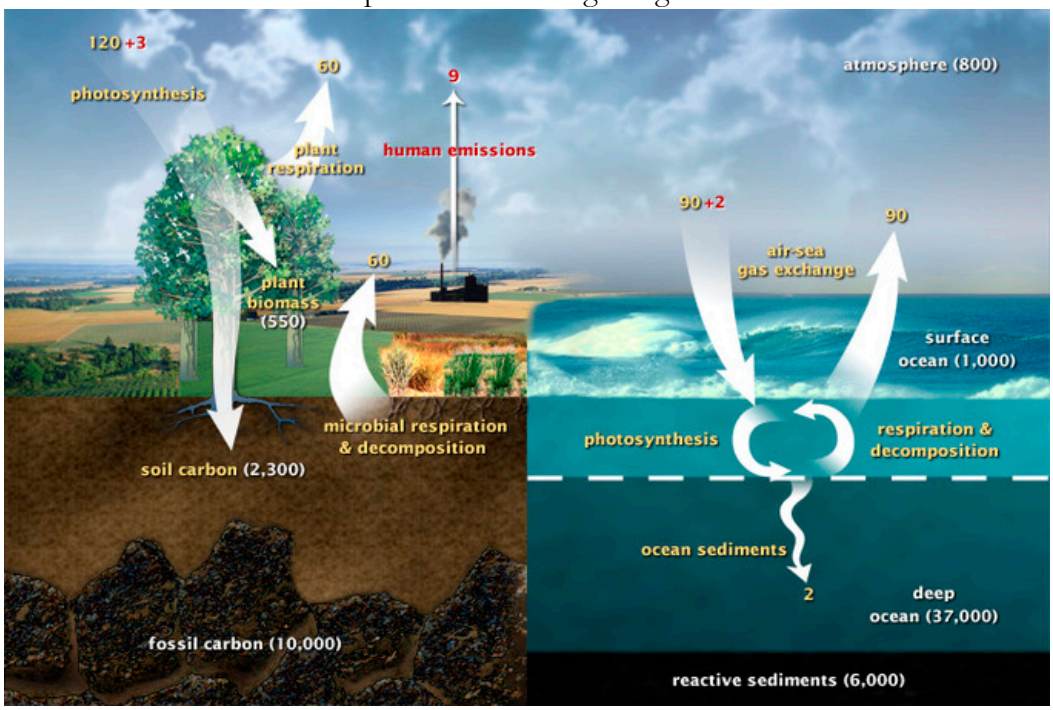
Carbon cycle

- Play this game to follow a carbon atom through the carbon cycle: https://www.windows2universe.org/earth/climate/carbon_cycle.html

Carbon moves through Earth's systems in various chemical forms. The carbon cycle describes how carbon flows through the living and non-living components of Earth systems. The **atmosphere** is an important carbon reservoir, even though CO_2 makes up a very small percent of its total volume. CO_2 and methane are two of the most important greenhouse gases in affecting changes in Earth's temperature. Carbon is the main component of all living things.



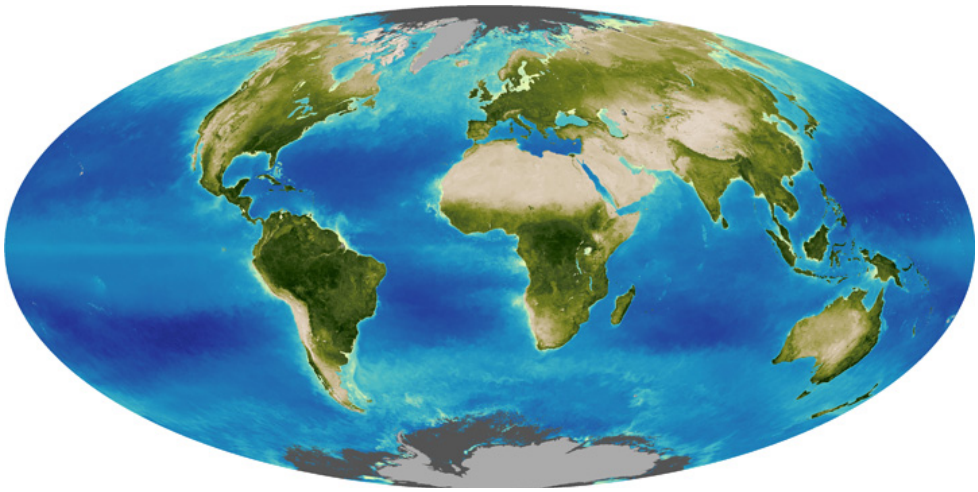
Carbon cycling. Numbers show amount of carbon cycled per year in billions of tons. Image source: Adapted from US DOE.

We know that humans are adding CO_2 to the atmosphere through burning fossil fuels. How is CO_2 removed from the atmosphere?

CO_2 is removed from the atmosphere through several different processes.

1) **Green plants** form the biggest carbon reservoir. Plants and algae take in CO_2 and emit oxygen during photosynthesis. During this process, sunlight provides the energy to combine carbon from the air and hydrogen from water to create glucose. The plant turns glucose into other molecules as it grows and uses them to build leaves, roots, trunk, and flowers. **Almost the entire mass of a huge oak tree comes entirely from the air!** The soil provides water and a few trace elements only.

Look at the extent of plants across the globe in the image on the next page. This will show you just how important a role they play in cycling carbon globally.



The distribution of terrestrial plants (green) and ocean algae (dark blue) indicated by satellite measurements of chlorophyll. NASA Earth Observatory.

Most of the organisms that don't photosynthesize get their carbon by eating organisms that do. This means that CO_2 from the air is the foundation of most food webs on the planet. Animals, like us, release a lot of CO_2 when we breathe out. In fact, by lunchtime, you are very likely exhaling a lot of the carbon that was contained in your breakfast! Besides releasing CO_2 through respiration, livestock also release carbon as methane (CH_4) by burping and farting.

2) Some CO_2 is also removed from the atmosphere through dissolving in surface water, forming carbonic acid. Since CO_2 also dissolves in water droplets in clouds, it is removed from the atmosphere when it rains.

3) Over time, carbonic acid in rain reacts with minerals in exposed rock. Called "weathering," this reaction forms limestone. **Limestone** is an important carbon reservoir. Though the process is slow, limestones store a significant amount of carbon, and do not give up the carbon again easily.

4) When organisms die and rot, they release CO_2 and methane. Much of the carbon in dead organisms either falls to the **bottom of the ocean**, or is stored in the **soil**. These are two significant carbon reservoirs. Wildfires also release some of the carbon in dead plant matter.

Before the rise of industry, carbon taken up by plants was generally balanced by natural emissions. Today photosynthesis removes about a quarter of our CO_2 emissions. About a quarter of our emissions are currently removed by dissolving in the ocean. This will not continue forever. There is a limit to how much more the oceans can hold.

In systems terms. Our emissions are moving carbon from the land component – fossil fuels – into another component – the atmosphere. In carbon cycle terms, fossil fuel and greenhouse gases both represent "reservoirs" of carbon. Emissions represent "flows" of carbon.