TOWNGREEN2025
Middle School Climate-Change Curriculum

Lesson 12

Carbon Cycles through Ecosystems

Unit Title: **Carbon Cycles through Ecosystems**	
Theme: **Ecosystems & Cycles**	Grade Level: **7**
# of sessions for the unit: **2**	Session #12: **Are you using energy even when you don't know it?**
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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

1. Students will sample "phantom" electrical energy (human interaction)
2. Students will critique (analyze) the amount of phantom energy they use
3. Students will investigate strategies to reduce their carbon footprint

Note any potential barriers to the lesson — consider variability

Student challenges

- recognizing everything that uses electricity, due to its invisible nature

Teacher challenges

- equipment needed
- Kill-A-Watt meter

Evaluation/Assessment

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

Formative Assessment

1. Review students' graphic organizer behaviors that contribute to your carbon footprint
2. Check over list of electrical devices and ideas to reduce their use, to scan for relevance and reasonableness

Summative Assessment:

1. Teacher evaluates students' Carbon Footprint behaviors and solutions in students' final presentation, graded by rubric

Vocabulary

- phantom energy
- carbon footprint
- MPG
- energy conservation (different than conservation of energy)

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: Ask if the TV uses energy, even when its off?

1. Prepare ahead of time
   - A. Get a TV and VCR/DVD player
     1. Plug them into Kill A Watt meter
     2. Turn the TV and player on and check the number of watts being used.
     3. Turn the devices off and check the Kill A Watt meter to see if power is still being used.
     4. If yes, these are good examples of phantom energy and good to use for this demonstration.
2. Background information
   - A. Phantom energy is a planned strategy for manufacturers. If the electrical device is still using energy when turned off, then it keeps the electronics warm for a faster start of the device.
     - An example — TVs — many people do not want to wait the 1 to 2 minutes for the TV to display a picture. So manufacturers made 'instant on' TVs as a marketing strategy. But this results in your electronic devices using electricity 24 hours a day, effectively wasting massive amounts of electricity/ energy.
   - B. This extra use of energy adds to pollution as well as the cost of your electricity.
     1. Some chargers or video games still use phantom energy.
     2. One easy way to tell is if the charger is warm even when turned off.
     3. Many newer electrical devices no longer use phantom energy, but many still do.
3. As students enter the classroom, many will say 'Oh are we watching a movie today?' And you can reply no and tell them they will have to wait and see what will happen.
   - A. You can start with a review of how we all use electricity at home.
     1. Ask how many have a TV at home.
     2. Ask if they know how much electricity it uses. Most will have no idea.
     3. Show them the Kill A Watt meter and say today we will check to see how much this TV and VCR/DVD uses.
     4. Plug the Kill A Watt meter into a power strip so it is easily seen by students.
     5. Plug in the TV and other device (you may have to do this one at a time).
     6. Call a student up to read the Kill A Watt meter.
     7. It should be at zero to start. Then turn on the TV and/or the device plugged into the Kill A Watt and wait a minute and have the student read the amount of watts being used.
     8. Then turn the TV/device off and ask students how much energy it should be using now (cover the Kill A Watt meter for this part). Most students will say zero, since it is off.
     9. Then uncover the Kill A Watt and show that is is still using some electrical energy. Tell them this is phantom energy, energy used when a device is turned off.
     10. Point out this energy is being used all day long, when they are here at school/parents at work, at night when they are sleeping. Remind them that somewhere, pollution is being put into the atmosphere for no apparent reason.
     11. Solicit ideas of how the students can stop that waste of energy. (You may get "unplug the devices" — how practical is this if the plug is behind the device and hard to reach? Or get a power strip that is easy to switch off).
4. Some students may have chargers with them and may want to plug them in to check. OK to do — make it personal.

A. Remember that the device needs to be on (i.e., actually charging a phone) and then put to rest to accurately measure the phantom energy.

B. You can also plug your laptop charger into it, or other electrical devices in your room to check them.

C. Ask students how many electrical devices they have and use regularly. Ask about specific devices used by students in your area — video games, chargers, hair dryers/straighteners/curlers; TVs, other devices they may have.

