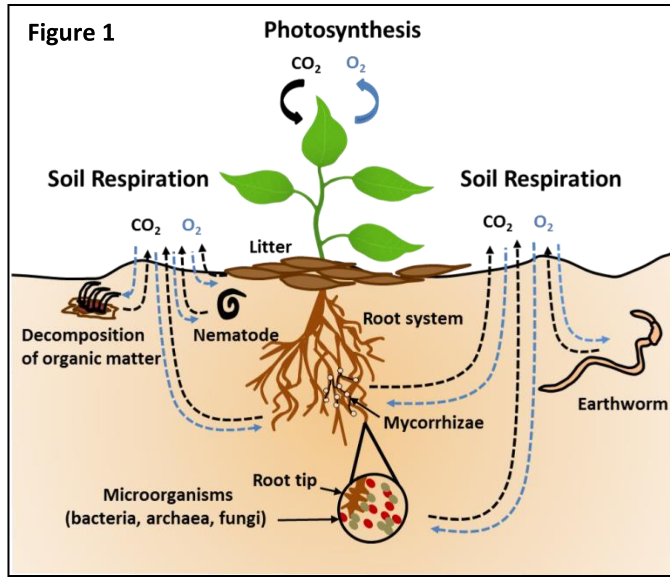
SOIL BREATHES!

Soil respiration is the carbon dioxide (CO_2) flux from soils to the atmosphere that results from cell respiration carried out by soil organisms (Figure 1). **Heterotrophic soil respiration** is due to the biological activity of microorganisms (bacteria, fungi, protists, etc.) and animals (worms, insects, nematodes, etc.). **Autotrophic soil respiration** is due to the biological activity of roots.

Soil respiration is a critical indicator of **soil health** as it denotes biological activity. A healthy soil should have a good representation of the community of organisms that can perform the functions of a healthy soil. A major biological activity of soil organisms is the decomposition of organic matter.



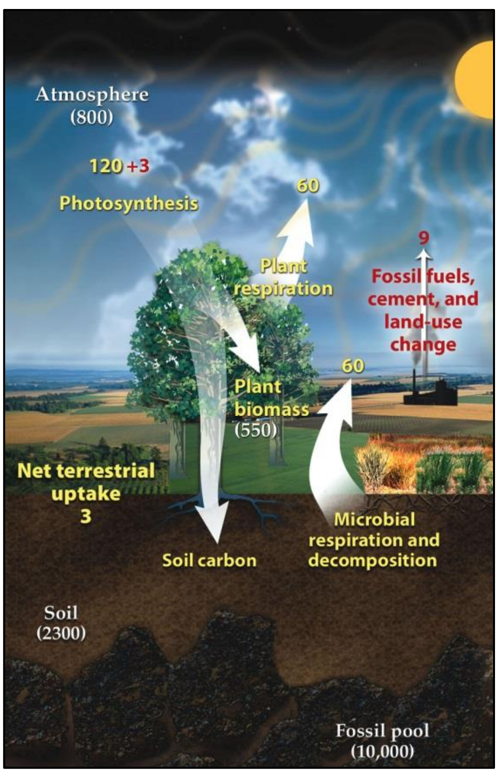


Figure 2. Simplify terrestrial carbon cycle. Numbers are Gigatons of carbon/year. Red indicates carbon human emissions. Source: U.S. Department of Energy Office of Science

Decomposition of organic matter in the soil begins with the physical breakdown of dead plants and animals into smaller **organic compounds** by soil animals. It continues with the chemical breakdown of these compounds by microbes into simpler **organic** and **inorganic compounds**.

Decomposition and soil respiration are tightly linked to **carbon cycle** processes. Decomposition provides microbes with the carbon compounds for energy source and to build cells and tissues. Microbes are the food source for other soil organisms. Soil respiration is the major pathway of **carbon transfer** from the soil to the atmosphere. These processes make soil a **carbon sink** with more carbon stored than the atmosphere and the plant biomass (Figure 2).

A **carbon balance** is critical for human well-being and for the environment. Decomposition and soil respiration are temperature- and water-dependent. Therefore, **changes in climate** will alter their rates, and consequently the carbon cycle. Extreme climatic events (droughts, floods, etc.) are influenced by agricultural practices and other human activities. For example, tillage practices destroy organic matter, release CO_2 into the atmosphere, destroy soil structure, and make soil more susceptible to erosion. Consequently, how we treat the soil can affect climate and vice versa. Climate and soil affect each other reciprocally. This means that maintaining a **healthy soil** through good agricultural practices is essential.

SOIL BREATHES!

HOW CAN WE MEASURE SOIL RESPIRATION?

There are different methods to measure soil respiration in the field and in the laboratory. Some methods are very complex and provide accurate quantitative results, while others are simpler and provide good estimates of soil respiration.

In the field

The LI-COR soil gas flux system is a closed system that deploys a chamber on the soil surface for a short period of time. The system circulates air from a chamber (white) to a gas analyzer (yellow), and then back to the chamber. CO_2 flux is calculated from the rate that the CO_2 concentration increases inside the chamber.

The Draeger-Tube® method consists of using a colorimetric gas detector tube filled with a chemical reagent that changes color in the presence of CO_2. A calibrated sampled soil-respired air is drawn through the tube. The length of the purple color change indicates the measured CO_2 concentration.

In the lab

The Solvita® method is a visual color measurement system to estimate soil respiration (CO_2 soil emissions pound/acre/day). It uses a thin-gel technology to assess carbon dioxide (CO_2) emissions from soil primarily due to microbial respiration.

Soil testing laboratories use a multi-channel soil respiration measuring system. The system can be programmed to test up to 24 soil samples for a desired period of time. The CO2 concentration is measured using an infra red gas analyzer similar to that used with the LI-COR system.

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