TOWNGREEN2025
Middle School Climate-Change Curriculum

Lesson 4

Carbon Cycles through Ecosystems

Unit Title: **Carbon Cycles through Ecosystems**	
Theme: **Ecosystems & Cycles**	Grade Level: **7**
# of sessions for the unit: **2**	Session #11: **How does burning fossil fuel affect the amount of atmospheric carbon?**
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

1. Carbon cycles through the atmosphere and land
2. Human activities increases atmospheric carbon by burning fossil fuel
3. Students will collect and measure samples to determine the amount of atmospheric carbon

Note any potential barriers to the lesson — consider variability

Student challenges

- physical challenges, such as field work mobility and walking students outside to parking lot

Teacher challenges

- equipment needed in unit, such as carbon dioxide probe

Student math-calculation disability

- graphing using an electronic spreadsheet

Evaluation/Assessment

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

Formative Assessment

- RAFT (Role, Audience, Format, Topic) activity advocating for "Limit Car Idling"

Possible RAFT Roles:

- Newspaper reporter, lawyer, chemist, lungs, codfish

Vocabulary

- Atmospheric carbon
- Carbon dioxide (CO_2)
- Human interaction

Differentiated Vocabulary Ideas

1. word wall
2. word splash
3. common prefixes and suffixes
4. content vocabulary roundtable
5. flashcards

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)

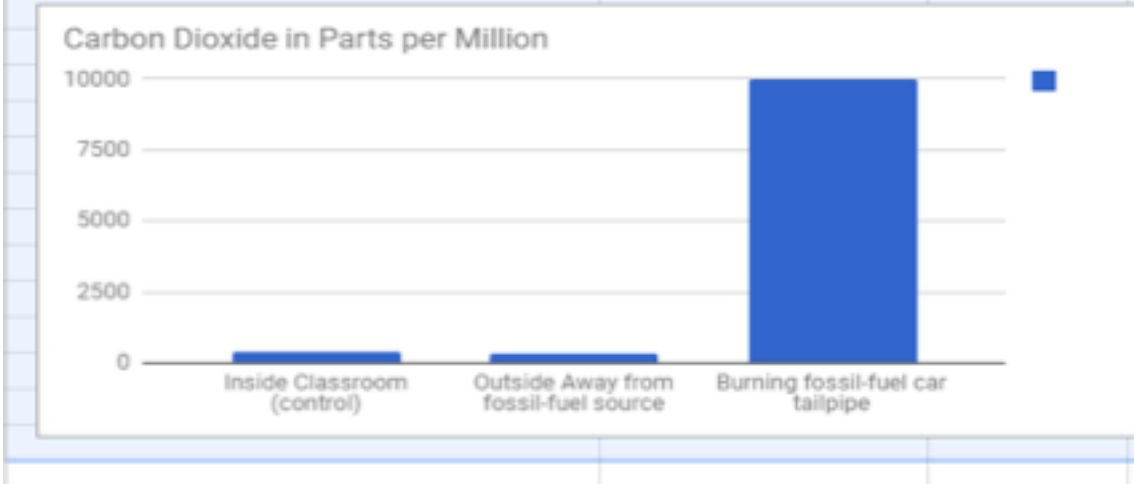
Hook: In a brief think, pair, share, students report out their opinions of this picture

1. When we burn fossil fuels, we increase atmospheric carbon.
   - A. Collect atmospheric carbon dioxide.
     1. Using a carbon dioxide meter, such as the Vernier LabQuest CO_2 sensor take at least 2 outdoor readings.
        - a. Take the first reading in the classroom and an open space, away from fossil-fuel burning sources perhaps in a bush or garden.
        - b. Take the second reading next to the tailpipe of an idling car.
   - B. Complete Data Table and Graph

Location	CO_2 parts per million	% Change
Inside Classroom (control)		
Outside, Away from fossil-fuel source		
Car Tailpipe burning fossil-fuel		

