Earth's organisms from severe weather and radiation from the sun, and keeps us warm

Fossil Fuels – natural fuels, such as coal, oil, and natural gas, that produce excess carbon dioxide into the atmosphere when burned; these fuels are considered non-renewable because they take millions of years to form through heat and pressure underground.

Greenhouse Gas– a gas that traps heat in the atmosphere; major greenhouse gasses include water vapor, ozone, carbon dioxide, methane, and nitrous oxide.

Renewable Energy – any natural source of energy, that is not depleted when used (ex. Solar, wind, water)

Non-Renewable Energy- any natural resource from the earth that exists in limited supply and cannot be replaced if it is used up (ex. Oil, natural gas).

Vampire Energy- the electric power consumed by an appliance while it is switched off or in stand-by mode but still plugged in.

Supplement E Carbon is not released for those who...:

- Carpooling or use public transportation
 - a. Carpooling or riding a bus or train saves gas and produces less carbon pollution. Fewer cars on the road means less CO₂ released into the atmosphere.

- Ride a bike
 - a. Bikes don't produce any CO₂ into the atmosphere, and its great exercise!

- Buying local food
 - a. Buying from local farmers' markets and/or growing your own food saves all the carbon that is produced in transporting food over long distances, and saves resources that are used in big factories.

- Recycling at home
 - a. Recycling means less plastic, paper, cardboard, glass, etc. going into landfills. This leaves more open space for trees to grow and help clean the atmosphere, and less CO₂ being produced from the decomposing waste in landfills.

- Hanging your clothes to dry
 - a. Using a clothesline not only saves your clothes, but also saves the energy a dryer would need to dry them. Hanging your clothes to dry doesn't generate any CO₂.

- Composting
 - a. Composting prevents many kinds of food waste from ending up in landfills, and also produces nutrient-rich soil.

- Planting trees
- Solar panels
- Turn off lights/TV
- Unplug chargers, etc.