TOWNGREEN2025
Middle School Climate-Change Curriculum

Lesson 2

Carbon Cycles through Ecosystems

Unit Title: **Carbon Cycles through Ecosystems**	
Theme: **Ecosystems & Cycles**	Grade Level: **7**
# of sessions for the unit: **2** 1 field-day: **about 3 hours**	Session #2: **Is there a difference of how much carbon wetlands store above and below ground?**
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 describe that 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 (Goal)

Compare the amount of stored carbon above and below ground in wetlands with that in an upland forest. Wetlands store carbon both above and below ground

Note any potential barriers to the lesson — consider variability

Student challenges

- physical challenges, such as degree of field work needed for mobility

Teacher challenges

- equipment needed in unit, such as soil-drying oven.

Student math calculation disability

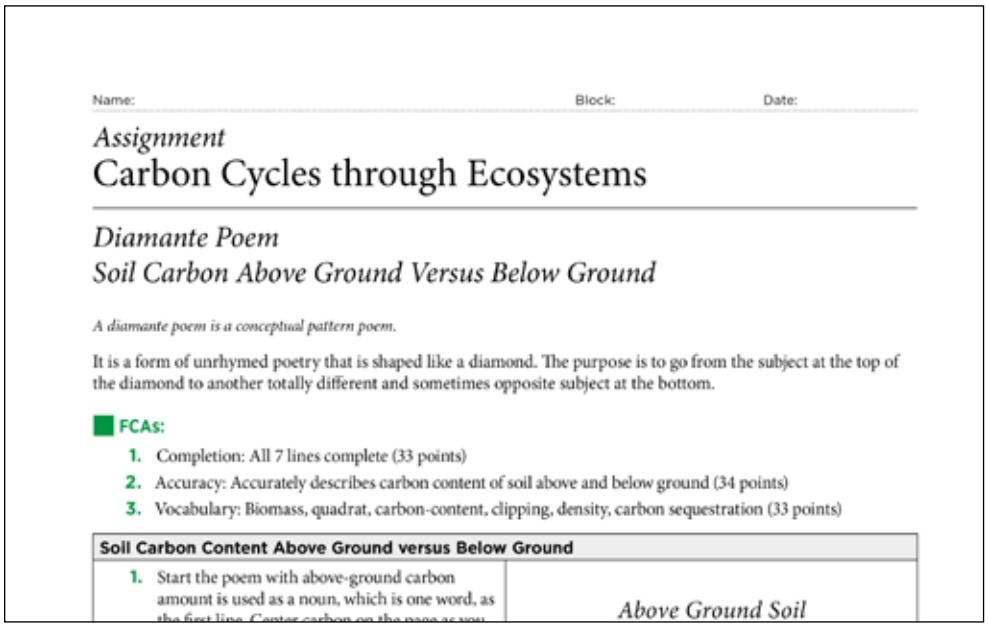
- calculating mass/volume density

NOTE:
If you can predict which students may not be able to achieve the goals, then you need to reduce barriers to maximize learning for all.

Evaluation/Assessment

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

1. Students write diamante poem: See full diamante poem at the end of this lesson



Name: Block: Date:

Assignment

Carbon Cycles through Ecosystems

Diamante Poem

Soil Carbon Above Ground Versus Below Ground

A diamante poem is a conceptual pattern poem.

It is a form of unrhymed poetry that is shaped like a diamond. The purpose is to go from the subject at the top of the diamond to another totally different and sometimes opposite subject at the bottom.

FCAs:

1. Completion: All 7 lines complete (33 points)
2. Accuracy: Accurately describes carbon content of soil above and below ground (34 points)
3. Vocabulary: Biomass, quadrat, carbon-content, clipping, density, carbon sequestration (33 points)

Soil Carbon Content Above Ground versus Below Ground	
1. Start the poem with above-ground carbon amount is used as a noun, which is one word, as the first line. Center carbon on the page as you	*Above Ground Soil*

2. Actively Learn "Soil Erosion" *www.activelylearn.com* (free subscription) Active Reading activity with companion questions

3. Electronic survey or Google Forms quiz:

1. **In the field, we collected samples from** *

Mark only one oval.