Sample Data Table & Graph

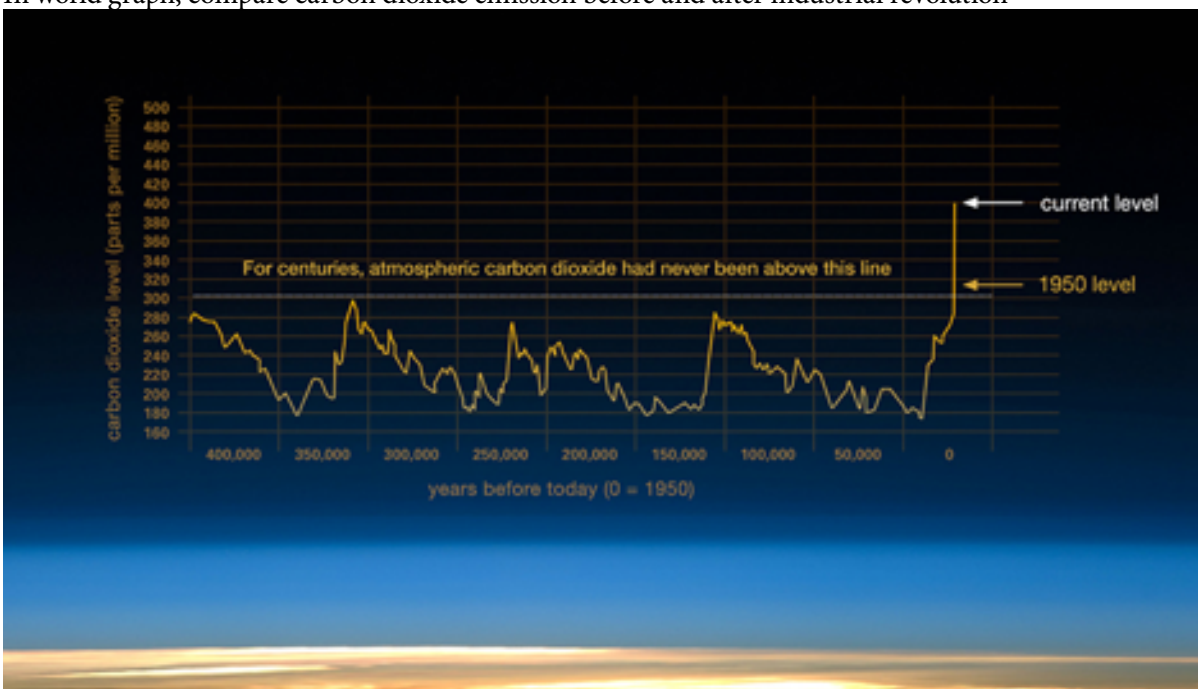
Location	CO2parts per million	% Change
Inside Classroom (control)	400	
Outside Away from fossil-fuel source	350	-0.875
Burning fossil-fuel car tailpipe	10,000	25



C. Discussion of data analysis: Human activities increases atmospheric carbon when we burn fossil fuel — Think-Pair-Share questions to frame discussion

1. In student graph, compare carbon dioxide emission before and after burning fossil-fuel

2. In world graph, compare carbon dioxide emission before and after industrial revolution



Ancient air bubbles trapped in ice enable us to step back in time and see what Earth's atmosphere, and climate, were like in the distant past. They tell us that levels of carbon dioxide (CO_2) in the atmosphere are higher now than they have been at any time in the past 400,000 years. During ice ages, CO_2 levels were around 200 parts per million (ppm), and during the warmer interglacial periods, they hovered around 280 ppm (see fluctuations in the graph). In 2013, CO_2 levels *surpassed 400 ppm* for the first time in recorded history. This *recent relentless rise* in CO_2 shows a remarkably constant relationship with fossil-fuel burning, and it can be well accounted for based on the simple premise that about 60 percent of fossil-fuel emissions stay in the air.

