

Name: _____ Date: _____

Exploring Plant Nutrients Widget

What are the necessary ingredients for life? Human beings need water, air, food, and sleep, among other things, to thrive. Just like humans, plants have needs that must be fulfilled in the correct amounts for them to survive. Water, sunlight, air, and nutrients all provide plants with what they need to live and grow.

Directions: Explore the variables (water, sunlight, and nutrients) on the *Exploring Plant Nutrients* widget at <http://www.thescienceofsoil.com/> by clicking on the hotspots (dots) that show how the variable functions within the plant. Then use the slider to examine what a plant looks like with too much or too little of a variable. Be sure to click all hotspots on all variables to finish! Use the widget to fill in the blanks and answer the questions below.

Water:

1. Nutrients enter the root cells through both _____ and _____. Roots absorb water and nutrients from the soil through tiny hairs.
2. Plants transport water from the roots to the rest of the plant using _____. The _____ is made of dead cells that form long, empty tubes that let water pass through. Water moves upward through the xylem using water's properties of cohesion and surface tension.
3. The plant loses water through evaporation in the leaves. As some water evaporates, the attraction between water molecules results in additional water molecules pulled into the leaves to replace the water lost to the air. This process is called _____ and drives water from the roots, through the stem, up to the leaves.
4. Phloem: The phloem tissue transports _____. Phloem tissue is made of living cells called sieve cells.
5. The pressure-flow hypothesis is one likely explanation for how sugars move through the phloem. According to this hypothesis, the cells of the phloem actively transport sugar molecules into their interior. Water flows in due to a process where fluid moves from an area of high concentration to low concentration through _____.

6. Short answer: Without water, describe the effects on the plant's stem and leaves.

7. Short answer: Without enough water, describe the kernels of a corn.

8. Which of the following is NOT an effect of excessive water:

- a. Decreased air pockets needed for the root system to breath.
- b. Diseases, especially root rot.
- c. White roots.
- d. Roots will be unable to absorb the nutrients the plants need from the soil.

9. Unhealthy roots caused by excess water affect the whole plant. List three effects of unhealthy roots caused by excess water:

- a. _____
- b. _____
- c. _____

Sun:

10. Summarize photosynthesis process.

11. Without sunlight, the stems of the plant will appear _____.

12. Without enough sunlight, chlorophyll— the light sensitive molecule necessary for photosynthesis— will not develop. What are the effects of chlorophyll not developing?

13. What do kernels of corn contain? _____

14. Too much sunlight damages leaves and can penetrate cells, causing damage to the plant's genes and often resulting in cell death. If the plant takes in too much energy, _____ from the leaves takes place more quickly, possibly using up water faster than the roots can take it in.
15. Too much sunlight can damage the _____ in leaves, killing cells.
16. With too much sun, the entire plant will weaken and droop, because its cells contain _____ and _____.

Nutrients:

17. In non-agricultural ecosystems, _____ return nutrients to the soil when they decay, providing essential elements for new life.
18. When farmers harvest crops, they take away many necessary nutrients from the ecosystem. Fertilizers are used to _____ so the next set of crop plants will have enough nutrients and essential elements for healthy growth.
19. List three plants that store starch in their roots.
- a. _____
 - b. _____
 - c. _____
20. The more extensive the plant's root system is, the better it can _____ and _____.
21. Describe how decomposing organic matter releases nutrients into the soil.
- _____
- _____
22. The earth's atmosphere contains about 80% nitrogen gas; plants _____ use this form of nitrogen.
- a. Can
 - b. Cannot
23. When a plant is lacking a specific nutrient, it will not grow properly and will show physical signs particular to that _____.
24. Nitrogen is also part of the _____, the green pigment of plants that helps the photosynthesis reaction take place. Thus, without enough nitrogen, plant leaves turn yellow.

25. Without nitrogen for the cell's DNA and proteins, all of these occur **except**:

- a. excessive flowering
- b. cell division slows
- c. the plant's stalk weakens
- d. it will no longer stand upright
- e. the kernels may fall off

26. Nutrient toxicity occurs when _____.

27. Short answer: Describe what happens to excess nutrients if plants are exposed to more nutrients than they can absorb.

Great work!

As we've seen, all three variables do not operate alone but interact to help a plant develop and stay healthy. The soil is a bank of nutrients, which dissolve in water and can be absorbed by the plant's root system. If the soil requires more nutrients, fertilizer can be added to restore the nutrient balance. Fertilizers are mainly composed of nitrogen, phosphorus, and potassium. Water transports nutrients throughout the plant and plays a key role in photosynthesis. Without light energy from the sun, plants cannot combine the CO₂ in the air with the H₂O in water to create the sugar they need to thrive. Each variable is essential to the health of plants.