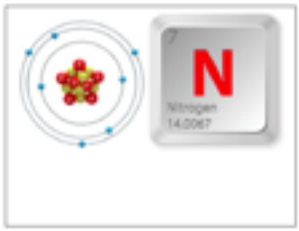
In a wetland ecosystem

In a forest ecosystem

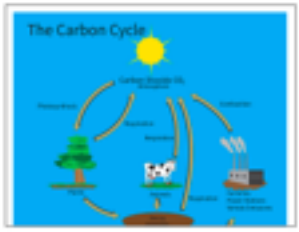
In a desert ecosystem

2. **In the field, we collected samples to determine** *

Mark only one oval.



the different nitrogen stores above and below the ground



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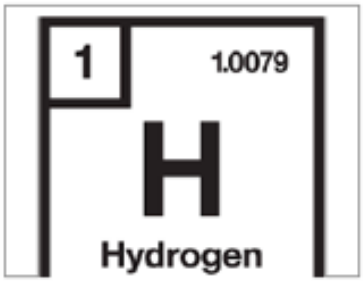
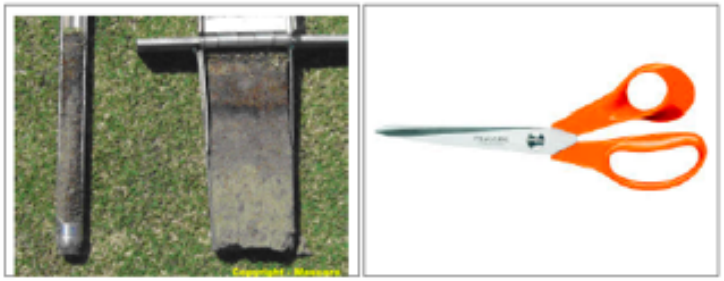


the different hydrogen stores above and below the ground

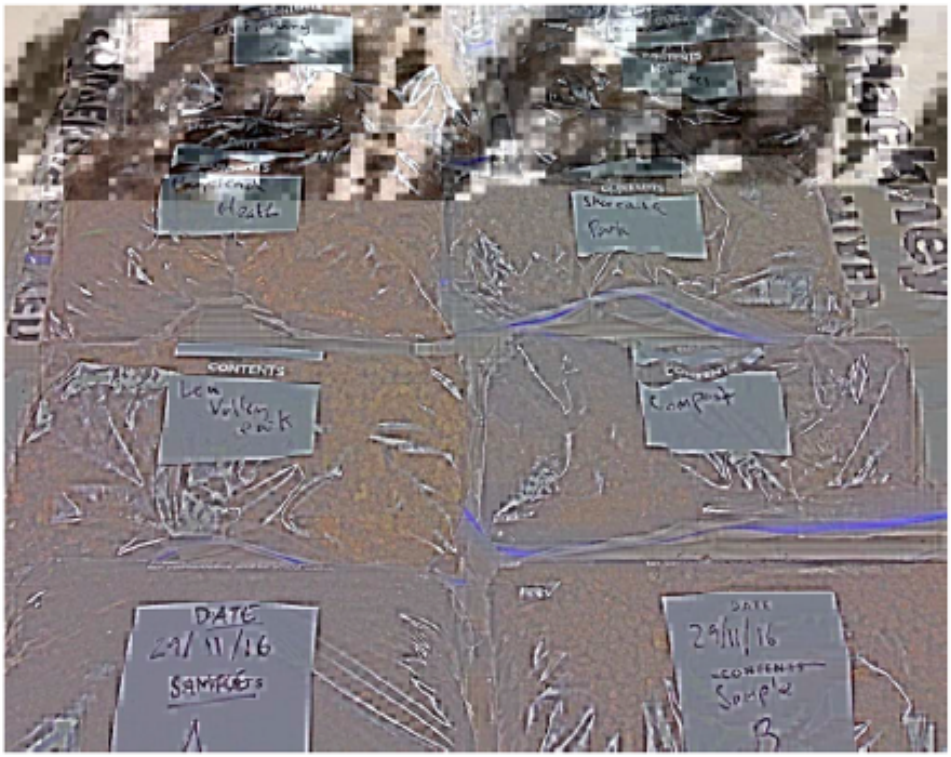
3. **To measure the carbon stores ABOVE the ground, we used the** *
Mark only one oval.



