April 2021

Lesson Plan - Where is the Carbon?

Center for Urban Resilience

LESSON 4: WHERE'S THE CARBON?

OVERVIEW:

Students will review the carbon cycle focusing on its qualities as a system. The lesson begins with a class discussion in order to illicit students' prior ideas about the carbon cycle in terms of where it comes from and where it goes in the earth's system. Then the teacher presents a PowerPoint presentation that discusses the inputs and outputs of carbon into the atmosphere and stresses the role of photosynthesis and cellular respiration in the cycling of carbon among the various reservoirs on Earth. Students will then simulate the movement of carbon throughout the carbon cycle by playing a game. The class ends with a discussion of the impact of humans on the carbon cycle and the importance of greenhouse gases in global warming.

SUB-QUESTION:

How does carbon cycle through the earth's system?

Ways of Knowing Urban Ecology:

	Students will…
Understand	• Recognize that carbon can be found in the environment within organic and inorganic compounds. *(ecosystem state and structure)* • Understand the various sources of inputs and outputs associated with the carbon cycle. *(ecosystem change, forces and drivers, ecosystem state and structure)* • Recognize that carbon moves throughout various carbon reservoirs on Earth. *(ecosystem change, ecosystem state and structure)*
Talk	*No specific goals connected with talking about urban ecology in this lesson.*
Do	• Simulate the movement of carbon through different reservoirs or sinks in the carbon cycle.
Act	*No specific goals connected with acting on urban ecology in this lesson.*

SAFETY GUIDELINES

No specific safety issues are associated with this lesson.

PREPARATION:

Time:

1-2 periods (Game playing may extend into the next day)

Materials:

Activity 4.1

PowerPoint presentation about the Carbon Cycle

Activity 4.2

Carbon Cycle Game obtained from http://gk12.asu.edu/node/45 . Print one game board and game card set for each group of 5 students. If printed on a large format printer, game boards can be laminated. If printed on a letter-sized printer, print on card stock and tape sections of game board together. Print game cards on card stock and cut out. Place one die with each game board. Paint 5 nuts and bolts for each game board 5 different colors. These will be the game pieces. Substitute nuts and bolts with other game pieces if it is more convenient.

Also, game cards with stars can be removed to simulate the carbon cycle without human industrial contributions to the cycle.

Per Group

One Game Board and set of Game Cards (best if laminated)
5 different colored game pieces (one per student)
One Die
Game Instructions

Per Student

Carbon Cycle Game Worksheet
Carbon Cycle Picture Worksheet
Comprehension Worksheet

Reflections:

Student notebooks

INSTRUCTIONAL SEQUENCE

Activity 4.1: Discussion – The Carbon Cycle:

1. Begin class by reviewing the key points discussed about the greenhouse effect from prior lessons. Ask students – Does anyone remember how the greenhouse gases worked to warm the earth?
    - Build up of greenhouse gases: greenhouse gases in the atmosphere absorb energy from the sun and trap it. The increased energy increases the average kinetic energy of the molecules therefore increasing the overall temperature of the atmosphere.
2. Does anyone remember any of the examples of greenhouse gases that we talked about earlier? Where do you think these gases come from? Besides water, what is common about the other molecules (carbon)? Where do you think carbon comes from and how does it move through the earth's system?

- Lesson 2 PowerPoint introduced the following as greenhouse gases – CO_2, H_2O, CH_4 (Methane) and CO.
- At this point, the curriculum has not discussed where the greenhouse gases specifically come from. The purpose is for them to brainstorm ideas before they explore this in more detail in this lesson.

3. After getting initial ideas from the students, the Carbon Cycle PowerPoint which has been included with this lesson can be presented to the class. Notes have been provided for your use as you present the PowerPoint.

Activity 4.2: The Carbon Cycle Game (obtained from Arizona State University http://gk12.asu.edu/node/45)

1. Introduce Game

- Tell students that in order to better understand the carbon cycle that we have been talking about, they are going to play a game where they are going to be carbon and they will be cycling through the earth's system.

2. **Students Play Game**

- Have students play the game in groups of 3-5.
- Half of the class should be playing the game with all the cards provided (modeling the carbon cycle with human impact). The cards with red stars should be removed for the other half of the class (modeling the carbon cycle without human impact).
- Allow students to play the game for the rest of the class period. If you want to continue playing the game the next day, students can start at the last pool location they entered on their worksheet. It is best if most students make it back to vegetation once before stopping the game.
- Once the game is stopped, have students draw their paths using arrows on the Carbon Cycle worksheet.

3. Discussion

- Come back together as a whole class and ask students to share some of their experiences playing the game. For example, you may want to ask students – Is there anything that surprised you in terms of the path you took as a carbon molecule? What were the differences in the paths for the individual in your group who one versus someone who never reached vegetation again?
- Compare groups both with and without human impact.
- Show PowerPoint slide of carbon cycle with human impacts. Ask students what are some of the differences we see here in the carbon cycle compared to when humans are not a part of this system?

Concluding the Lesson

1. As an end of the class reflection, have students consider the following question in discussion or writing: Given your understanding of global warming, why is

important that the amount of carbon dioxide in the atmosphere does not increase or decrease substantially?