

## Lesson: Concerning climate-Lots of Watts!

\*Arlington Echo works to continuously improve our lessons. This lesson may be modified over the course of the school year.

**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' 4<sup>th</sup> grade module based at Arlington Echo Outdoor Education Center.



### Content Standards:

#### Environmental Literacy

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-

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 foot print.
- Investigate how humans can reduce their greenhouse emissions and carbon footprint.
- Determine the amount of energy their household electronics use.

### 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	Clipboards
Data sheets	Carbon cycle poster	Kill-A-Watt meters
Plush carbon cycle toys	Wooden arrows	Chairs

- **Supplements:**

- A: The carbon cycle
- B: Kill-A-Watt meter
- C: Data sheet
- D: Vocabulary
- E: Carbon is reduced for those who...

### Instructional Delivery

#### Lesson setup:

- Set up stations with various household electronics. Set all Kill-A-Watt meters to read watts (**see instructions in Supplement B**). Make sure Carbon Cycle arrows, poster, and plush toys (**Supplement A**) are set up and ready to use with students. Chairs should be in a semi-circle with clip boards, data sheets, and markers attached under each one.

**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:

Take the students to the *Bus circle* with the arrows on the ground

1. Ask the students if they know what the carbon cycle is (*The process and movement of carbon as it is recycled and reused throughout all of the earths ecosystems*) Tell the kids that they will make a map of the carbon cycle.
2. Hand out the plush indicators of the different parts of the carbon cycle
3. Start by placing the sun in the correct position and then give the kids 1 minute to organize the rest of the parts in the carbon cycle.
4. When time is up check to see if they are correct. If they are not give them another minute to fix their order, giving them some hints.
5. Once they have the order correct turn the board around. Explain the carbon cycle using the prompts in **Supplement A**.
6. Take the students inside field hall into the bee room and have them sit down in the chairs.

##### Procedures:

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 the item and read the meter in Watts and record. Turn off the item, read the meter in watts record. Never plug anything in or unplug anything!
4. 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.
5. Have students pick up the clip boards with the data sheets where they will record results at the stations. Have students work in pairs or groups of three as they go to each station and fill in the table as they go (**see Supplement C**).
6. 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.
7. 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?  
-*The electric heater on high*
  - Which item uses the least?  
-*The energy saving light blub*
  - Which electronics still used energy even whan powerd off? This is called vampire energy.  
-*TV, and computer charger*

### **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, CO<sub>2</sub> 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 CO<sub>2</sub> 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 CO<sub>2</sub> into the atmosphere.*
3. Have students answer the question. “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.*

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

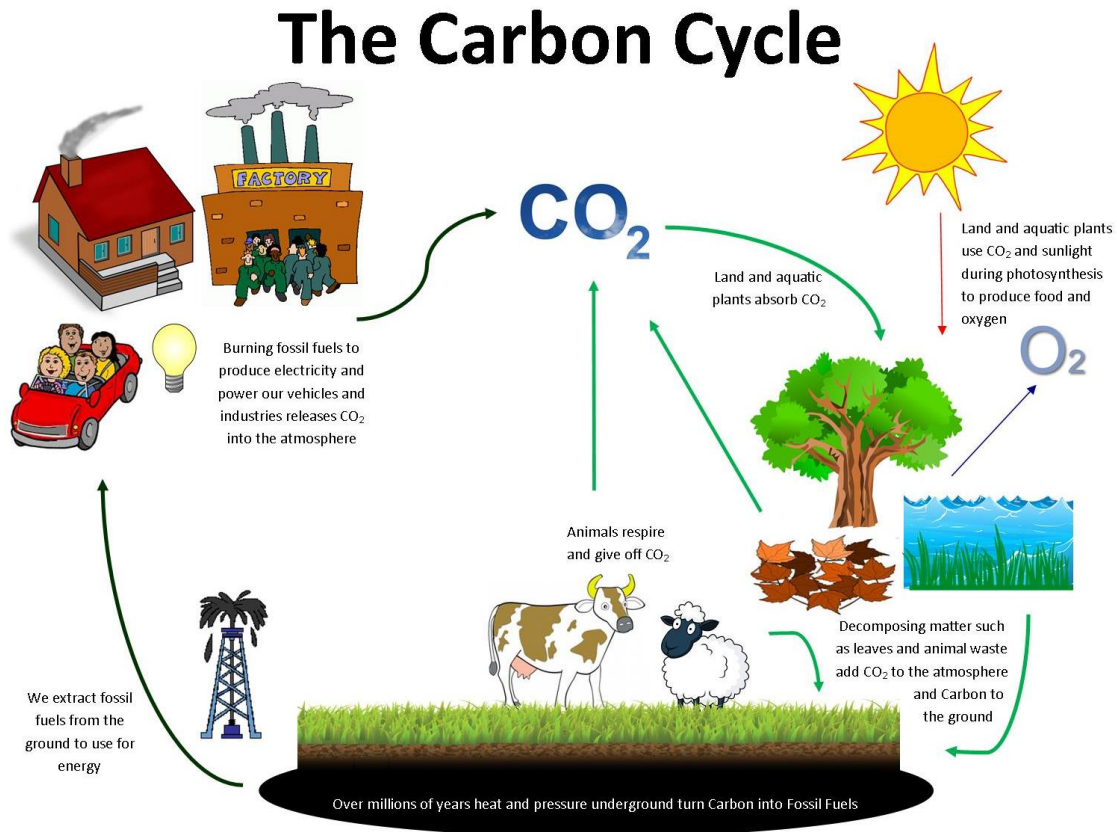
### Notes for Clean up:

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.

### Notes for Inclement Weather:

Arlington Echo encourages keeping our outdoor activities outdoors—even in the rain—but in the case of severe weather (thunder/lightning extreme cold, etc.), the introduction of the lesson will take place in  
**To Be determined**

### Supplement A



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 (CO<sub>2</sub>).
2. Land and aquatic plants absorb CO<sub>2</sub> 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 CO<sub>2</sub>—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.

## 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

**Supplement A continued**

- 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

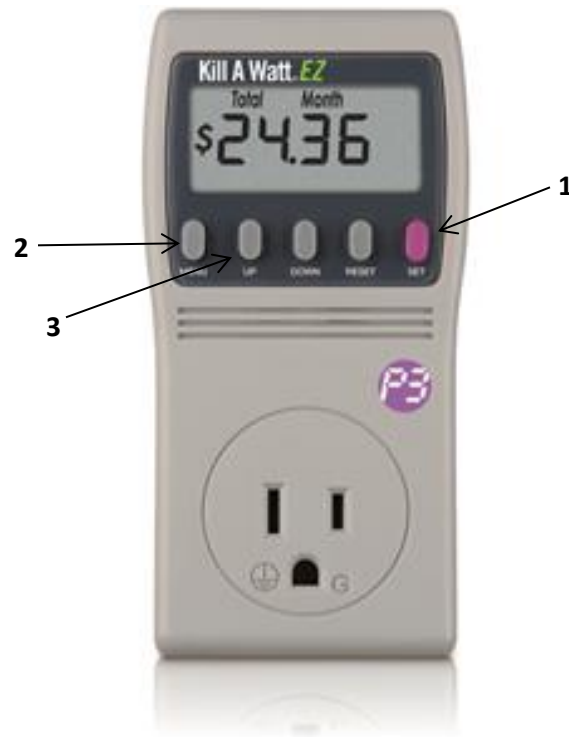
**e. Is there anything you can do to help?**

- 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?

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Which item uses the least energy?

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

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## 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 reduced for those who...:**

- Carpool 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 CO<sub>2</sub> released into the atmosphere.
  
- Ride a bike
  - a. Bikes don't produce any CO<sub>2</sub> into the atmosphere, and its great exercise!
  
- Buy 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.
  
- Recycle 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 CO<sub>2</sub> being produced from the decomposing waste in landfills.
  
- Hang 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 CO<sub>2</sub>.
  
- Compost
  - a. Composting prevents many kinds of food waste from ending up in landfills, and also produces nutrient-rich soil.
  
- Plant trees
- Use solar panels
- Turn off lights/TV
- Unplug chargers, etc.