D. Ask how many unplug or use a power strip to turn off their devices.

E. See if they have noticed if the charger/power cord feels warm or hot when on or off.

5. For homework, assign students to do a home inventory of electrical devices, including types of light bulbs, in each room of their house.

   A. Also have them see how many power strips are in use and are actually turned off when not in use.

   B. The resulting list by students should be by room, with the number of lights in each room and the type of light bulb being used, as well as all other devices that are plugged in in that room.

6. Then ask students how else they use energy that causes pollution.

   A. Someone should say they get rides to places.

   B. Ask 'how many get rides to places?'

      1. Ask 'how many have bikes and use then regularly?'
      2. Ask 'how necessary it is to get rides everywhere?'
      3. Could they walk or bike to their destination?

7. This can lead into a discussion on the different types of cars and MPG (miles per gallon).

   A. Ask if students know what MPG means and explain if necessary.

   B. Explain that a car that gets 50 MPG will go a lot further than a large car or truck that gets 20 MPG.

   C. Translate that to cost per mile, based on the price of a gallon of gas in your area. Big families likely need a larger vehicle so all can fit, and that is important for many students to understand (the number of people in the vehicle divided by the cost of gas is less for larger families).

   D. All gas-burning cars give off carbon monoxide (which can be deadly if breathed in — carbon monoxide poisoning), which changes to carbon dioxide in the atmosphere.

   E. Discuss if hybrids or electric cars are better than gas engines alone.

      1. Opinions may vary depending on knowledge of the different types.
      2. Do electric cars cause a lot of pollution because they use electricity? (Typically no, as the electricity needed produces less pollution than a gas-powered car).

8. Food Audit

   A. The following are assigned for homework and shared the next day in class. In class: Ask students what food they have at home to eat.

   B. Write a list on the board.

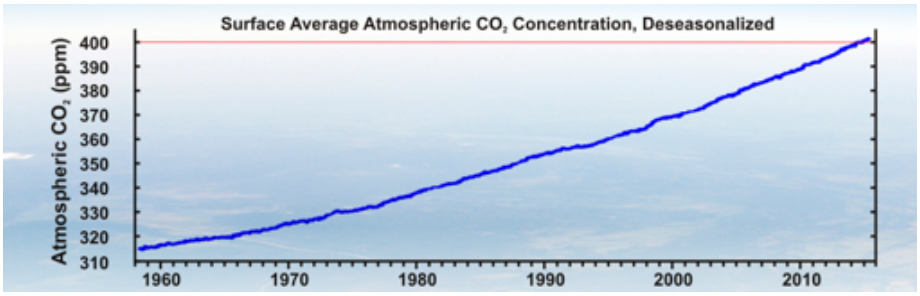
   C. Ask students if they know where these foods came from. Many will say the grocery store, the ask them where does the grocery store get that food. Most students will not know where their food comes from.

   D. Explain Food Audit homework:

   - Students should pick one or two items from the list or in their house and read the label on it to see where it came from (for students that may not be able to do this, use some grocery store ads that list the origin of some of the foods).
   - Students should think about and write down some ideas of how this food got to their grocery store (where/how grown, harvested, packed and shipped from where grown to where they live) and how that may contribute to climate-change.
   - Write some ways that students and their families can reduce this effect on climate-change.

- Students should then research on the web how food contributes to climate-change. One major area that will pop up is meat, especially beef.
- Have students write about those processes and how they can contribute to climate-change.
- What can be done to reduce the amount of carbon in this area?
- Write some ways that students and their families can reduce this effect on climate-change.
- Students will share their research in class then next day. Open for discussion for all students to contribute.

