Lesson: Energy-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 can we reduce our energy use and help the environment?

Unit/Lesson Sequence: This is one of two lessons in the 'Energy' 4th grade module based at Arlington Echo Outdoor Education Center.

Content Standards:

Environmental Literacy

3.B.1.d. Explain and diagram how greenhouse gases increase thermal energy in the atmosphere and its effect on earth's temperature and systems.
5.A.1. Analyze the effects on human activities on earth's natural processes.
6.A.1. Identify and describe natural changes in the environment that may affect the health of human populations and individuals.
8.F.1.b. Identify actions that can be taken as individuals and those that require the involvement of other people, organizations and government.

Science

3.4.F.1.a. Identify and describe the interactions of organisms present in a habitat.
4.ESS3.1 Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
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: 45 minutes.
*Times subject to change based on group size and arrival to Arlington Echo.

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 gases; 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
Solar Panels		

- **Resources:**

Dry erase markers	Electronics/chargers	Clipboards
Data sheets	Carbon cycle poster	Kill-A-Watt meters
Parachute	Solar Gadgets	Chairs
Carbon Cycle Arrows & Cards	Solar Energy Poster	

- **Supplements:**
  - A: The Carbon Cycle
  - B: Kill-A-Watt Meter
  - C: Data Sheet
  - D: Vocabulary

Instructional Delivery

Lesson setup:

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

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

Engage

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 indicators of the different parts of the carbon cycle.
3. Start by placing the sun and the carbon dioxide in their correct positions, 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 the order, giving them some hints.
5. Once they have the cards correct, talk about 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.

Explore

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 that 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, read the meter in Watts, and record the number. Turn off the item, read the meter in watts. Record. **Never plug 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 bulb
- Which electronics still used energy even when turned off? (*This is called **vampire energy***.)
  -TV, and computer charger

Explain

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, carbon disoxide ($CO_{2)}$ 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_2 into our atmosphere, but they are also in limited supply.
   - *We cannot make more fossil fuels if they run out because they are non-renewable. This means that 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_2 into the atmosphere.*
3. As you take students to the parachute activity be sure to point out the solar panels on the roof of Field Hall. Briefly explain to students that these panels receive the sun's light and turn it into electricity; this is what we call solar energy.
4. If you are teaching for a **DAY** program or a **9-Way OVERNIGHT** please continue to the **Elaborate** parachute activity section. If teaching for a **6-Way OVERNIGHT** program please continue to **Solar Panel Activity** directly below.

For 6-Way OVERNIGHT programs ONLY:

Solar Panel Activity

Materials:

- Solar energy poster in the Sensory Room
- Solar gadgets (placed at outside bog picnic table)

Discussion:

- Tell students "Now that we've explored how the majority of energy we use come from the burning of fossil fuels, can anyone think of any different ways we may get energy without burning fossil fuels?"
  - *Wind, Sun, Water*
- Ask students, "Can anyone guess the percentage of electricity supplied by BGE that comes from clean, renewable energy sources?
  - *Less than 5%*
- "Today we are going to explore solar energy and how we may use the energy from the sun to make electricity."
- Show students the Solar Energy poster **(Supplement F)** and explain that the light of the sun is received through solar panels and is then converted into electricity.

Activity:

- Take students outside and point out the solar panels on the roof of Field Hall and briefly review what was just discussed about the solar energy poster. Then, take students to the bog picnic table.
- Hand one solar gadget to each group of 2-3 students. Allow them to take the gadgets to an open space (i.e. the field, bus circle).
  - *What happens when we expose the gadgets to the light? When covered?*
  - *What are the gadgets using to work?* **The sun** (Point out the small solar panel where the sun is received)
  - *Did they stop working when covered?* **Even when covered the gadgets stilll work even though there is LESS light received.**
- Ask students why solar energy is important.
  - It is clean energy; as it does not emit carbon into the atmosphere.
  - It helps to save money.

