Title: It's a cycle--Yo!
Grade: 9th Grade
Duration: 2 weeks (55 minute periods)
Resources Needed: (scientific journal/notebook, computer (links provided), internet access, colored pencil/markers, blank paper, ruler, compass, protractor.)
NGSS Standards:

- **HS-LS2-5 Ecosystems: Interactions, Energy, and Dynamics**: *Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.*
- **HS-ESS2-6 Earth's Systems**: *Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.*

ELA Standards
Speaking and Listening Standards

1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grades 9–10 topics, texts, and issues,* building on others' ideas and expressing their own clearly and persuasively.
2. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
3. Present information, findings, and supporting evidence clearly, concisely, and logically (using appropriate eye contact, adequate volume, and clear pronunciation) such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose (e.g., argument, narrative, informative, response to literature presentations), audience, and task.
4. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Engage Section:

1. **Word Wall Fun**-- Splitting into teams of 4 (table groups), learners will work on a competitive activity to see who can finish first
2. The Word Wall is presented to the class and teams are asked to define each of them, as in depth as possible, first team with their sheets finished, win. They can use the internet, prior knowledge, or textbooks. They will be sharing their answers out loud.

a. Word Wall Vocabulary

Cycle	Carbon	Carbon Cycle	Geological Carbon Cycle
Weathering/Dissolution	Precipitation of Minerals	Phytoplankton	Burial and Subduction
Photosynthesis	Respiration	Decomposition	Diffusion

1. Video on the Carbon Cycle: https://goo.gl/BtBydQ
2. Ask the learners what they already know about carbon. In what forms is it found on Earth? (beforehand if you want)
3. Discuss the components of the Carbon Cycle.
4. Break learners into groups of three and assign groups various locations such as:
    - Ocean floor
    - Jungle
    - Desert
    - Rock layers• Atmosphere
2. Give the learners 10 minutes to discuss and write about what the carbon cycle might look like in their new location.

Misconceptions we see: Kiddos don't understand that the carbon cycle is more than one simple cycle, but many cycles that work together to balance the carbon on Earth.

Exploration (Station fun)

Learners will be rotating around the different stations throughout various days of our class. The Stations are as follows:

1. **Explore it- Station**: (this is where I spend the majority of my time making sure learners understand the concepts. This is where I guide and check the diagrams the learners are building.
    a. Directions: One member of the group will read the task cards in order. The group will be responsible for completing each of the tasks that are being read.Each member of the group will then write their conclusions down on the lab sheet (provided). Use your Scientific Notebook.
        i. Card #1: The carbon cycle shows how carbon flows among the biosphere, pedosphere, geosphere, hydrosphere, and atmosphere of the Earth. Use the cards and arrows at the table to build a diagram of the carbon cycle. **HINT**: The atmosphere is at the top of the diagram.

        ii. Card #2: Have your teacher check your diagram. A “Check” is required to move forward. Write your own definitions of what you think the following words mean based on your diagram.

2. **<u>Illustrate it: Station</u>**
    a. <u>Directions</u>: Each member of the group will draw a quick sketch on the lab sheet that shows they understand the concept being taught. Use the colored pencils and markers that are provided. The directions for the sketch are provided on the task card at the table.
        i. Use the colored pencils to draw a carbon cycle diagram.
        ii. Your facilitator will allow you to use diagrams as a guide, but you are to make your own illustration. Your take on it is welcome
        iii. You must include the following terms as labels:
            1. **Atmosphere, Diffusion, Respiration, Photosynthesis, Decomposition, Volcanism, Combustion, Fossil Fuel Deposits, Biosphere**

3. **<u>Read it Station</u>**
    a. <u>Directions</u>: Each member of the group will read the passage and answer the questions from the task cards on the lab sheet in the Read It! Section. It is important to remember that the answers will come directly from the reading passage (attached for you to read)
    b. Task Card questions: (Place in your Scientific Notebook)
        i. How is the geological carbon cycle different from the biological carbon cycle?
        ii. How does the most carbon get released back into the atmosphere during the geological carbon cycle?
        iii. What is one way carbon is taken out of the atmosphere?
        iv. Why were the levels of CO2 much higher in the atmosphere millions of years ago?