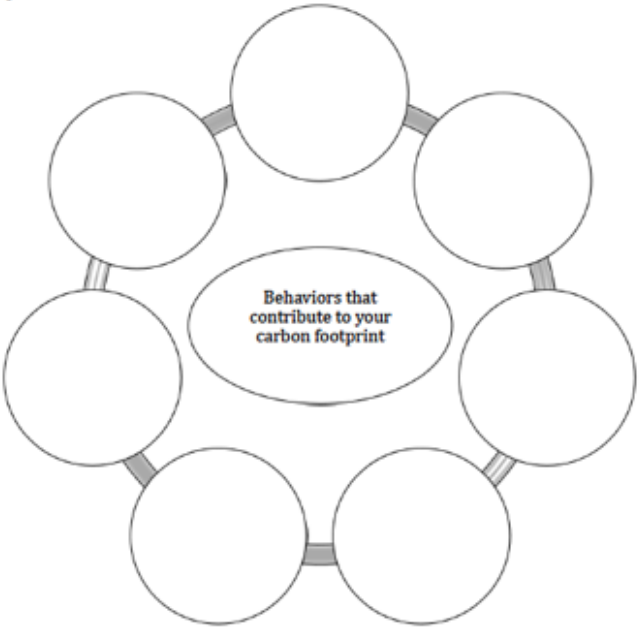
9. Homework: A) Home Inventory B) Food Audit

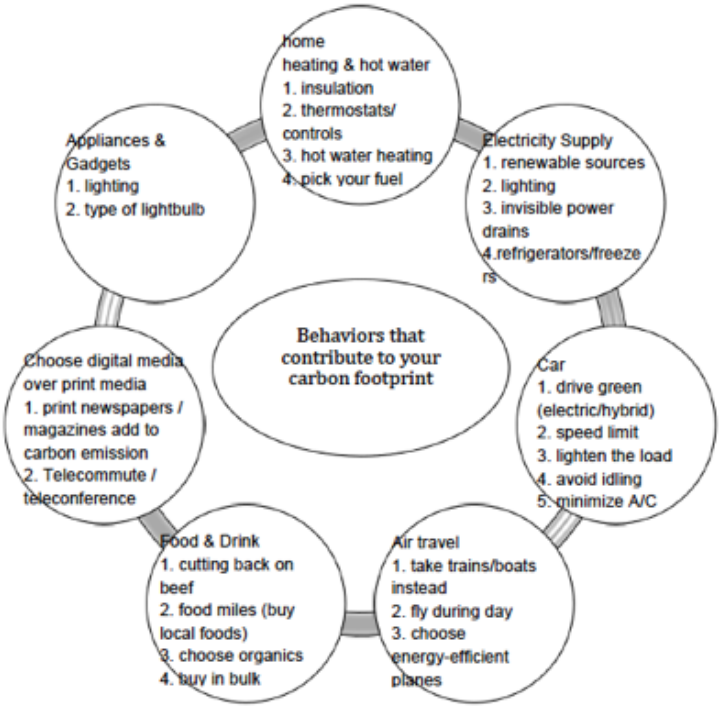


Day 2: Hook: Show this picture and graph. Ask how phantom energy has contributed to this graph?

1. Ask for students to share their home inventory.
   - A. Some may have a very large number of lights and devices and some may have a few.
   - B. Grading for this is based on completion and following directions (done by room) as it is impossible to verify accuracy.
   - C. Ask for students to come up with ways they can cut down on their electricity use and walk or bike more.
     1. In small groups, students think, share, and pair with the graphic organizer (on the next page)
     2. Students write possible solutions outside/next to each circle; students access these websites to help with solutions:
        - "Home Idle Load" *www.nrdc.org/sites/default/files/home-idle-load-action-guide.pdf*
        - Energy Efficient Computer Use *https://energy.gov/energysaver/energy-efficient-computers-home-office-equipment-and-electronics*
     3. After students complete the graphic organizer, students go to these websites to critique the amount of phantom energy they use (analyze)
        - "How Much Phantom Energy do your electronic use?" *http://www.mnenergysmart.com/how-much-phantom-energy-do-your-electronics-use/*
        - "Just How Much Power?" *www.nytimes.com/2016/05/08/science/just-how-much-power-do-your-electronics-use-when-they-are-off.html?mcubz=2*
   - D. To try to quantify *http://www.mnenergysmart.com/how-much-phantom-energy-do-your-electronics-use/*
     1. Students tape this graphic organizer into their science notebook, to integrate into their final project.

