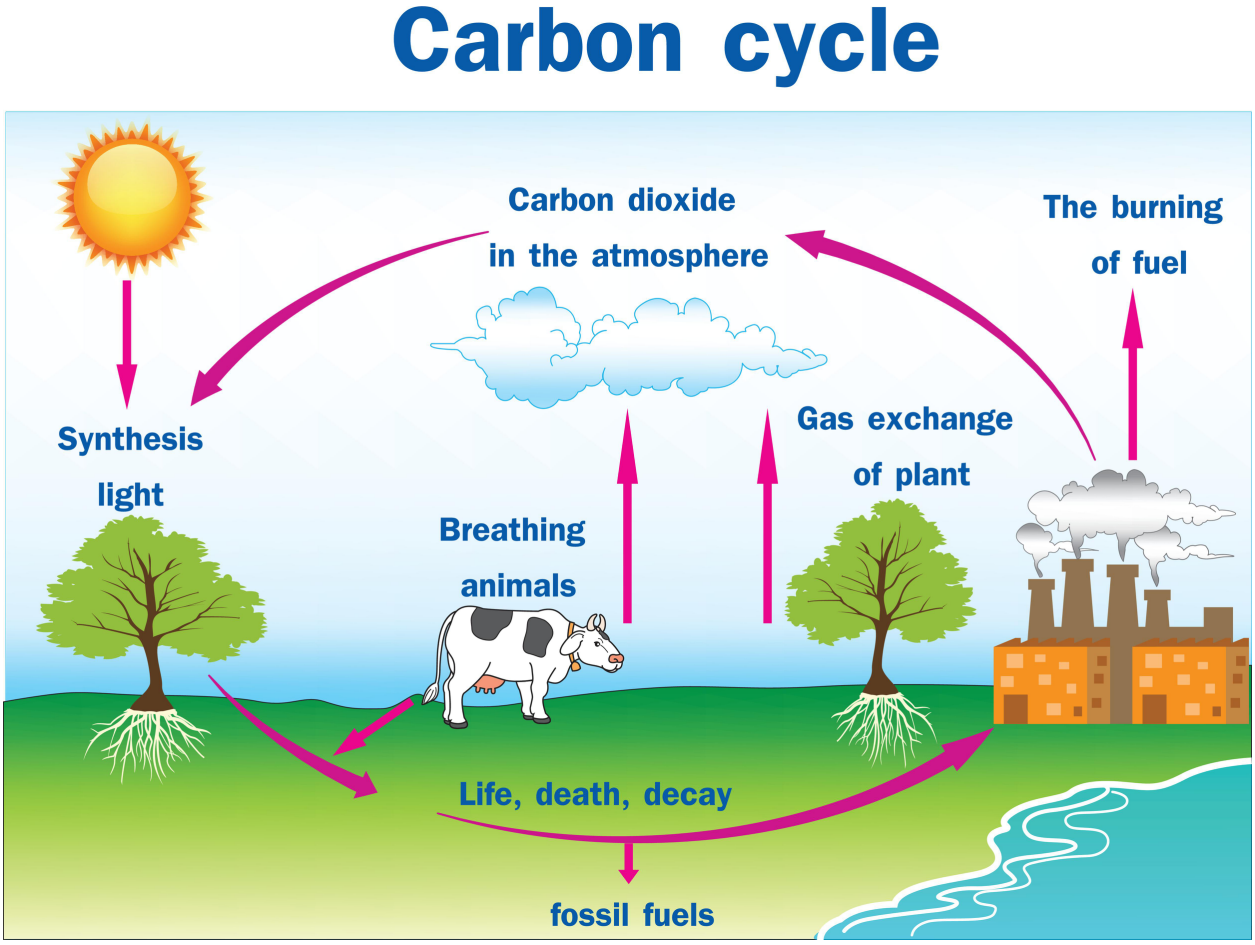
How-To: Carbon Cycle and Carbon Sequestration

The amount of carbon in the Earth and its atmosphere is constant: Like all elements, it's neither created nor destroyed. However, carbon occurs in various forms. In its purest state it's a diamond, or graphite (pencil "lead"). More commonly, carbon atoms combine with other atoms; for example, a carbon atom binds with two oxygen atoms to create carbon dioxide.