Soil Core technique

Clipping Vegetation Quadrat technique

4. **Soil collected in the field must have an appropriate label for tracking the sample back to the location from which it was collected** *



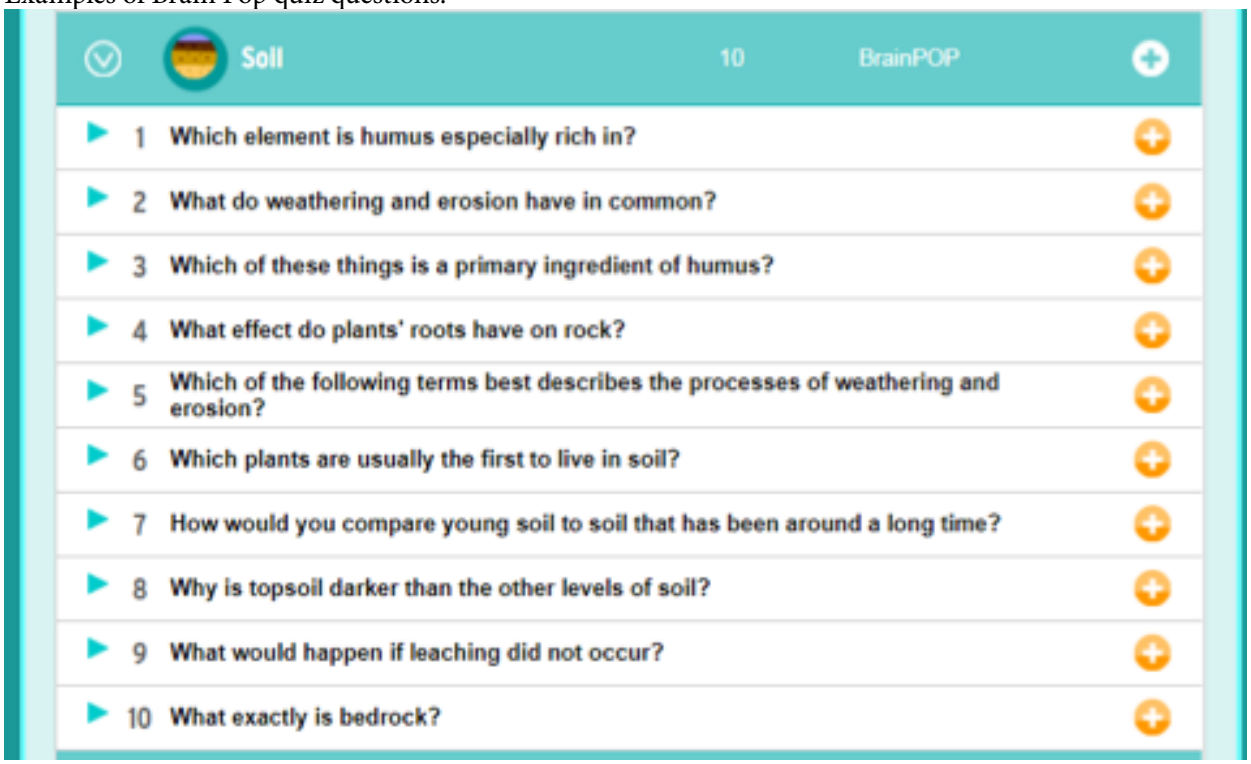
Mark only one oval.

True

False

4. Homework: Brain Pop Soil video & quiz *https://www.brainpop.com/science/earthsystem/soil/*

5. Examples of Brain Pop quiz questions:



6. If you do not have a Brain Pop subscription, here is an alternate HW assignment: Sequestering Carbon in Wetlands You Tube Video *https://youtu.be/2IJz5XSpW1I*

Vocabulary

- Carbon-content
- Biomass
- Wetland
- Quadrat
- Soil horizon
- Carbon sequestration

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)

Lesson #1 Objectives (Goal): Contrast the wetlands store carbon above versus below ground