4. **<u>Watch it Station:</u>**
    a. <u>Directions</u>: Each member of the group will go to the website listed. Every member will answer the questions from the lab sheet provided
        i. Watch the Video: https://www.youtube.com/watch?v=Sd8D7WyVS6A
        ii. Answer the questions as groups in your Scientific Journals
            1. Explain the process of Combustion
            2. How are combustion, respiration, and decomposition similar and different to each other?

3. What are some of the processes that take CO_2 out of the atmosphere?
4. Doodles and diagrams are appreciated to help you process the information.

5. **Organize it Station:**
   a. You should complete a majority of the other stations before this one is completed.
   b. I will make cards that have all of our vocabulary on it, pictures and definitions on front sides. (diffusion, respiration, consumption, etc..)
   c. Learners will mix up the cards, put the corresponding cards together and get it checked off by the facilitator before they may move on. They may test each one another for fun, or see who can go the fastest.
6. **Write it Station**
   a. Explain the role of photosynthesis in the carbon cycle.
   b. Describe two scenarios where respiration can occur.
   c. What is the difference between the geological carbon cycle and the biological carbon cycle?
   d. The carbon cycle is the biogeochemical cycle by which carbon is exchanged among the biosphere, pedosphere, geosphere, hydrosphere, and atmosphere of the Earth. In your own words, how would you rephrase this to teach someone that doesn't understand the Carbon Cycle?
7. **Research it**
   a. https://www.windows2universe.org/earth/climate/carbon_cycle.html
   b. Use the different reservoirs listed below to answer the questions about carbon from that particular environment.
      i. **Soil** – How does carbon get into the soil?
      ii. **Surface Ocean** – What are 3 ways carbon can get into the surface of the ocean?
      iii. **Atmosphere** – What form does carbon most often take in the atmosphere?
      iv. **Land Plants** – Describe the process of carbon as it relates to photosynthesis.
      v. **Deep Ocean** – How does carbon get into the deep ocean?
      vi. **Marine Life** – What role do phytoplankton play in the carbon cycle?

8. **Assess it Station**
   a. Quiz
      i. Which is an example of respiration?

ii. What role does photosynthesis have in the carbon cycle?
iii. Which process(es) add CO2 to the atmosphere?
iv. The burning of fossil fuels adds CO2 to the atmosphere. What is this process called?

Explanation Section:

1. Direct Instruction Lesson (powerpoint attached)
2. Interactive Notes and Flip Book Instructions to be completed as the lesson moves is going on. (attached)
3. This is a great time for me to check for understanding as well.

Elaboration

Decide what your would like to know more about in the carbon cycle of our biosphere. Here are some ideas you might like to investigate. You are not limited to these, if you would like to investigate something else, please ask. Choose a presentation style, this is also up to you. Game, presentation, video, comic, etc...

- How the Earth stores carbon
- Processes that move carbon from one carbon store to another.
- Is there a balance between carbon in storage and carbon released?
- How does the carbon cycle affect weather?
- Does man alter the carbon cycle?
- Geological carbon cycle
- Biological carbon cycle

Evaluation

Make a sketch of a cross section of Earth including atmosphere, ocean, and crustal layers. You may use your Interactive NoteBook to prep. Label the 4 processes for both the geological and biological carbon cycle on your diagram. You may want to add diagrams of organic matter such as plants or animals and inorganic items such as volcanoes, rocks, rivers.
Add arrows to indicate the direction of flow for the carbon.

Geological Carbon Cycle	Biological Carbon Cycle

Weathering and dissolution	Photosynthesis
Precipitation of minerals	Respiration
Burial and subduction	Decomposition
Volcanic eruptions	Diffusion

I will be checking these to ensure they are correct, simple point scale. I will also utilize a checklist to ensure learners are staying on top of their stations as a formative assessment tool. Check-ins are an important part of my assessment routine. The rotations also build in quite a few opportunities for formative assessment. I can check on them at any point and help scaffold learners' needs as they arise.