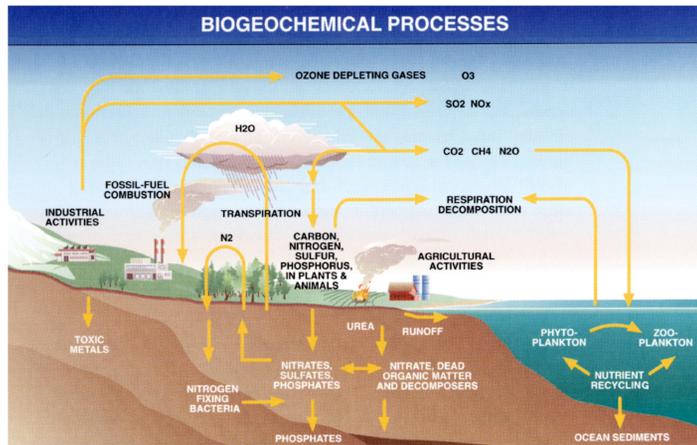


Basic Biological Factors of Soil Carbon and Nitrogen

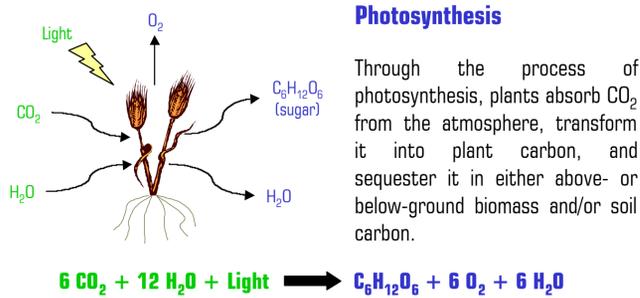


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Introduction

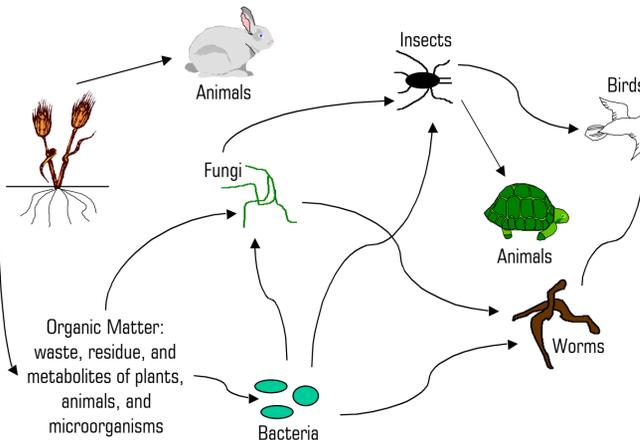
Carbon is essential for life. Soil organic matter (SOM) contains the nutrients and energy organisms and plants need.



The Soil Food Web

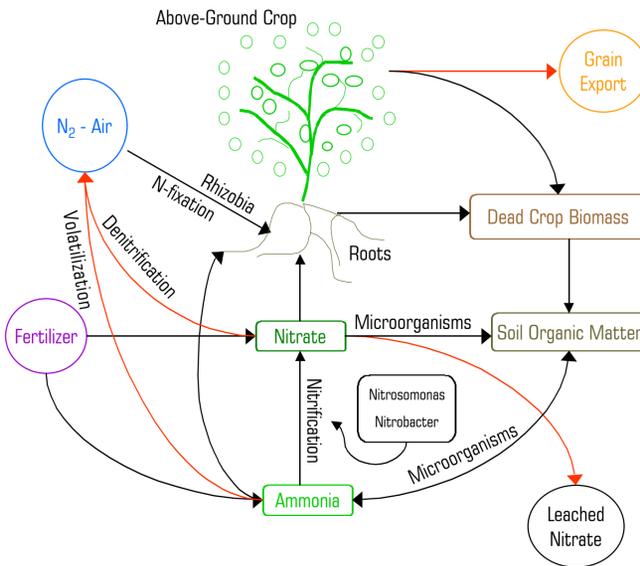
Soil organisms are responsible for the transformation of plant material to humus. Plant and animal residue make up a large portion of organic matter (OM) in soil. SOM or humus is the glue that helps hold soil into aggregates. Plant cover helps stop both wind and water erosion as does the aggregation effect of SOM.

Burrowing animals, insects, and earthworms mix, help form aggregates, and add nutrients to the soil. When animals die, they decompose returning nutrients to the soil. Insects chop up plant and animal residue which increases the surface area available to microorganisms for decomposition.



