

Chapter 37: Soil and Plant Nutrition

37.1 Describe the components of soil and explain the importance of soil conservation.

37.2 Identify nutrients required by plants and their functions.

37.3 Give examples of how plants meet their nutritional needs by interacting with other organisms.

Watch for how this chapter connects to several other important topics you will study this year, including basic chemistry, nutrient cycling, and ecological relationships such as parasitism and mutualism.

Study Tip: The major ingredients in commercial fertilizers are nitrogen (N), phosphorus (P), and potassium (K). Using Figure 37.1 in your text, describe how these three elements are essential for plant growth.

nitrogen

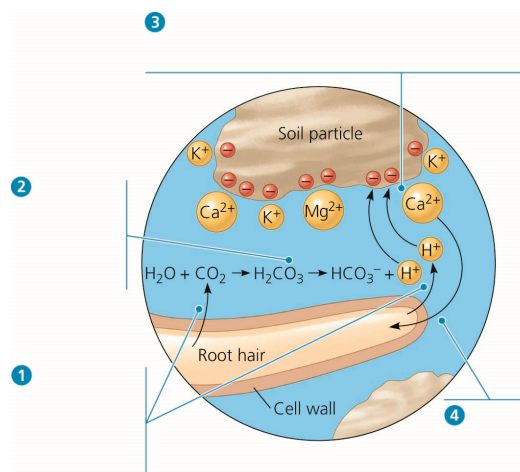
phosphorus

potassium

Concept 37.1 Soil contains a living, complex ecosystem

LO 37.1: Describe the components of soil and explain the importance of soil conservation.

- How the elements in fertilizers and other cations are absorbed by the roots is a central idea in understanding the relationship between soils and plants. In the figure below explain the four-step process that brings cations into the plant body.



2. In this concept, the section on Soil Conservation addresses a wide range of environmental impacts caused by agriculture and how these might be moderated. Although your own life may be urban or seem far removed from soil, human impact is significant. Describe a negative impact of each of these, and how it can be moderated:

irrigation

fertilization

changes in soil pH

erosion

toxic metals/organic pollutants

Concept 37.2 *Plant roots absorb many types of essential elements from the soil*

LO 37.2: *Identify nutrients required by plants and their functions.*

3. What is an *essential nutrient*?
4. What are the nine *macronutrients*? List them in order of relative abundance in plants. (You may use atomic symbols.)
5. Of all the mineral nutrients, which one contributes most to plant growth and therefore crop yields?
6. What three key molecules in plants require nitrogen? (Hint: Check Table 37.1.)
7. What is a primary role of magnesium?
8. What three macronutrients are most commonly deficient? You should notice that these are the same three nutrients found in most fertilizers.

9. The effects of global climate change are often very complicated. Discuss the probable effects of climate change on agricultural production and also on food quality.

Concept 37.3 *Plant nutrition often involves relationships with other organisms*

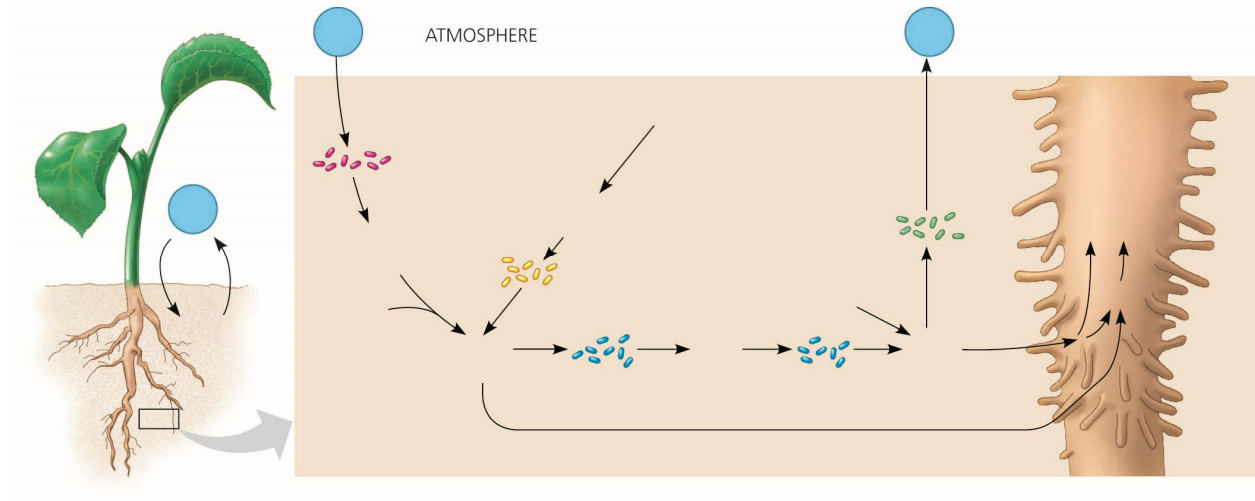
LO 37.3: *Give examples of how plants meet their nutritional needs by interacting with other organisms.*

10. Mutualism plays a critical role in plant nutrition. Figure 37.9 in your text uses some interesting examples to explore mutualism across many kingdoms and domains.
 - a. What is *mutualism*?
 - b. Complete the following chart on mutualism.

Type of Mutualism	Organisms Involved	How It Works
Fungus–Bacterium		
Animal–Bacterium		
Plant–Bacterium		
Animal–Fungus		
Plant–Fungus		
Plant–Animal		

11. Which nutrient is most limiting to plant growth on a global scale?

12. Plants have mutualistic relationships with bacteria that help make nitrogen more available. *Nitrogen-fixing* bacteria such as *Rhizobium* are able to convert atmospheric nitrogen (N_2), which plants cannot use, to ammonia (NH_3), which they can use. Review the *nitrogen cycle* by labeling this diagram.



13. Where is the nitrogen-fixing bacterium *Rhizobium* found?
14. The principle of *crop rotation* employs alternation of a crop that depletes nitrogen with a legume crop that fixes nitrogen. In the United States, this often means alternation of corn with soybeans. Which of these two crops is the nitrogen depletor? _____ Which is the nitrogen fixer? _____
15. How do *mycorrhizae* enhance plant nutrition?
16. The earliest fossils of plants show mutualistic relationships between plants and fungi. What factors provided the evolutionary stimulus to forge this mutualistic relationship?
17. In many parts of the eastern United States, garlic mustard (*Alliaria petiolata*) has become a serious pest. What is its negative impact on native species, and how does it appear to do this?

18. Briefly describe the unusual nutritional adaptations of the following:
 - a. Epiphytes
 - b. Parasitic plants
 - c. Carnivorous plants

19. What type of ecological relationship is shown by each of the above plant groups?

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1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____
7. _____ 8. _____ 9. _____