

**Signal Transduction and Plant Responses**

1. Compare the growth of a plant in darkness (etiolation) to the characteristics of greening (de-etiolation).
2. Describe the signal pathways associated with de-etiolation.
3. Describe the role of second messengers in the process of de-etiolation.
4. Describe the two main mechanisms by which a signaling pathway can activate an enzyme.
5. Explain, using several examples, what researchers have learned about the activity of plant hormones by study of mutant plants.

**Plant Responses to Hormones**

6. For the following scientists, describe their hypothesis, experiments, and conclusions about the mechanism of phototropism:
  - a. Charles and Francis Darwin
  - b. Peter Boysen-Jensen
  - c. Frits Went
7. List six classes of plant hormones, describe their major functions, and note where they are produced in the plant.
8. Explain how a hormone may cause its effect on plant growth and development.
9. Describe a possible mechanism for the polar transport of auxin.
10. According to the acid growth hypothesis, explain how auxin can initiate cell elongation.
11. Explain why 2,4-D is widely used as a weed killer.
12. Explain how the ratio of cytokinin to auxin affects cell division and cell differentiation.
13. Describe the evidence that suggests that factors other than auxin from the terminal bud may control apical dominance.
14. Describe how stem elongation and fruit growth depend on a synergism between auxin and gibberellins.
15. Explain the probable mechanism by which gibberellins trigger seed germination.
16. Describe the functions of brassinosteroids in plants.
17. Describe how abscisic acid (ABA) helps prepare a plant for winter.
18. Describe the effects of ABA on seed dormancy and drought stress.
19. Describe the role of ethylene in the triple response to mechanical stress, apoptosis, leaf abscission, and fruit ripening.

**Plant Responses to Light**

20. Define photomorphogenesis and note which colors are most important to this process.
21. Compare the roles of blue-light photoreceptors and phytochromes.
22. Describe the phenomenon of chromophore photoreversibility and explain its role in light-induced germination of lettuce seeds.
23. Define circadian rhythm and explain what happens when an organism is artificially maintained in a constant environment.
24. List some common factors that entrain biological clocks.
25. Define photoperiodism.
26. Distinguish among short-day, long-day, and day-neutral plants. Explain why these names are misleading.

27. Explain what factors other than night length may control flowering and what is necessary for flowering to occur.

**Plant Responses to Environmental Stimuli Other than Light**

28. Describe how plants apparently tell up from down. Explain why roots display positive gravitropism and shoots exhibit negative gravitropism.
29. Distinguish between thigmotropism and thigmomorphogenesis.
30. Describe how motor organs can cause rapid leaf movements.
31. Provide a plausible explanation for how a stimulus that causes rapid leaf movement can be transmitted through the plant.
32. Describe the challenges posed by, and the responses of plants to, the following environmental stresses: drought, flooding, salt stress, heat stress, and cold stress.

**Plant Defense: Responses to Herbivores and Pathogens**

33. Explain how plants deter herbivores with physical and chemical defenses.
34. Describe the multiple ways that plants defend against pathogens.