1. Students will collect and measure samples to contrast the different carbon-stores above and below ground
   - **A.** Stored carbon amount in wetland ecosystem
     1. Above ground (10x10 cm area) — Collect
        - **a.** Clipping vegetation quadrat
          - to dry and mass material
          - convert mass and area carbon /meter2 to calculate density
          - Live biomass has 50% carbon (multiply 50% x dry mass in grams)
     2. Below ground (same 10x10 cm area) — Observe
        - **a.** Munsell Chart soil sample to visual carbon layers
          - Photograph core sample, before pulling it out of the ground, looking for horizon layers
          - If possible, identify color/texture decomposition gradients
     3. Below ground (same 10x10 cm area) — Collect soil core to measure its bulk density
        - **a.** Procedure: Soil sample biomass bulk density in grams/cubic centimeter (below ground)
          - Dry mass density — remove water content
          - Oven temperatures
            i. wetlands ~60 degrees C for 48 hours (organics dry at lower temperatures than minerals)
          - If no oven available, air dry in sunny warm place. Option to have students weigh sample regularly until the weight becomes stable.
   - **B.** Measure stored camount of carbon in ecosystem
     - Wetland stored carbon
       i. above ground live 50% x dry weight
       ii. below ground 12% – 18%* x dry weight
   - **C.** Students complete Data Summary Chart

Primary-Source Data Table

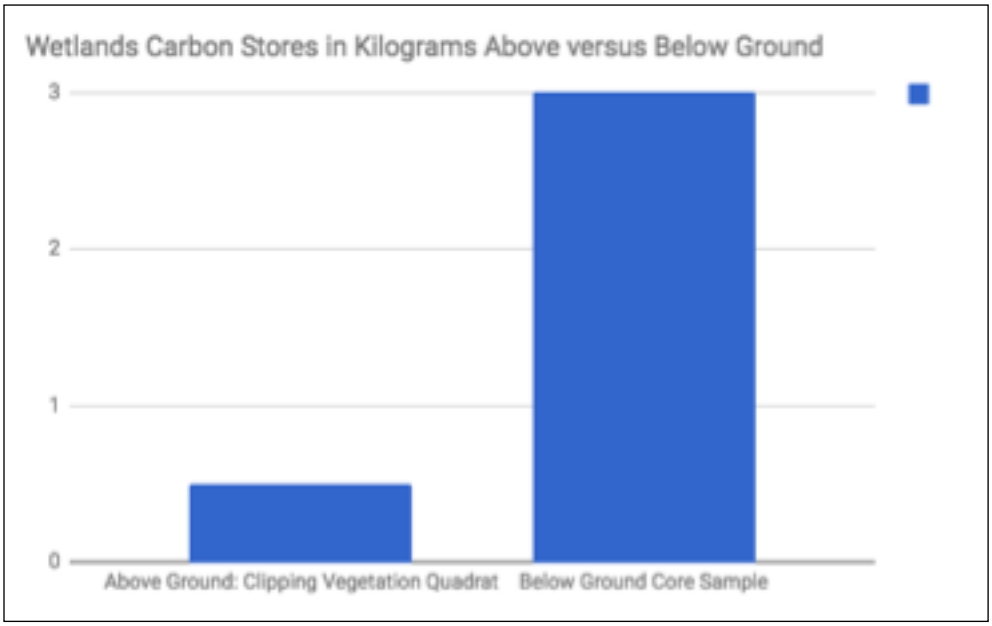
Wetland carbon-stores above and below ground

Date:

Location:

Sampling Technique	Measurement Type	Carbon Content in grams	Rank Carbon Amount
Above-Ground: Clipping Vegetation Quadrat	Live Biomass		
Below-Ground Core Sample	Soil Bulk Density		

Sample Graph



D. Observe collected photographic evidence

1. Take pictures during field work of above- and below-ground samples
2. Show students photographs during classroom data table discussion to link observation with data evidence

Materials

- tape measure
- compass
- flagging
- chalk
- soil corer
- shovel
- munsell color chart
- zip-lock bags/containers
- 10x10 cm quadrat
- scissors
- drying oven
- camera (cell phone camera is fine)
- graphing spreadsheet

