What is the carbon cycle?

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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

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.

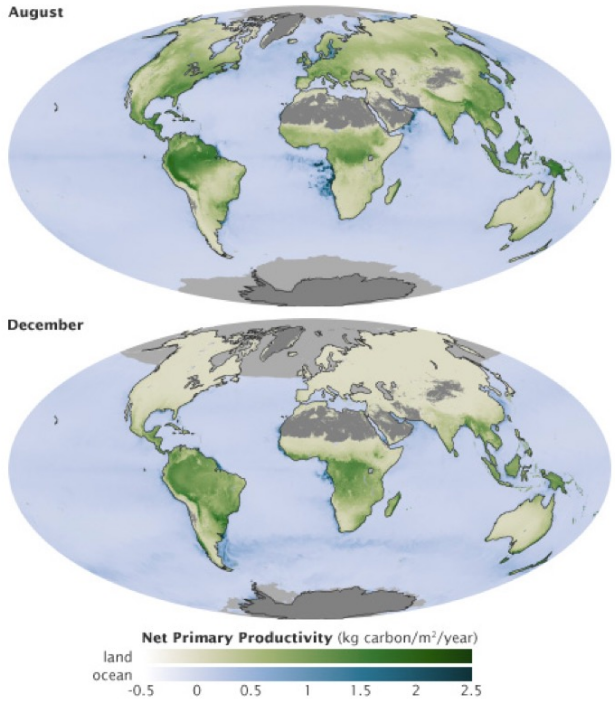
Carbon is an important part of life on Earth. All living things have carbon in their cells.

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.



The fast carbon cycle is visible in the changing seasons. As the large land masses of Northern Hemisphere green in the spring and summer, they draw carbon out of the atmosphere.

These maps show the amount of carbon consumed by plants on land (green) and in the oceans (blue) during August and December, 2010. In August, the green areas of North America, Europe, and Asia represent plants using carbon from the atmosphere to grow.

Graph by Marit Jentoft-Nilsen and Robert Simmon, using data from the NOAA Earth System Research Laboratory. Maps by Robert Simmon and Reto Stöckli/NASA.

Humans Clear Land, Burn Fossil Fuels

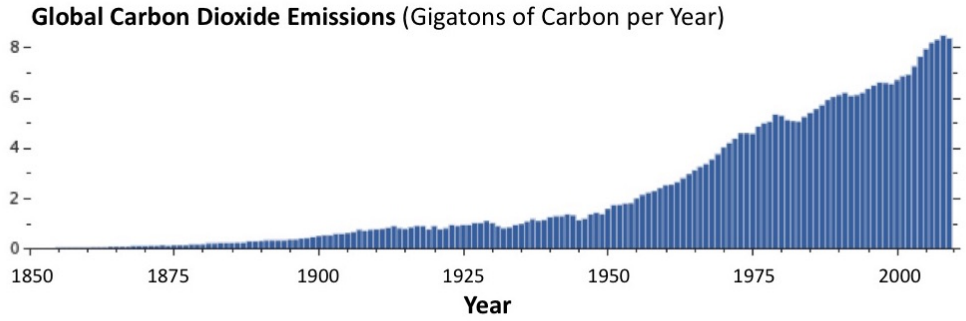
The carbon cycle changes as Earth's climate changes. When the Earth gets cooler, the carbon cycle slows. The carbon in the atmosphere decreases, and that causes more cooling. The opposite happens when temperatures rise. Scientists call these cycles feedback loops.

Today, changes in the carbon cycle are happening because of people. We affect the carbon cycle by burning fossil fuels and clearing land. Humans are currently releasing just under a billion tons of carbon into the atmosphere per year.

Without human interference, the carbon in fossil fuels would leak slowly into the atmosphere over millions of years. By burning coal, oil and natural gas, we speed up the process. Fossil fuels take millions of years to form. That is why they are not a renewable resource. At some point, we will run out.

"Highest Concentration In Two Million Years"

Since people first started burning fossil fuels, carbon dioxide in the atmosphere has risen by 39 percent. That is the highest concentration in two million years.



Emissions of carbon dioxide by humanity have been growing steadily since the onset of the industrial revolution. About half of these emissions are removed by the fast carbon cycle each year, the rest remain in the atmosphere. Graph: NASA.

All of this extra carbon needs to go somewhere. Plants and the ocean have absorbed a little more than half of the extra carbon. A little less than half is in the atmosphere.

Extra carbon in the atmosphere warms the planet. Extra carbon in the ocean makes the water more acidic, putting marine life in danger.

Quiz

1 Which paragraph in the section "Plants Take In Carbon" illustrates a specific example of plant life's effect on carbon levels?

2 Which two of the following are MAIN ideas of the article?

1. *Carbon shifts from one area to others through the slow and fast carbon cycles.*
2. *When the ocean takes in more carbon than it releases, it becomes more acidic.*
3. *Rain breaks down rocks, which are eventually brought to the ocean.*
4. *Human behavior has led to increased carbon levels in the atmosphere.*

(A) 1 and 2

(B) 1 and 4

(C) 2 and 3

(D) 3 and 4

3 Based on information in the article, which of these statements is TRUE?

(A) Plants release carbon when they die at the end of the season.

(B) The ocean now releases more carbon than it absorbs.

(C) When there is less carbon in the atmosphere, the Earth warms up.

(D) Less carbon is released during the winter months of the year.

4 Which detail from the article BEST support's the article's MAIN idea?

(A) In certain places, carbon turns into oil, coal or natural gas.

(B) There are four ways that carbon returns to the atmosphere from plants.

(C) Today, changes in the carbon cycle are happening because of people.

(D) Plants and the ocean have absorbed a little more than half of the extra carbon.