Carbon compounds form the basis of all life on earth. Carbon is found in the tissues of all plants and animals, and both release as carbon dioxide during respiration. During photosynthesis, plants use the carbon from the carbon dioxide in the air to create sugars to fuel their metabolism. Animals, in turn, eat plants to get the energy they need. Then, when the bodies of both plants and animals decompose, they release carbon into the atmosphere.
Carbon

This movement of carbon through various forms and places is called the Carbon Cycle.



Why Care About Carbon?

Carbon in the atmosphere combines with oxygen to become carbon dioxide, which is a greenhouse gas. Greenhouse gases absorb and then re-emit energy back to the Earth. The more carbon dioxide there is in the air, the warmer the temperatures on land and in the oceans. Scientists believe this warming is responsible for increasingly destructive storms, desertification, and rising sea levels.

Atmospheric Carbon

Fossil fuels — coal, petroleum, natural gas — are made up of the bodies of tiny plants and animals that lived and died millions of years ago and were subsequently buried under various rock formations. Because fossil fuels are made up of once-living organisms, they contain carbon, and when they're burned that carbon is released into the atmosphere. Humans worldwide are dependent upon fossil fuels for their energy needs, but this has come at the cost of higher carbon dioxide levels in the atmosphere.

Carbon Sequestration

Sequestering carbon sounds fancy, but it really means simply removing carbon from the air and storing it somewhere, in a form that's stable and won't easily revert back to its atmospheric form. The term is used with respect to mitigating the effects of climate change. On an industrial scale, carbon is sequestered when power plants use special equipment to prevent its release from smokestacks. Planting trees on marginal agricultural land is another technique: Trees incorporate atmospheric carbon into their "biomass" and store it there long-term.

Carbon in the Soil

Under the right conditions, soil can hold an enormous amount of carbon. The key? Providing the right conditions. All plants offer some measure of carbon storage. Even annual flowers and vegetables store some carbon underground in their roots. Plus, all roots release carbon into the soil via "exudates." These root exudates fuel the growth of various beneficial fungi and bacteria, which, in turn, supply roots with various macro- and micronutrients. Root exudates also support the formation of humus — the mysterious substance comprised of fully decayed organic matter that improves nearly every aspect of soil with respect to crop cultivation: nutrient storage, water-holding capacity, and drainage. And humus-rich soils are also less prone to erosion. Humus may be spongy or gel-like, and the carbon it contains is held in complex, stable molecules, making it an excellent site for carbon sequestration. Scientists are still unlocking the secrets of soil humus.

Carbon also enters the soil from above, when leaf litter and other organic matter is consumed by "decomposers" — the organisms large and minute (from earthworms to bacteria) that eat the carbon-rich organic matter and transform it into stable compounds that make their way into the soil.

Gardening for Carbon Management

First, let's look at what NOT to do. Plowing, rototilling, and extensive digging, including "turning over the soil," all break up the fungal networks and expose buried soil to the air, which allows previously stored carbon to be "released" into the atmosphere. The myriad soil organisms that work together to create healthy soil are thrown into disarray and imbalance. Also, at the end of the growing season, allowing soils to remain bare over the winter deprives soil organisms of their food supply and the insulating effects of a winter "blanket."

So what's a gardener to do?

Disturb the soil as little as possible. Till or plow only if you must to break new ground. In established beds, gently remove weeds without tilling.

Never allow soil to remain bare. During the growing season, cover soil with an organic mulch, such as straw, bark mulch, or pine straw.

During the off-season, plant a cover crop to nurture the soil ecosystem, deter weeds, prevent soil compaction from heavy rains, and add nutrients.

Include some perennial plants in your annual flower and vegetable beds. These plants' roots — and the carbon they contain — remain intact year-round.

Add compost — homemade or purchased — to soil every year. Soil microbes consume organic matter, such as compost, and need to have a continual supply.