<u>"Carbon Is Reduced When…" Game</u>

Materials:

- Poly-spots

Directions:

- **See Supplement E**

Elaborate

1. Ask the students "Are there any energy sources that do not release carbon dioxide?"
   - *Solar, Wind, Hydropower*
2. Tell the students that we will be creating our own electricity today by using a bike generator! Show students the bike generator poster.
   - *The students will convert their kinetic energy into electricity and will try to power some of our electronics.*
3. Give each student a chance to ride the bike and power one of the electronics.
   - *The lightbulbs are the easiest to power, but students can try to power the other electronics.*
   - *Have the students try to ride the bike at a steady pace, not too fast that they can't sustain that speed.*

Notes for Clean up:

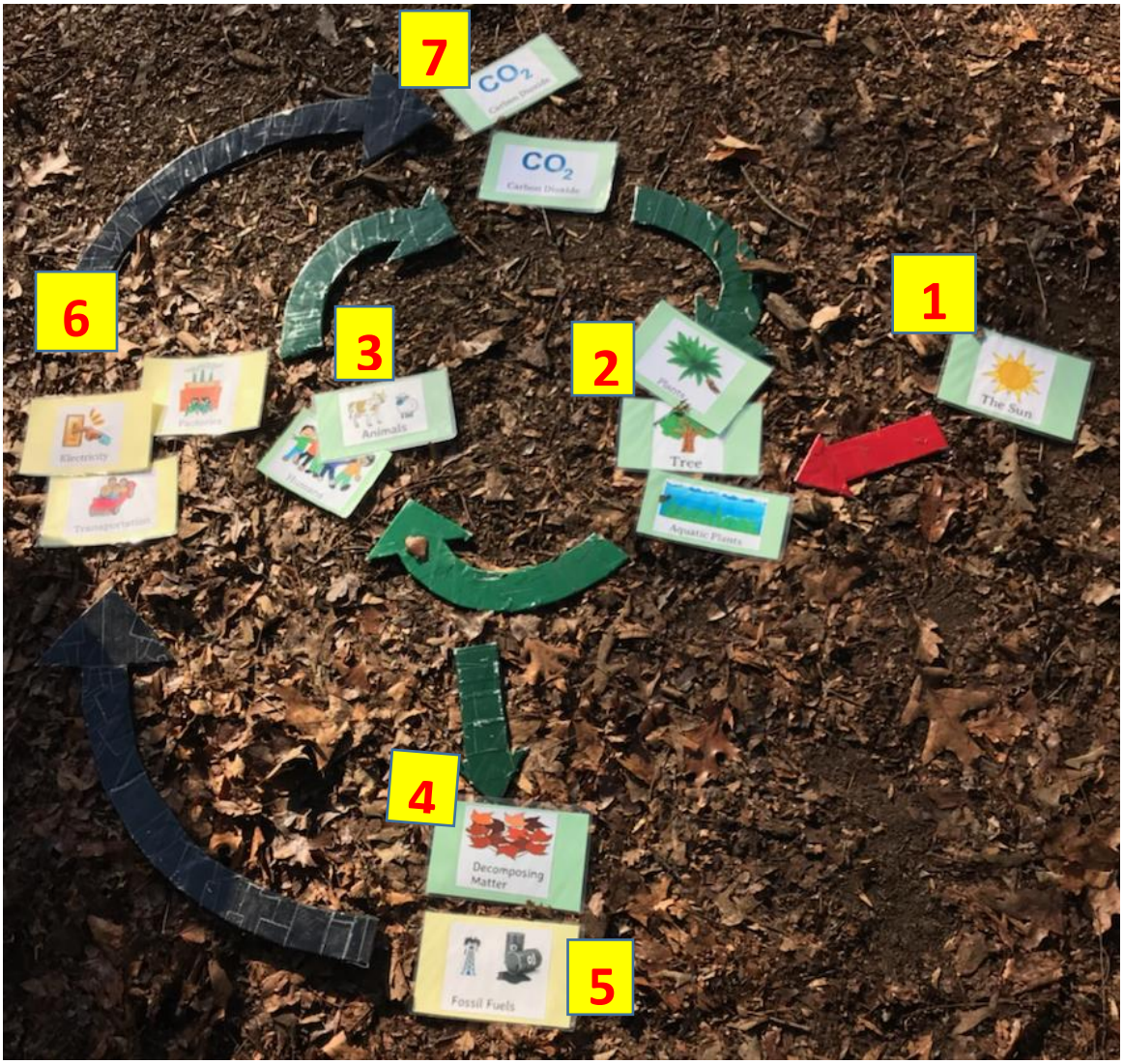
Please clean, organize and return the lesson materials to their proper locations at the end of each day of instruction. Remember to inform the Arlington Echo staff if you need assistance or if any materials are damaged or missing.