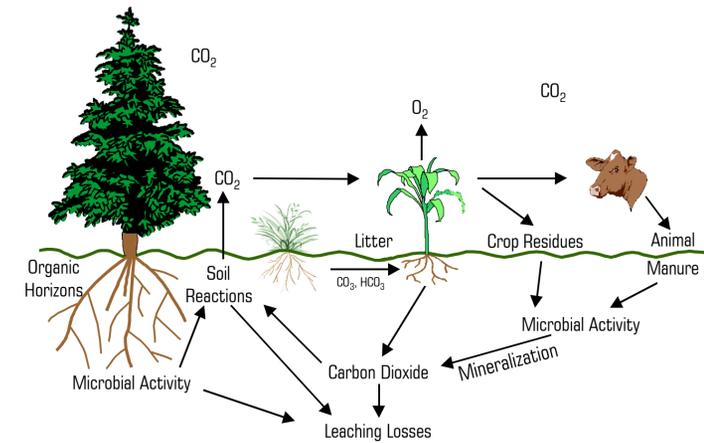
Nitrogen Cycle

- Plants take up inorganic nitrogen (NH₄⁺, NO₃⁻).
- At harvest, nitrogen may leave the farm in commodities or can be returned if livestock consume the crops and the manure is returned to the fields.
- Precipitation adds small amounts of nitrogen to the soil.
- N₂ gas in the atmosphere is converted to NH₄⁺ by chemical and biological processes (nitrogen fixation).
- Crop residues and green and animal manures contain organic N.

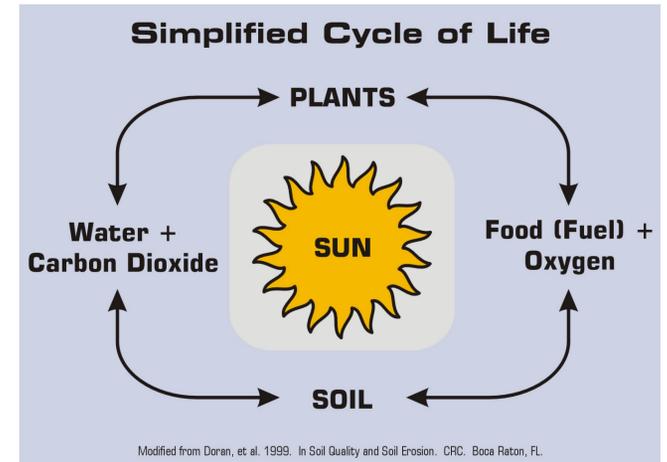


- The conversion of organic N to inorganic N is mineralization.
- The opposite of mineralization is immobilization.
- Nitrification is the conversion of NH₃ (ammonia) to NO₃ (nitrate), carried out by two microorganisms -- Nitrosomonas and Nitrobacter.
- Ammonia can be volatilized (turned to gas) and lost to the atmosphere.
- When NO₃ is converted to nitrous oxide, it is called denitrification.
- Nitrate is mobile in soil and therefore easily leached.
- Erosion and runoff remove N from the agricultural field.

Carbon Cycle



- CO₂, through photosynthesis, is converted to plant material.
- When the crop is harvested and removed from the farm, carbon is lost. If livestock consume the crop, the carbon may be returned to the soil in the form of manure.
- Crop residue, roots, and manure are a carbon (energy) source for microorganisms.
- Converting organic carbon to CO₂ is mineralization of carbon. When microorganisms respire, CO₂ is released to the atmosphere.
- Short-term SOM is residue that is readily decomposed. Short-term SOM is a source of nitrogen, phosphorus, and sulfur for plants. Short-term SOM lasts 1 to 3 years.
- Long-term SOM (humus) is the carbon form that resists decomposition and may last for greater than 1000 years.
- Soil carbon losses are exacerbated through erosion and, to a lesser extent, may be lost through leaching of dissolved organic carbon (DOC).
- The basic processes of the carbon cycle are: CO₂ in through photosynthesis, and CO₂ out through decomposition.**



Carbon / Nitrogen Ratio

Carbon / Nitrogen (C/N) ratios are important. Plant and animal residues that have a C/N of 30:1 and over, have too little N to allow for rapid decomposition. Therefore, the microorganisms will take ammonium and nitrate out of the soil to fuel decomposition. This depletes the soil of nitrate and ammonium. Plants and animal residues with low C/N ratios (20:1 and less) have sufficient N for the microorganisms to decompose the residues without taking from the soil.