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Soil Carbon Content Above Ground versus Below Ground	
1. Start the poem with above-ground carbon amount is used as a noun, which is one word, as the first line. Center carbon on the page as you will for all the remaining lines of the diamante.	*Above Ground Soil*
2. Write two adjectives to describe carbon below ground. This makes up line two. (2 adjectives)	
3. Write three action words which end in "ing" and tell more about carbon in above-ground soil. This forms line three. (3 "ing's")	
4. For line four, write four nouns total. The first two nouns should tell about above-ground conditions. The second two nouns should tell about below-ground carbon content. An alternate version is to write four nouns that tell about soil both above and below ground soil-carbon. (4 nouns to switch form above to below ground carbon)	
5. Write three action words which end in "ing" to tell more about carbon in below-ground soil. This forms line five of the poem. (3 "ing's")	
6. Write two adjectives that describe soil below ground carbon for line six. (2 adjectives)	
7. To form the final line of the diamante poem, write Below-Ground Soil. This is one word and is a noun also. (1 noun)	*Below Ground Soil*

What is a diamante poem?

A diamante is fun and easy to write. The purpose is to go from the subject at the top of the diamond to another totally different (and sometimes opposite) subject at the bottom. Here are examples of what a diamante poem looks like and how the lines are both formed and organized. The general shape of the poem should resemble a diamond.

Winter
cold, icy
freezing, frosting, snowing
blizzards, flurries--melting, sweating
sunshine, sprinklers, blue sky
warm, heat
Summer.

Friend
care, share
trusting, loving, laughing
secrets, helping--lies, strangers
scary, frightening, weaknesses
hate, dislike
Enemy.

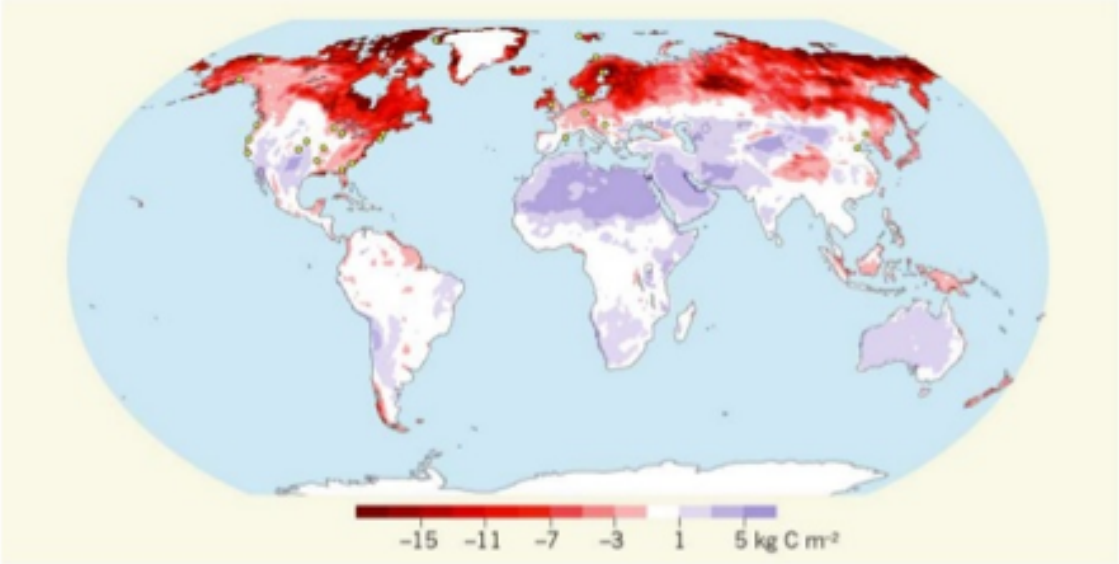
Baby
small, cute
cuddling, crawling, teething
giggling, spitting--faxing, telephoning
working, fully grown, laughing
large, mature
Adult.

Dog
Playful, friendly
Barking, wagging, jumping
Companion, playmate, master, friend
Sleeping, purring, playing
Soft, independent
Cat

Notes and Comments: Resources for Class Discussion

A new twist to our story: Soils are losing carbon across the northern part of the globe

Map of predicted changes in soil C stocks due to a 1°C rise in temperature by 2050 under a 'no acclimatization' scenario.



Source: Crowther et al., (2016)

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