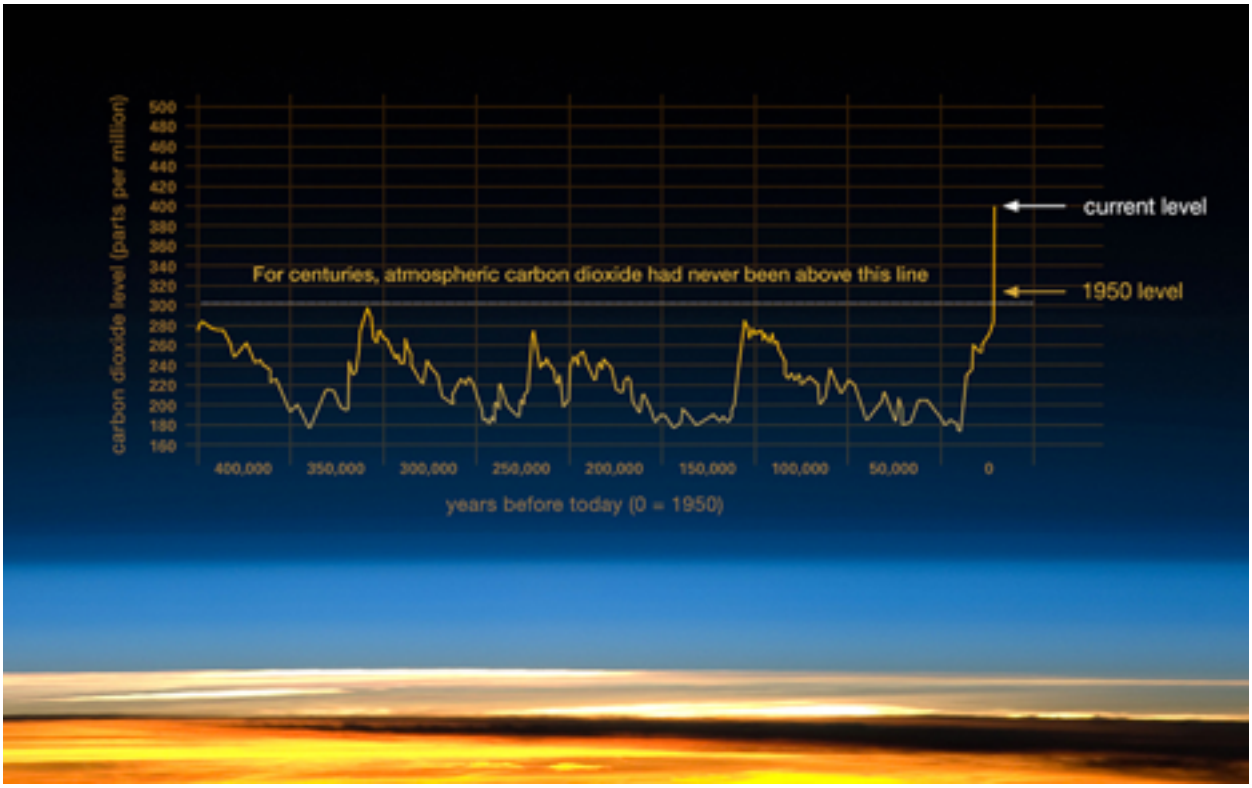
Materials

1. Vernier LabQuest CO_2 sensor
1. Graphing spreadsheet

Resources

https://climate.nasa.gov/climate_resources/24/

Source: Global Climate-change website



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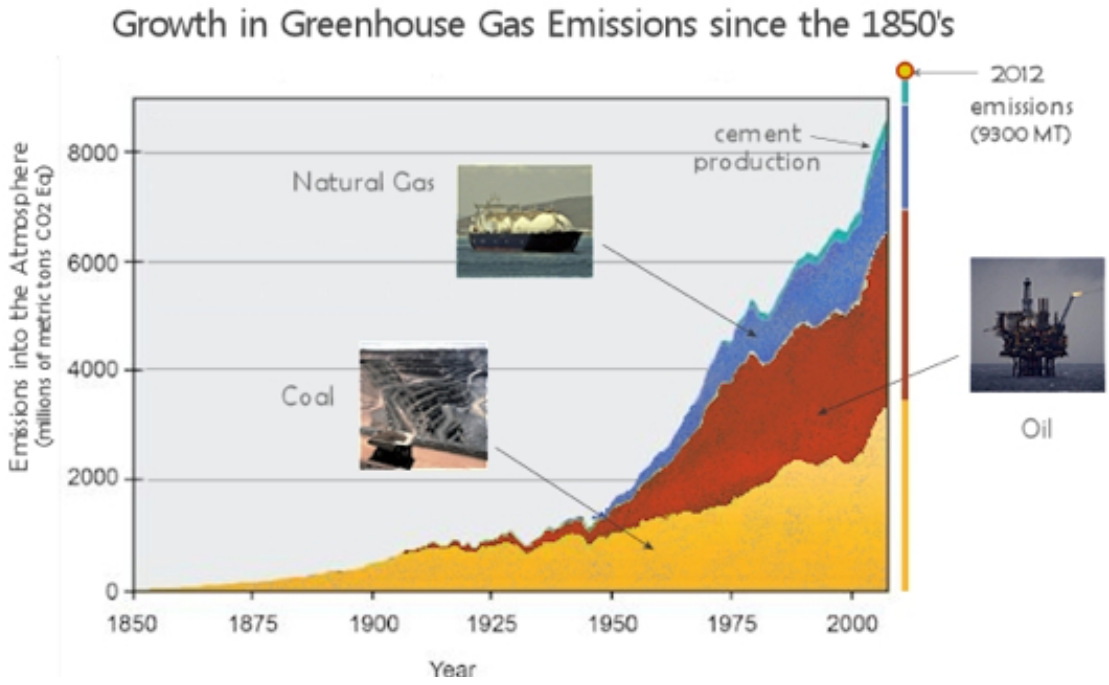

https://www.esrl.noaa.gov/gmd/ccgg/about/mlo_by_flag_2014.png

https://www.esrl.noaa.gov/gmd/ccgg/about/co2_measurements.html

http://cdiac.ornl.gov/

http://cdiac.ornl.gov/faq.html = frequently asked Climate-change questions (discussion ideas)