

Lesson Plan: Teaching the Carbon Cycle through Climate-related Examples

As a **high school** or **undergraduate Chemistry or Earth Sciences** teacher, you can use this set of computer-based tools to help you in teaching topics in **environmental chemistry** such as **the carbon cycle** or **biogeochemical cycles**.

This lesson plan allows students to understand the carbon cycle, its components, and the flow among the different components of this biogeochemical cycle. The activity will introduce the link between the carbon cycle and climate. It will also explore how human activity (such as increased fossil fuel use) may affect the natural carbon cycle, and may thus cause climate-related changes.

Thus, the use of this lesson plan allows you to integrate the teaching of a climate science topic with a core topic in Chemistry.

Use this lesson plan to help your students find answers to:

- *What is the role of weathering of rocks in the carbon cycle? What are the chemical reactions in this process?*
- *Which components in the carbon cycle act as carbon sinks?*
- *If fossil fuel usage increases, what would be the effect on the different carbon sinks? What would be the possible changes in the Earth's climate?*
- *What are the possible impacts of deforestation on the natural carbon cycle? How might these changes affect the Earth's climate?*

About the Lesson Plan

Grade Level	High school, Undergraduate
Discipline	Chemistry

Topic(s) in Discipline	Environmental Chemistry, Carbon Cycle, Biogeochemical Cycles
Climate Topic	Long-term Cycles and Feedback Mechanisms
Location	Global
Access	Online
Language(s)	English
Approximate Time Required	120 – 160 min

1 Contents

- 1. Interactive diagram (~30 min)** An interactive diagram that introduces the global carbon cycle, its components, and the flow among the various components through video clips and images.
https://www.sciencelearn.org.nz/image_maps/3-carbon-cycle
- 2. Reading (20 – 30 min)** A reading that provides an overview of the carbon cycle, and explains the link between the carbon cycle and the Earth's climate.
<http://www.columbia.edu/~vjd1/carbon.htm>

3. Classroom/Laboratory activity (Simulation and associated exercises) (60 – 90 min)

A classroom/laboratory activity using an interactive simulation and associated exercises to explore and analyze how human activities may affect the natural carbon cycle, and to discuss the potential effects on the Earth's climate.

<https://www.learner.org/courses/envsci/interactives/carbon/index.php>

4. Suggested questions/assignments for learning evaluation

- What is the role of weathering of rocks in the carbon cycle? What are the chemical reactions in this process?
- Which components in the carbon cycle act as carbon sinks?
- If fossil fuel usage increases, what would be the effect on the different carbon sinks? What would be the possible changes in the Earth's climate?
- What are the possible impacts of deforestation on the natural carbon cycle? How might these changes affect the Earth's climate?

2 Step-by-step User Guide



Here is a step-by-step guide to using this lesson plan in the classroom/laboratory. We have suggested these steps as a possible plan of action. You may customize the lesson plan according to your preferences and requirements.

1. Topic introduction and discussion through an interactive diagram

- Introduce the topic of the global carbon cycle by using the interactive diagram "[Carbon Cycle](#)", from the Science Learning Hub (New Zealand).
- Students can observe the components of the carbon cycle and observe the flow among these parts. They can interact with the components by clicking on them to learn more details.

The interactive tool, “Carbon Cycle”, can be accessed at https://www.sciencelearn.org.nz/image_maps/3-carbon-cycle.

2. Read about the topic

Then, use the reading “[The Carbon Cycle and Earth’s Climate](#)” from Columbia University to discuss details of the carbon cycle, some of the chemical reactions involved in the cycle, and the role of the carbon cycle in the Earth’s climate.

The reading, “The Carbon Cycle and Earth’s Climate”, is available at <http://www.columbia.edu/~vjd1/carbon.htm>.

3. Conduct a classroom/laboratory activity

Next, conduct a classroom/laboratory activity “[Carbon Lab](#)” (from Annenberg Learner’s Habitable Planet) to further explore the topic in an engaging manner.

This activity uses a simulation and associated exercises for students to explore and analyze possible anthropogenic impacts on the carbon cycle, and how such changes may impact our climate.

- Read the overview of the Carbon Lab at <https://www.learner.org/courses/envsci/interactives/carbon/index.php>.
- Conduct the activity described in The Carbon Cycle (Step 1, Step 2, and For Your Consideration) at: https://www.learner.org/courses/envsci/interactives/carbon/carbon_cycle_1.php.
- The simulator for the activity is accessible at: <https://www.learner.org/courses/envsci/interactives/carbon/carbon.html>.

Questions/assignments are available at the end of the activities in The Carbon Cycle (Step 1, Step 2, and For Your Consideration).

4. Questions/Assignments

Use the tools and the concepts learned so far to discuss and determine answers to the following questions:

- *What is the role of weathering of rocks in the carbon cycle? What are the chemical reactions in this process?*
- *Which components in the carbon cycle act as carbon sinks?*
- *If fossil fuel usage increases, what would be the effect on the different carbon sinks? What would be the possible changes in the Earth's climate?*
- *What are the possible impacts of deforestation on the natural carbon cycle? How might these changes affect the Earth's climate?*

3 Learning Outcomes

The tools in this lesson plan will enable students to:

- describe the global carbon cycle and its components
- explain the flow among the components in the carbon cycle
- discuss the role of the carbon cycle in climate
- analyze and discuss the impact of human activities (such as the use of fossil fuels) on CO₂ levels in the carbon cycle
- predict the possible effects of excess carbon in the system on the Earth's climate

4 Additional Resources



If you or your students would like to explore the topic further, these additional resources will be useful.

1. Video

A short video, "The carbon cycle", from the World Meteorological Organization (WMO):

https://www.youtube.com/watch?v=E8Y6L5TI_94

2. Model

A carbon cycle model in InsightMaker, "The Carbon Cycle", as initially proposed by Bill White of Cornell University, adapted and created by France Caron:

<https://insightmaker.com/insight/79473/Global-Carbon-Cycle>

3. Interactive model

An interactive model of the Terrestrial Carbon Cycle, “Land Carbon Budget with Growing Plants & Three Decomposing Pools,” from the Denning Research Group at Colorado State University:

<http://biocycle.atmos.colostate.edu/shiny/Land/>

5 Credits/Copyrights

All the teaching tools in our collated list are owned by the corresponding creators/authors/organizations as listed on their websites. Please view the individual copyright and ownership details for each tool by following the individual links provided.

We have selected and analyzed the tools that align with the overall objective of our project and have provided the corresponding links. We do not claim ownership of or responsibility/liability for any of the listed tools.

1. Interactive diagram, “Carbon Cycle” [The Science Learning Hub, New Zealand](#)
2. Reading, “The Carbon Cycle and Earth’s Climate” [Columbia University \(New York\)](#)
3. Classroom/Laboratory activity [The Habitable Planet from Annenberg Learner](#)
4. Additional Resources [The World Meteorological Organization \(WMO\)](#);
[Bill White \(Cornell University\) and France Caron](#);
[Denning Research Group \(Colorado State University\)](#)