



MATH APPLICATION ACTIVITY: THE GLOBAL CARBON BUDGET

INTRODUCTION: Carbon occurs primarily as carbon dioxide (CO_2) in air and water, organic carbon 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.

MATH COMPUTATION WORK: Be sure to show the correct units!

Student Sheet 2

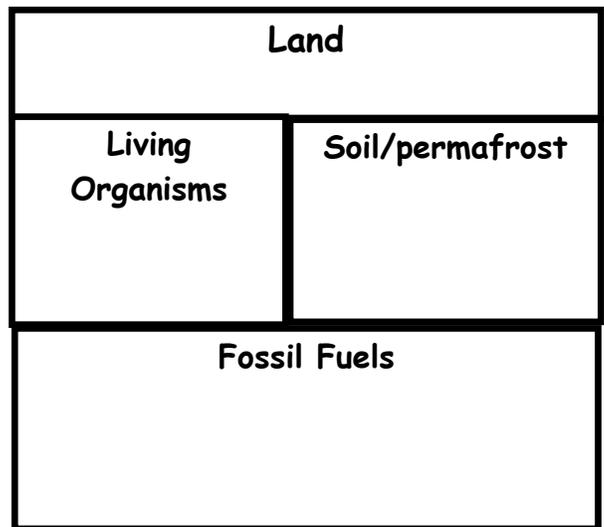
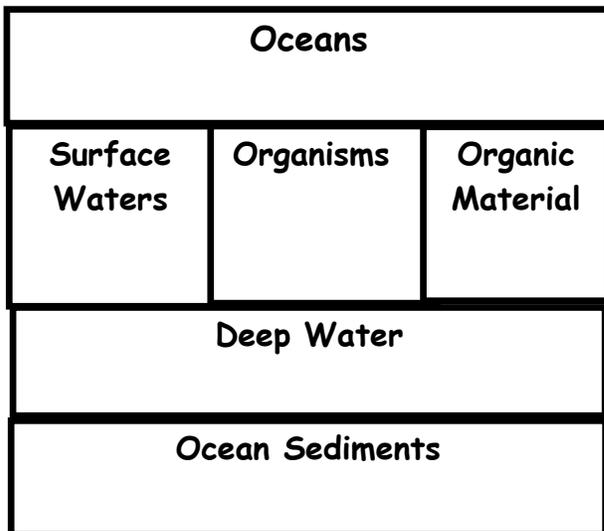
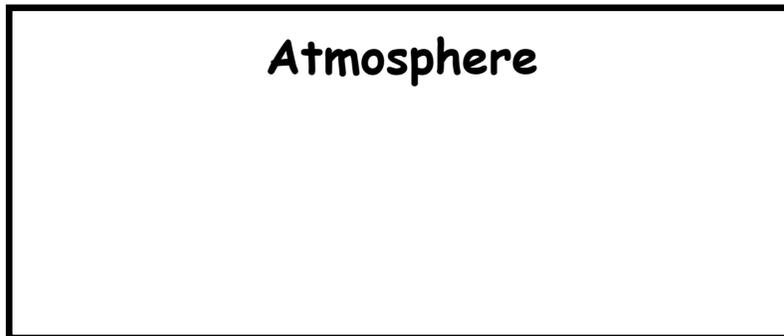
DATA TABLE 1: CARBON RESERVOIRS (Gt)

| RESERVOIR | CARBON in Gt |
|---------------------------|--------------|
| Ocean surface | 1,000 |
| Ocean life | 6 |
| Organic material in ocean | 1500 |
| Deep ocean water | 37,100 |
| Ocean sediments | 1,750 |
| Sedimentary rocks | 100,000,000 |
| Soil/Permafrost | 4,100 |
| Fossil fuels | 2500 |
| Living land organisms | 650 |
| Atmosphere | 830 |

DATA TABLE 2: CARBON FLUXES (GtC/yr)

| DIRECTION OF MOVEMENT | FLUX (GtC/yr) |
|--------------------------------------|---------------|
| Ocean to atmosphere | 78.4 |
| Atmosphere to ocean | 80 |
| Ocean surface to deep waters | 90 |
| Deep waters to ocean surface | 101 |
| Ocean surface to ocean life | 50 |
| Ocean life to ocean surface | 37 |
| Soil to atmosphere | 118.7 |
| Atmosphere to soil | 123 |
| Deforestation/land use change | 1.1 |
| Fossil fuel combustion to atmosphere | 7.8 |
| Geological processes | 0.5 |

GLOBAL CARBON BUDGET



Student Sheet 4

ANALYSIS:

1. Which is the largest reservoir of carbon?
2. Which is the second largest?
3. Which processes release carbon into the atmosphere?
4. What human activities release carbon into the atmosphere?
5. Which processes remove carbon from the atmosphere? Which of these processes is the fastest?
6. Which process in this activity is so long that it is not considered part of the cycle in our diagram?
7. What percentage of the total carbon in the land, ocean and atmosphere (excluding the sedimentary rocks) is in the atmosphere?
8. Considering this answer, why is the level of carbon in the atmosphere considered so important?
9. Scientists monitoring carbon dioxide in the atmosphere estimate that of the 7.1 Gt of carbon dioxide released annually by human activities, approximately 3.2 Gt remain there. Another 2 Gt diffuse into the ocean. How many Gt of carbon are unaccounted for? What are some of the hypotheses to explain what happens to this missing carbon?
10. How large are the pools and fluxes of the global carbon budget?
11. How big is a gigaton of carbon?
12. How do you calculate residence time?
13. Why aren't animals included in the pool?
14. What role do humans play in the carbon cycle?
15. Is the global carbon cycle in balance?