

Understanding the Carbon Cycle : A Jigsaw Approach

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Abstract

How does carbon move through our planet? How long does it reside in various reservoirs? Understanding the carbon cycle is critical to determining how long CO₂ will reside in the atmosphere. Since CO₂ is the most important greenhouse gas, this knowledge is fundamental for our ability to predict how climate change will occur.

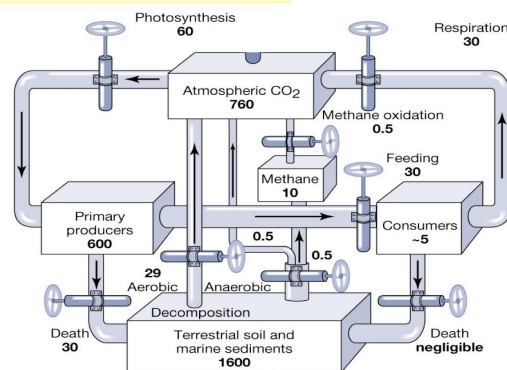
In this "jigsaw" exercise, each student is assigned one of five processes in the carbon cycle to research, fully understand, and then explain to others in small groups. At the end of class all students will know about each of the five processes, and thus develop an integrated understanding of the entire carbon cycle. The jigsaw approach focuses on listening, speaking, co-operation, and integration of individual processes into the entire carbon cycle.

Background:

A thorough understanding of the carbon cycle is fundamental to understanding the eventual fate of CO₂. To achieve this, students must understand individual processes, such as photosynthesis and decomposition, as well as how these processes relate to each other.

As in a jigsaw puzzle, each student's part is essential for the full understanding of the carbon cycle. If each student's part is essential, then each student is essential, which is what makes this strategy so effective.

My experience is that this approach is a highly efficient way for students to learn the material. In addition, the jigsaw process encourages listening, engagement, and collaboration by giving each member of the group an essential part to play in the academic activity. Group members must work together as a team to learn the material.



Short-term terrestrial carbon cycle

reservoir sizes in Gt C, fluxes in Gt C/yr
from The Earth System, Kump et al., 2004

Nuts and Bolts

There are five fundamental processes involved in the short-term terrestrial organic carbon cycle: photosynthesis, respiration, feeding, death, and decomposition. The objective of this one-day exercise is to have each student become an expert in one of these five processes, and then explain to others in their small group the essentials of this process.

Before class, each student is asked to research and fully understand one aspect of the carbon cycle. They write one to two pages fully describing this process, including answering the following questions:

- Where does this process occur in the biosphere and geosphere?
- What is the correct **chemical equation** to describe the process?
- What is the **rate** of the process, with correct units?
- What is the **residence time** of carbon in the reservoir that leads to this process?
- How does this process affect or **control atmospheric CO₂**?

In class, the now expert students first consult with other classmates who have studied the same process to strengthen and deepen their understanding. They then form teams of five students and explain to other students their particular process. In exchange, other students explain additional aspects of the carbon cycle. Finally, one or two groups presents to the entire class, with class discussion. At the end, all students develop a comprehensive understanding of the integrated organic C cycle.

Students research specific processes individually

(each word represents one student studying one process)

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|------------------|---------------|---------|-----------------|-----------|
| • Photosynthesis | • Respiration | • Death | • Decomposition | • Feeding |
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Assessment:

Students are assessed according to their:

- understanding of one process as reflected in written assignment;
- class participation and engagement;
- understanding of entire carbon cycle assessed in examination.

Summary:

A jigsaw approach encourages collaboration, co-operation, and avoids a lecture-based approach to delivering content. Each student becomes an expert and also must rely on others to complete their understanding. Students recognize the importance of each individual process, and how each process fits into the rather complex integrated carbon cycle. Additional processes can be added for advanced classes including long-term processes such as sedimentation and burial in rocks.