2. Below are some sample behaviors, as teacher notes.





E. As students work on graphic organizer, teacher chooses whether or not to project images in the notes section of this lesson

1. Graph: Growth in Greenhouse Gases since 1950
2. Graph: CDIAC Monthly CO_2

2. Homework ideas

A. Brain Pop Conserving Energy video quiz

1. video = *https://www.brainpop.com/science/energy/conservingenergy/*
2. quiz = *https://www.brainpop.com/science/energy/conservingenergy/quiz/*

1 Coal and oil are examples of _____ resources.

A Non-natural

B Non-efficient

C Non-polluting

D Non-renewable

2 In January and February, you should set your thermostat to about 68 degrees Fahrenheit. What can you infer about the prefix "thermo?"

A It refers to heat

B It refers to electricity

C It refers to the winter

D It refers to devices that burn fossil fuels

3 What might happen if we continue burning fossil fuels at the rate we do today? Choose the best answer.

A The cost of fossil fuels may drop

B Fewer and fewer oil wells and coal mines may be constructed

C The earth's climate may change rapidly

D Automobiles will become less fuel-efficient

4 Weatherstripping will allow you to use less of which appliance?

A

B

C

D

5 Which of the following processes consumes the least energy?

A Turning a tree into paper products

B Extracting oil from the ground and turning it into a plastic jug

C Recycling an old glass bottle so it can be used again

D Mining aluminum and shaping it into a soda can

6 You can save money by avoiding disposable items. Which of the following is a disposable item?

A

B

C

D

7 During the winter, insulation functions much like:

A A warm jacket

B A space heater

C A hot beverage

D A pot of boiling water

8 How is a compact fluorescent light bulb different from a conventional bulb?

A It is much smaller

B It emits less light

C It consumes less power

D It doesn't last as long

9 Which of the following is the most energy-efficient form of transportation?

