2.2 Nutrient Cycles in Ecosystems

**What are “Nutrients”?**

* Nutrients are\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Nutrients move­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Nutrients often \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in areas called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Without interference, generally the amount of nutrients flowing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_equals the amount of nutrients \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Human activities can \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of nutrient cycles.
  + Land clearing, agriculture, urban expansion, mining, industry, and motorized transportation can all

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

* + Excess nutrients in the biosphere can have unexpected \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* There are five chemical elements required for life.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cycle between living things and the atmosphere.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cycles in from sedimentary rock.

**The Carbon Cycle**

* + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ are a fundamental unit in cells of all living things.
  + Carbon is also an essential part of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Carbon can be stored in many \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Short-term storage is found \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, in\_\_\_\_\_\_\_\_\_\_\_2 in

the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and in the top layers of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

* + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is found in middle and lower ocean layers as dissolved CO2 and in coal, oil, and gas deposits in land and ocean sediments.

**Carbon Stores**

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ traps many long-term stores of carbon.
  + Layers of soil and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_become buried on land

and under the oceans. Slowly, under great pressure over many years, coal, oil,

and gas form.

* + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_also are deposited in sediments on the ocean floor, forming carbonate rocks like limestone over long periods of time.
* Carbon stores are also known as\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**So How Does Carbon Cycle?**

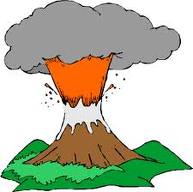
* Carbon is cycled through ecosystems in a variety of ways.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: energy from the sun allows CO2 and H2O to react

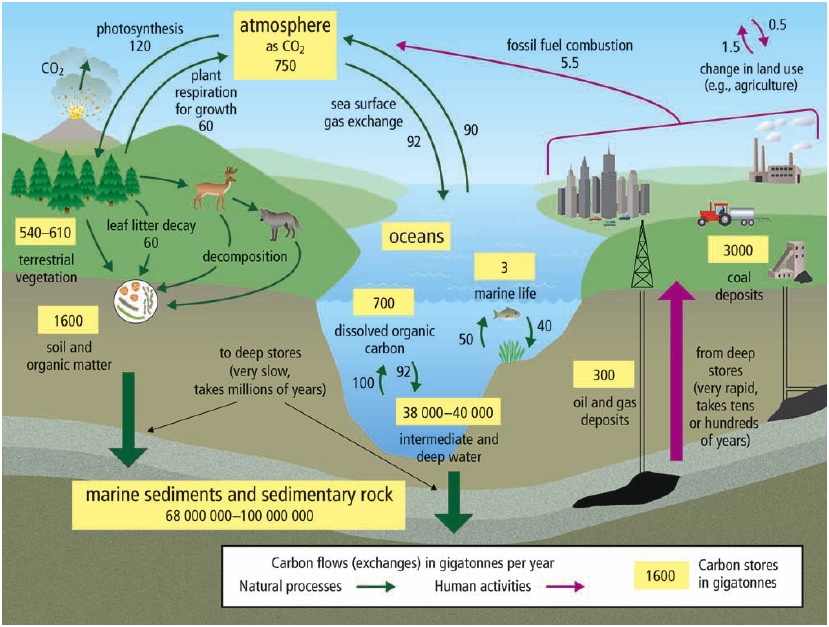
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* + - Transformed by plants (land), algae and cyanobacteria (ocean)
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: carbohydrates release energy in consumers

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* + - The energy released is used for growth, repair, and other life processes
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: decomposers break down large quantities of cellulose
    - Cellulose is a carbohydrate most other organisms cannot break down
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: CO2 dissolves in cold, northern waters and sinks
    - Ocean currents flow to the tropics where the water rises and releases CO2.
    - This process is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: volcanic eruptions can release CO2
    - Forest fires also release CO2.

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**The Whole Carbon Cycle**:

* + Many human activities can influence the carbon cycle.
    - Since the start of the Industrial Revolution (160 years ago), \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ due to the increased burning of fossil fuels.

* + - **The increase in CO2 levels in the previous 160 000 years was 1 - 3 percent**
    - Carbon is being removed from long-term storage more quickly than it naturally would as we mine coal and drill for oil and gas.
    - CO2 is also a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the atmosphere.
  + Clearing land for agriculture and urban development \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
    - Farmed land does not remove as much CO2 as natural vegetation does.



**Carbon Cycle Webquest**

**Directions**: With a partner, visit the following websites and answer the related questions. Your goal is to gain a

better understanding of the carbon cycle. The answers to each question are found on the page if you read

carefully! Write your answers in full sentences. Try to use your own words as much as possible, and don’t copy

something you don’t understand!!

**Background**: In biogeochemical cycles (including carbon, water and nitrogen cycles), elements are transported

between the atmosphere, biosphere (living things), hydrosphere (water), and geosphere (rocks, minerals, and

soils). These cycles help us remember that Earth is a complex system.

**Go to www.windows2universe.org/earth/Water/co2\_cycle.html and answer these questions:**

1. Draw the carbon cycle:

1. How does carbon exist in the atmosphere?
2. How are fossil fuels created?
3. Describe two ways that carbon enters the atmosphere.

1.

2.

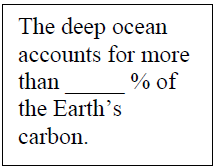
1. How are the oceans involved in the carbon cycle?
2. How is the temperature of the Earth partly controlled by carbon?
3. What role do rocks have within the carbon cycle?

**Go to www.windows2universe.org/earth/climate/carbon\_cycle.html to play the carbon cycle game. You are a carbon atom!**

1. Where are you starting within the carbon cycle?

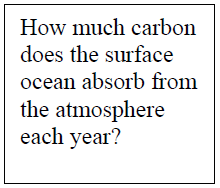
**“Click to begin your journey”**

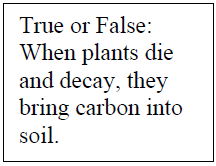
1. How much of the atmosphere is made of carbon dioxide (CO2)?
2. By how much has CO2 increased in the atmosphere during the past 150 years?

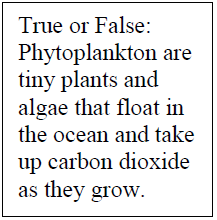
**As you work through this game, take some notes about where you go as a carbon atom.**

**Make sure you visit all reservoirs!**

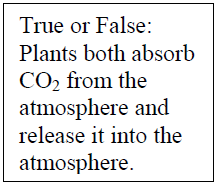
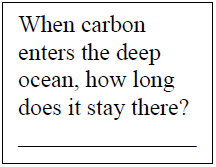
1. Next stop = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ What did you learn?



1. Next stop = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ What did you learn?
2. Next stop = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ What did you learn?
3. Next stop = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ What did you learn?



1. Next stop = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ What did you learn?

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Approximately how many Megatons of Carbon do humans produce by burning fossils fuels each year? (1 Megaton = one million tons)

True or False: The ocean absorbs more carbon dioxide from the atmosphere than the land.