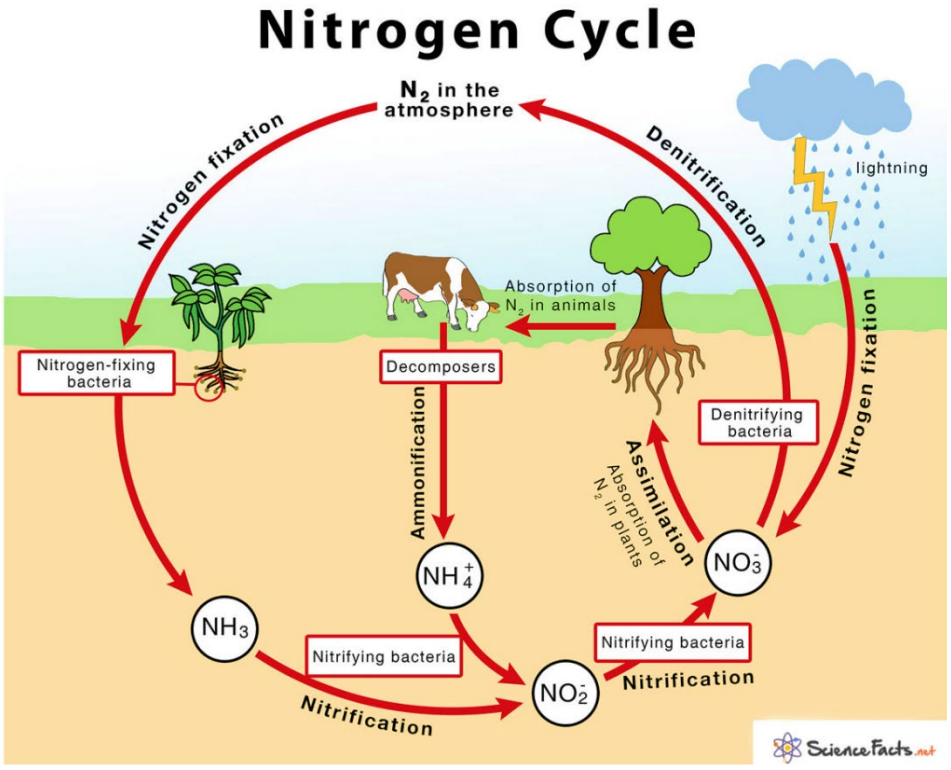
Soil Nutrient Cycling with Microbes

Nitrogen is an essential macronutrient that plants need continually to enable healthy growth and development. When a plant is deficient in nitrogen, older leaves appear pale yellow as the plant will mobilize the element from older leaves to younger leaves, resulting in delayed growth. Just as nitrogen can move in the plant, this element also moves through the soil and atmosphere in many different forms. The nitrogen cycle is the process of how nitrogen travels from the air to the soil and back in many different chemical forms.



Most of the earth's atmosphere (78%) is made up of **atmospheric nitrogen** (**N_2**). Both atmospheric nitrogen and organic nitrogen are not readily usable by the plant and need to be converted to nitrate (NO_3^-) or ammonium (NH_4^+) forms that can be taken up by the plant's root system.

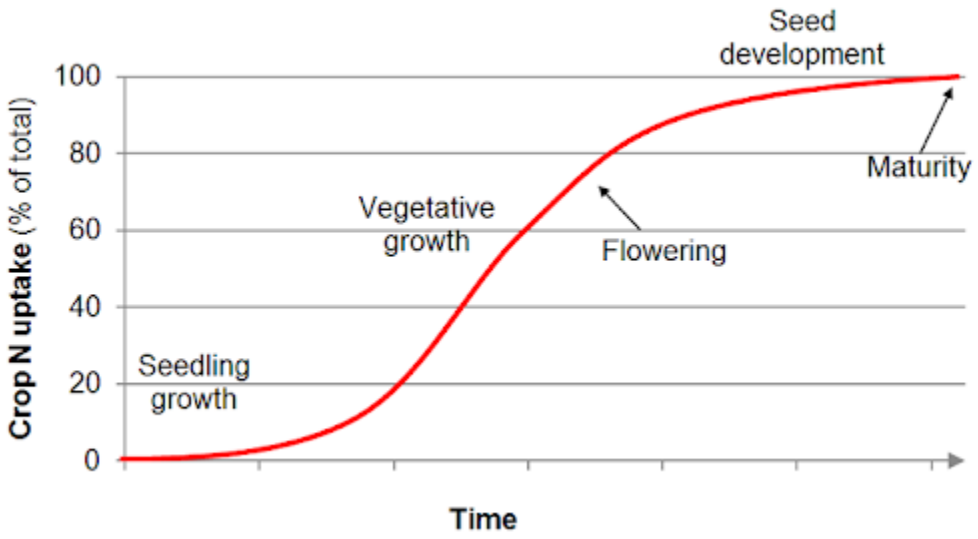
The nitrogen fixating process involves energy such as lighting reacting with the nitrogen in the air or the industrial Haber-Bosch process to create ammonia. Nitrogen fixation also occurs naturally in the soil by bacteria, such as Bacillus, Clostridium, and Rhizobium. Symbiotic relationships form naturally when the plant's roots provide nutrients to the bacteria and the bacteria provide nitrogen to the plant.

Nitrification is the process of converting ammonium (NH_4^+) to nitrate (NO_3^-). Ammonium adheres tightly to the negatively charged soil particles. Microbes are needed to stimulate the nitrification of ammonium to release the charged particles so the plant can access the nutrient. Ammonium ions are converted to nitrate in a two-step process where bacteria convert ammonium to nitrite (NO_2^-) then to nitrate (NO_3^-). Nitrifying bacteria are the driving force for this reaction, but the speed of conversion is affected by soil temperature and the amount of oxygen in the soil.

Nitrogen from organic sources is not readily available to plants and needs microbes to undertake chemical changes to be accessible to the roots. Microbes degrade organic matter, such as plant debris, which releases nitrogen compounds. Microorganisms convert these compounds to ammonia (NH_3) during **mineralization.** The ammonia is further converted to ammonium (NH_4^+) during **ammonification**. Microorganisms are vital to the decomposition of organic matter and releasing nutrients to cycle back to the soil.

Assimilation is when nitrates are taken up by the roots and are used by the plant for growth and photosynthesis. Plants utilizing the added nutrients is the main goal of fertility. Nitrogen can be lost due to leaching (downward movement in the soil), volatilization, and runoff. This loss of nutrient is important to reduce by following proper nitrogen management.

Nitrogen is needed by the plant in large quantities during vegetative stage of growth where it is fundamental for energy metabolism, protein synthesis and chlorophyll production. These nitrogen derived functions are all critical components of yield and unusable nitrogen forms could delay plant development. The right source of nitrogen is a vital component of management practices to reduce nitrogen loss and increase nutrient efficiency. The nitrogen cycle is one of many plant components that is affected by a diverse and healthy soil.



Worm Power plays a part in nutrient cycling by taking agricultural waste from cattle and creating a liquid extract packed with beneficial microbes that promotes plant health and increases crop yield. Worm Power Liquid Extract is an environmentally friendly and sustainable process that promotes healthy crops and soils. Microbes are crucial for nitrogen fixation and mineralization in the nitrogen cycle.

Lanae Wilhelmi | Agronomist