Lesson Title	The Carbon Cycle and Soils
Length of Lesson	50 minutes
Created By	Cheryl McLaurin
Subject	Earth and Space Science
Grade Level	10-12
State Standards	5.a.
DOK Level	1,2,3, & 4
DOK Application	Connect, Assess, Categorize, Draw Conclusions
National Standards	A: Science as Inquiry, C: Life Science, D: Earth and Space Science
Graduate Research Element	Soil's role as a carbon source and sink is an important part of soil classification.

Student Learning Goal:
Students will learn about the carbon cycle, its sources and sinks, and the pedosphere's place in the carbon cycle. Students will then be presented with a variety of scenarios and asked to identify and discuss the carbon movement through the scene.

State Standards for Earth and Space Science:
5. Apply an understanding of ecological factors to explain relationships between Earth systems.

a. Draw conclusions about how life on Earth shapes Earth systems and responds to the interaction of Earth systems (lithosphere, hydrosphere, atmosphere, and biosphere). (DOK 3)

• Geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) that interact through time to cycle matter and energy, and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming and channeling of rivers).

Students will be taught the dynamics of the carbon cycle and will then use this information to analyze different natural and anthropogenic scenarios for carbon cycling.

National Content Standards for 9^{th}-12^{th}:
A: Science as Inquiry: Recognize and analyze alternative explanations and models.

C: Life Science: Matter, Energy, and Organization in Living Systems:

- As matter and energy flows through different levels of organization of living systems – cells, organs, organisms, communities – and between living systems and the physical environment, chemical elements are recombined in different ways. Each recombination results in storage and dissipation of energy into the environment as heat.

D: Earth and Space Science: Geochemical Cycles:

- Movement of matter between reservoirs is driven by the earth's internal and external sources of energy. These movements are often accompanied by a change in the physical and chemical properties of the matter. Carbon, for example, occurs in carbonate rocks such as limestone, in the atmosphere as carbon dioxide gas, in water as dissolved carbon dioxide, and in all organisms as complex molecules that control the chemistry of life.

Materials Needed (supplies, hand-outs, resources):
Powerpoint, slides of carbon cycle scenarios, soil profiles showing different organic layers.

Lesson Performance Task/Assessment:
Students will be involved in and may lead a discussion analyzing the carbon cycle. This discussion could be used for a participation grade. Students will also be asked to decide which of two soil profiles is more sink or source.

Lesson Relevance to Performance Task and Students:
Comprehension of the mechanisms of the carbon cycle is essential to prediction of the flow of the carbon cycle in a given scenario.

Anticipatory Set/Capture Interest:
Students will asked to trace back the source of increased CO2 in the atmosphere, eventually leading back to CO2 in the atmosphere.

Guided Practice:
A short explanatory lecture will be given. Leading questions will be asked during the discussion period. Two different profiles of soils will be shown and the carbon cycle within the pedosphere will be discussed.

Independent Practice:
The discussion will be mostly student-led, dissecting the carbon cycle in different photos/illustrations.

Remediation and/or Enrichment:
IEP's will be supported. There are many websites with carbon cycle games for review/repetition. Students can also be asked to predict how the carbon cycle would change if the given scenario was tweaked in some way.

Check(s) for Understanding:
Does the student understand that the amount of carbon on the Earth is relatively fixed? How will excesses/deficiencies of carbon affect the carbon cycle and its rate?

Closure:
Students be asked to describe the carbon cycle around them.

Possible Alternate Subject Integrations:
Biology, Botany, Ecology

Teacher Notes:
EPA and NASA have activities for further exercise with the carbon cycle. Darker soil profiles act as more of a carbon source, while soil profiles with carbonates act as more of a carbon sink.