A A hybrid car

B A city bus

C A diesel train

D A bicycle

10 What does it mean when a product has an Energy Star seal? Choose the best answer.

A It draws power from renewable energy sources only

B It uses less energy than comparable products

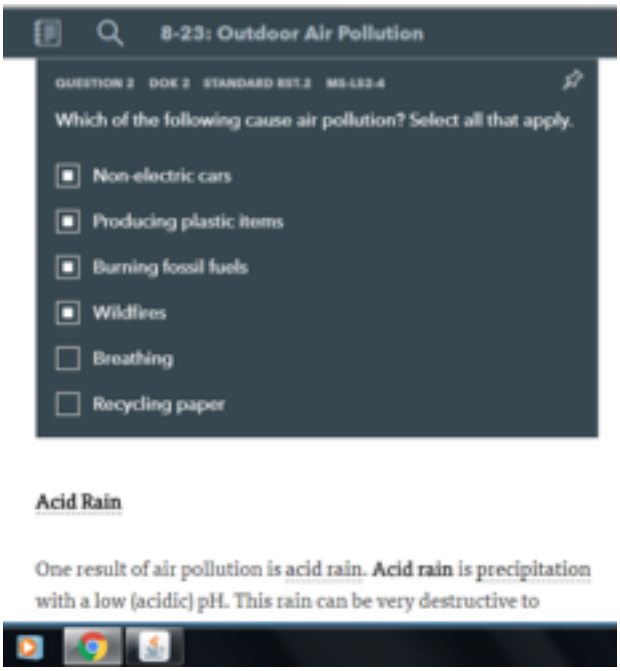
C It is safe to use inside your home

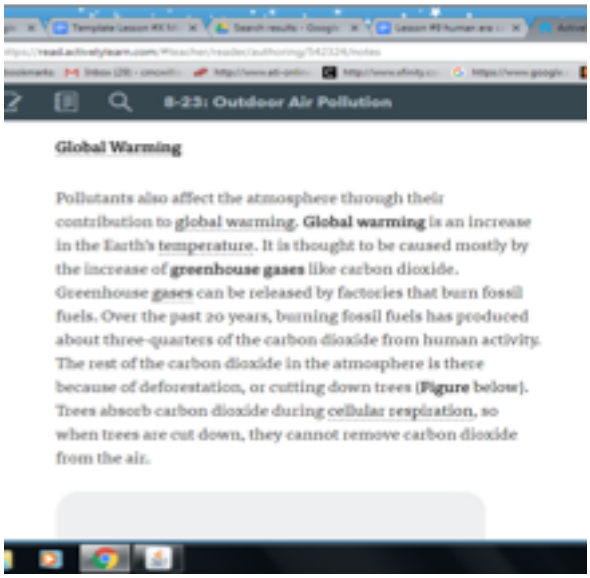
D It is made out of recycled parts

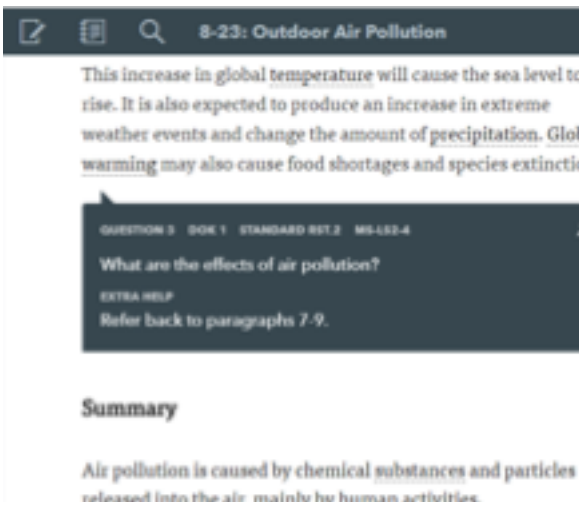
3. Homework ideas continued

A. B. *www.activelylearn.com* "Outdoor Air Pollution"

- Screen shots from Outdoor Air Pollution



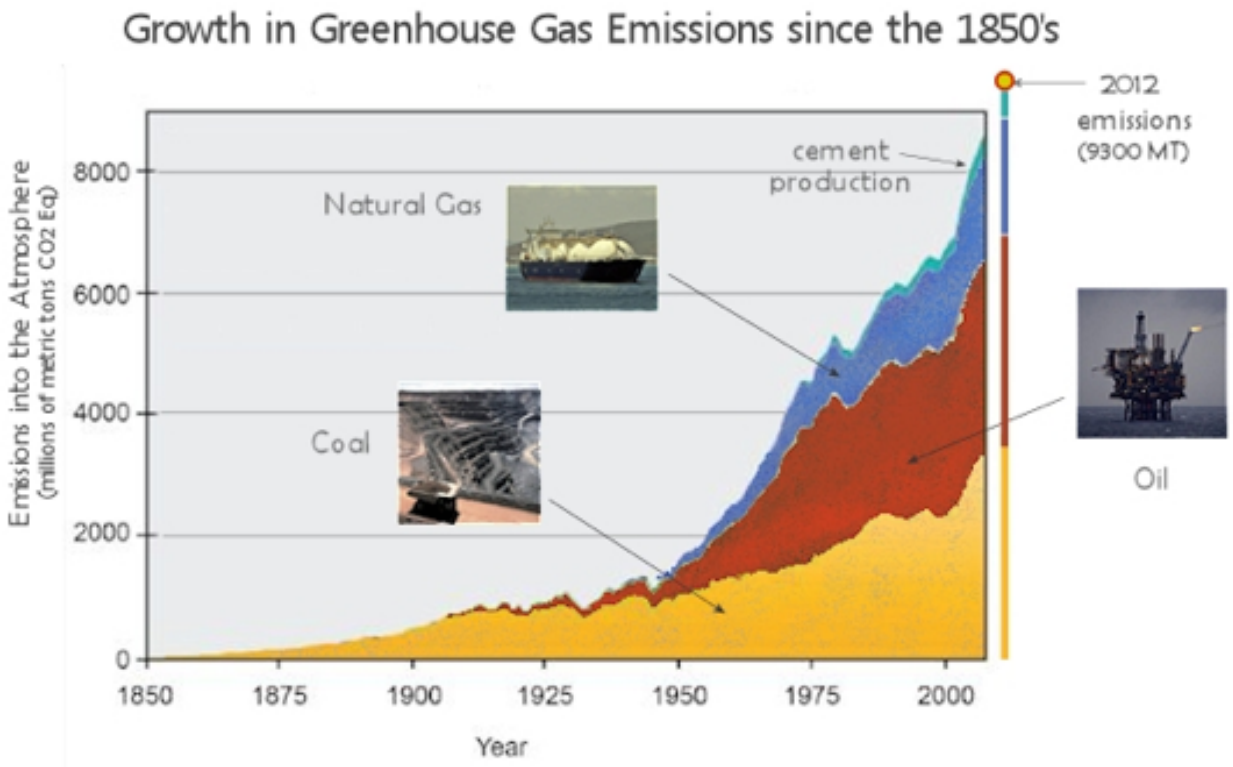


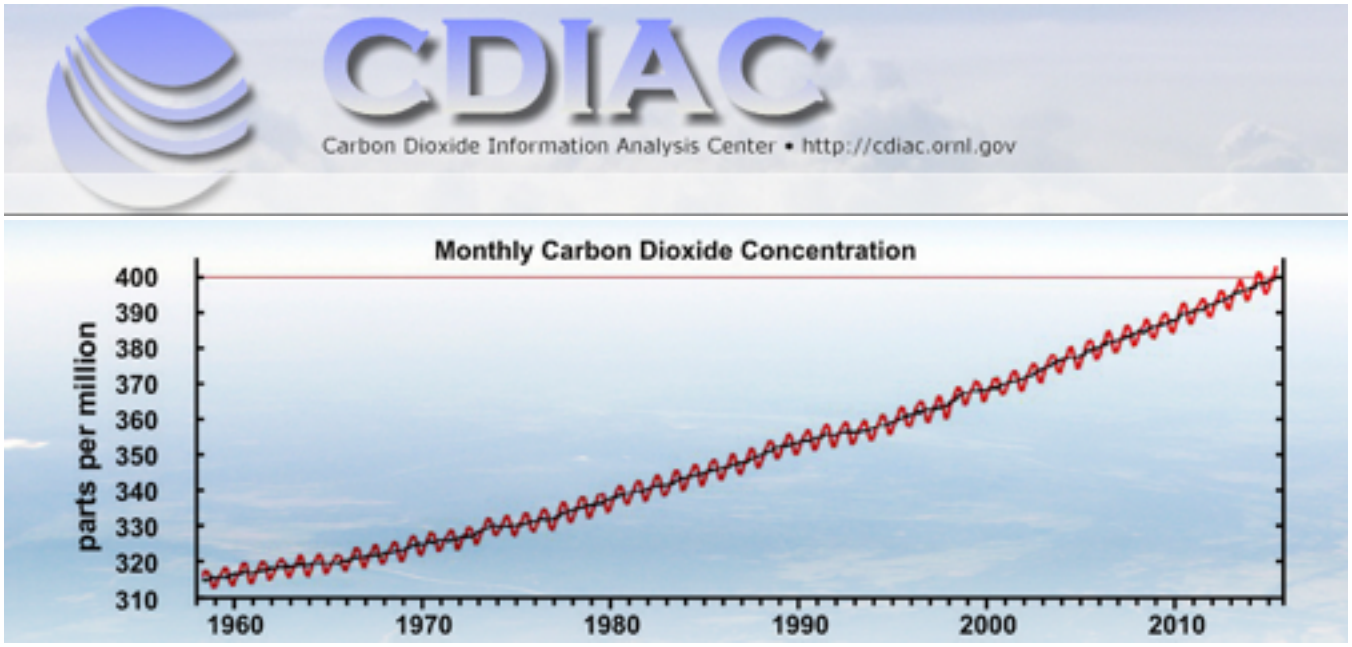


Materials

- Kill A Watt meter
- TV or other devices that use phantom energy
- *http://www.carbonfootprint.com/calculator.aspx*
- *http://coolclimate.berkeley.edu/calculator*
- Handout "Behaviors that Contribute to Your Carbon Footprint" graphic organizer

- Unit Resources for class discussion





http://cdiac.ornl.gov/