Science & Math

What is the carbon cycle?

Carbon is both the foundation of all life on Earth and the source of the majority of energy consumed by human civilization. Swamp ecosystems like this one in Norway are a carbon sink that take carbon out of the atmosphere. Photo: Pixabay/Public Domain

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Carbon is the backbone of life on Earth. We are made of carbon. We eat carbon. Our cars and homes are built and powered by carbon. We need carbon, but that need is also connected with one of our most serious problems: global climate change.

Carbon is the fourth most common element in the universe. Earth has about 65,500 billion metric tons of carbon. Most of it is stored in rocks. The rest is in the ocean, atmosphere, plants, soil and fossil fuels, like coal and oil.

Carbon flows between each of them in an exchange called the carbon cycle. There is a fast carbon cycle and a slow carbon cycle.

As carbon shifts out of one area, it goes to the others. When carbon ends up in the atmosphere, temperatures get warmer on Earth.

Over the long term, the carbon cycle seems to maintain a balance. This balance helps keep Earth's temperature relatively stable.

Rocks Break Down, Eventually Turn Into Shells

Carbon takes 100 million to 200 million years to move between rocks, soil, ocean and atmosphere in the slow carbon cycle. On average, 10 million to 100 million metric tons of carbon move through the slow carbon cycle every year. Human emissions of carbon to the atmosphere are 10 to 100 times more than that.

Rain moves carbon from the atmosphere to rocks. The rain causes the rocks to break down. Rivers carry pieces of rock, called sediment, to the ocean.

In the ocean, coral and plankton turn those bits into shells. After they die, they sink to the seafloor. Over time, layers of shells and minerals are cemented together and turn to rock, storing the carbon in stone.

This is how most carbon-containing rock is made. The other rocks come from living things that have been embedded in mud. Over millions of years, heat and pressure turn the mud and carbon into rock. In certain places, carbon turns into oil, coal or natural gas.

The slow cycle returns carbon to the atmosphere when volcanoes erupt. They release the carbon dioxide into the atmosphere. They also cover the land with fresh rock to begin the cycle again.

If volcanoes raise the carbon dioxide in the atmosphere, temperatures rise, leading to more rain. That breaks down more rock, which will eventually put more carbon on the ocean floor.

The oceans also absorb and release carbon dioxide at the surface. Once in the ocean, carbon makes the ocean more acidic.

Human activity has increased carbon concentrations in the atmosphere. The ocean now takes more carbon from the atmosphere than it releases.

Plants Take In Carbon

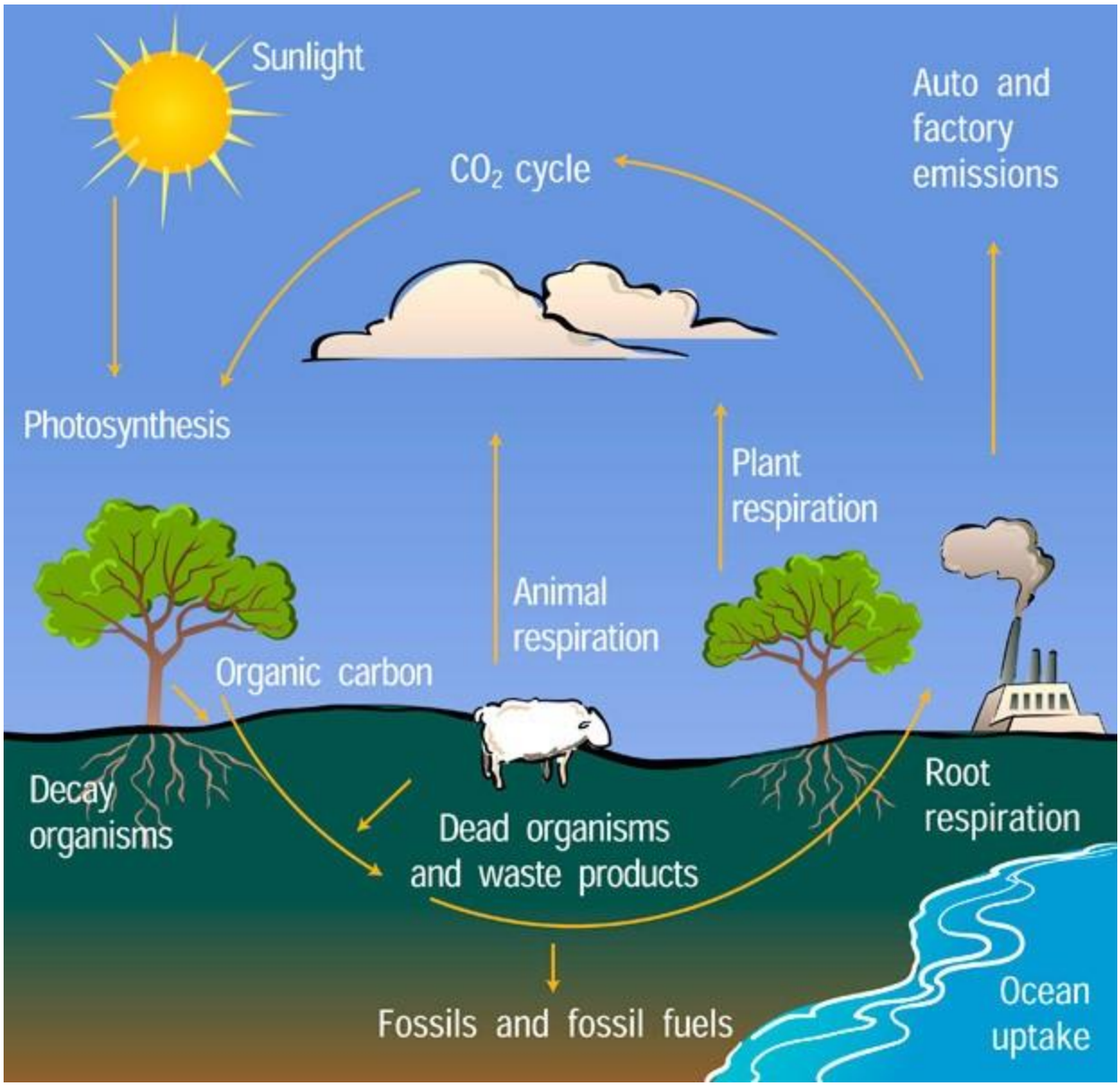
The fast carbon cycle is how carbon moves through life forms on Earth. Between 10 million and 100 million metric tons of carbon move through the fast carbon cycle every year.

Carbon is an important part of life on Earth. All living things have carbon in their cells.

Plants take carbon dioxide from the atmosphere by absorbing it into their cells.

There are four ways that carbon returns to the atmosphere from plants. Plants break down the carbon to grow. Animals and people eat the plants. Plants die and break down at the end of the growing season. Fire consumes plants.

In all four cases, the carbon dioxide released usually ends up in the atmosphere. Plant life plays a huge role in the fast carbon cycle. That is why carbon dioxide concentrations fluctuate based on the season. When it is winter in the Northern hemisphere, few plants are growing and many are decaying, which releases carbon dioxide. That causes carbon dioxide concentrations to climb. When plants begin to grow again, they absorb more carbon dioxide. Then, the concentrations drop.


Sunlight
CO_2 cycle
Auto and factory emissions
Photosynthesis
Plant respiration
Animal respiration
Organic carbon
Decay organisms
Dead organisms and waste products
Root respiration
Fossils and fossil fuels
Ocean uptake