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 entire lesson will remain indoors in the Bee Room.

Notes for Overnights:
Please remember to set up your materials and be ready at your activity's location before morning lessons begin.

Supplement A: 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.

Lay the arrows out as shown in the diagram above. Add the Sun card by the red arrow, and the CO2 card at the top of the green arrow cycle.

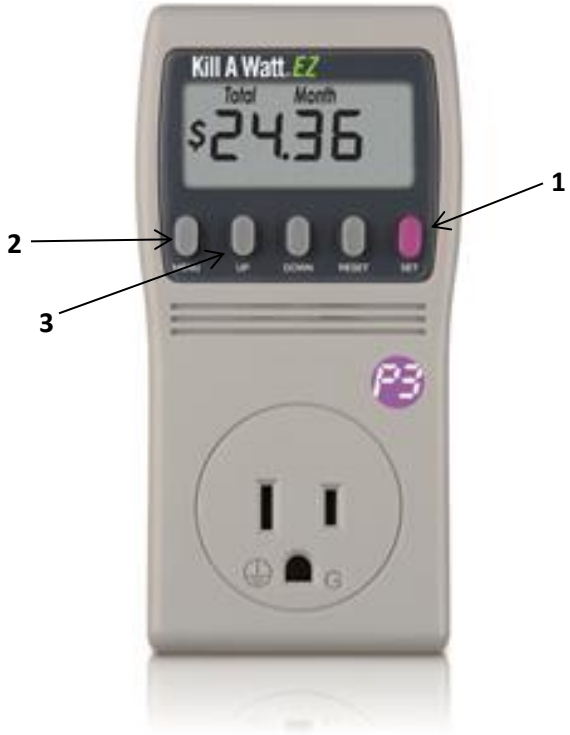
Explain the carbon cycle using the steps below; for each step ask a student to place the corresponding

pieces and arrows on the board (shown in italics). Alternatively, hand out all of the green cards and give the students one minute to figure out where they go within the green (and one red) arrows. Then, go through the explanation, and adjust the cards as necessary to match the above diagram.

1. The sun shines down onto the Earth – what organisms use photosynthesis to get their energy directly from the sun? (*Plants/Trees/Aquatic Plants)*
2. Land and aquatic plants absorb CO_2 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_2—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.
7. Through the burning of fossil fuels, humans have created a new **source** of carbon into the atmosphere.

Supplement B: Kill-A-Watt Meter

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 ears 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 when…" Game

Objective: To debrief students on knowledge acquired about energy use, and how weather and climate change are affected by humans.

Background: This game has been adapted from the popular game of "Musical Chairs". This game will focus on ways in which students may reduce their carbon footprints.

Directions:

1. Place poly spots in a circle; there should be enough spots for all but one student. Have students stand on one of the poly spots in the circle. The student that does not have a spot will stand in the center of the circle.

2. Tell students to think of ways that they can help reduce the amount of carbon being released into the atmosphere.

3. Have the student in the middle think of a way to reduce our energy use and ask the other students if they do those things by using the phrase "Carbon is reduced when…".

4. If the statement applies to them, students will run to another poly spot, as long as it is not right next to them.

5. One student will again be without a poly spot, so this student will go in the middle and give another statement.

6. Continue the game until time runs out or all students have had a chance to be in the middle.

7. If students have a hard time generating questions, use the suggestions below to guide them to come up with their own.

Statements may include:

- Carpooling or use public transportation
    - Carpooling or riding a bus or train saves gas and produces less carbon pollution. Fewer cars on the road means less CO_2 released into the atmosphere.

- Ride a bike
    - Bikes don't produce any CO_2 into the atmosphere, and its great exercise!

- Buying local food

  - 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
  - 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_2 being produced from the decomposing waste in landfills.

- Hanging your clothes to dry
  - 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_2.

- Composting
  - 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.