Global Carbon Cycle

The cycling of carbon through photosynthesis and respiration is only part of the global cycling of carbon. Geochemical processes also contribute to carbon cycling. Biological processes transfer carbon between organisms and the environment; geochemical processes transfer carbon between sedimentary rocks and the atmosphere, oceans and living organisms. Biological processes are relatively short term, occurring over years to hundreds of years while geochemical processes work on a time scale of millions of years.

Carbon occurs primarily as carbon dioxide (CO_2) in air and water, organic carbon (proteins, fats, carbohydrates, and nucleic acids) in living and dead organisms, and carbonate ions (CO_3^{-2}) in water, rocks, shells, and bones. To understand how these are connected in a cycle, it is useful to think in terms of sources, sinks, and fluxes. Sources are carbon emitters; sinks are carbon absorbers; fluxes are flows of carbon between sources and sinks. A source may also be a sink. For example, the atmosphere is a source of carbon dioxide for photosynthesis, but it is also a sink for carbon released during respiration, burning, and decay.

Because carbon dioxide is a greenhouse gas, scientists are concerned that continued increases in atmospheric carbon may lead to global climate change.

In this activity you will model the carbon reservoirs and fluxes and consider what might happen to the increasing carbon dioxide produced by human activities.

Table 1: Carbon Reservoirs

Reservoir	Carbon in Gt
Ocean surface	1,000
Ocean life	6
Organic material in ocean	1,000
Deep ocean water	38,000
Ocean sediments	3,000
Sedimentary rocks	100,000,000
Soil	1,600
Fossil fuels	4,000
Living land organisms	600
Atmosphere	750

Table 2: Carbon Fluxes

Direction of Movement	Flux (Gt/yr)
Ocean to atmosphere	102
Atmosphere to ocean	105
Ocean surface to deep waters	39
Deep waters to ocean surface	37
Ocean surface to ocean life	28
Ocean life to ocean surface	29
Soil to atmosphere	60
Life on land to soil	60
Life on land to atmosphere	50
Atmosphere to life on land	110
Deforestation to atmosphere	1.6
Fossil fuel combustion to atmosphere	5.4

1. Use the information in the table "Carbon Reservoirs" to complete the diagram of the global carbon cycle. Put the number of gigatonnes of carbon stored in each reservoir in the small boxes in each reservoir. One gigatonne (Gt) equals 1,000 million tones, and 1 tonne equals 1,000 kg.
2. Table 2 shows the fluxes of carbon between reservoirs, measured in gigatonnes of carbon per year (Gt/yr). Add these fluxes to the diagram of the global carbon cycle. **Clearly label each line and indicate the direction of flow.**

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