Name _____ Period _____

Chapter 39: Plant Responses to Internal and External Signals

Concept 39.1 Signal transduction pathways link signal reception to response

This concept brings together the general ideas on cell communication from Chapter 11 with specific examples of signal transduction in plants. As with animals, plants have receptors that trigger signal transduction pathways when activated. Let's begin with a review of three steps in signal transduction.

Step 1: Reception. Cell signals are detected by receptors that undergo changes in shape in response to a specific stimulus.

Step 2: Transduction. Transduction is a multistep pathway that amplifies the signal. This effect allows a small number of signal molecules to produce a large cellular response.

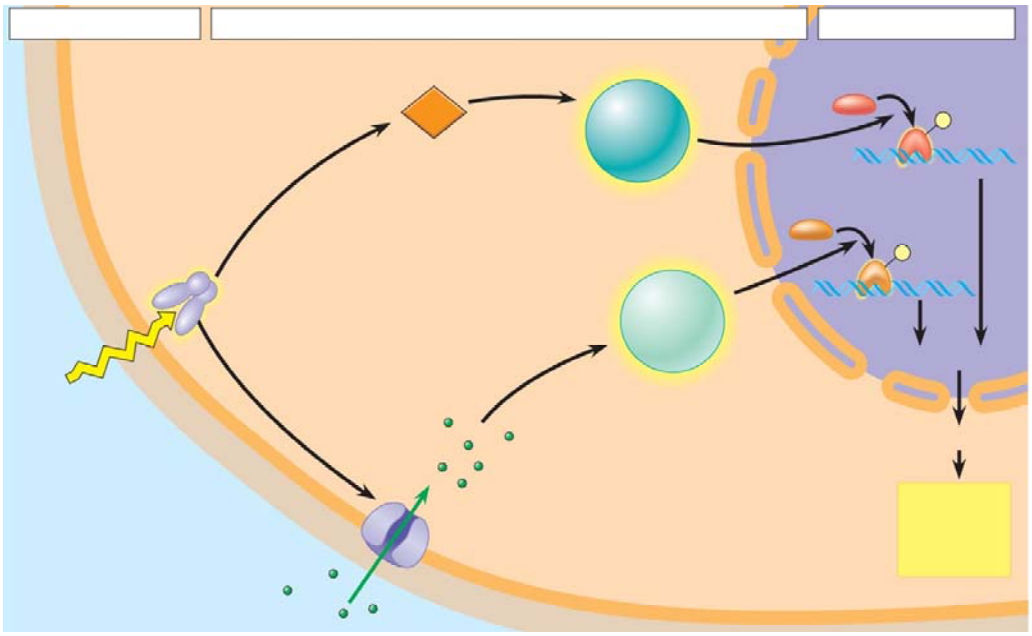
Step 3: Response. Cellular response is primarily accomplished by two mechanisms:

a. increasing or decreasing mRNA production
b. activating existing enzyme molecules

1. Have you ever seen a shriveled potato sending out skinny, pale sprouts? What is this called?

2. If you move the potato into the light, the sprout will respond by forming short, sturdy stems and broad, green leaves. What is this response to light called?

3. The figure below gives a specific example of a signal transduction in plants for the *greening* or *de-etiolation response* described above. Label these parts of the figure: *reception, transduction, response, phytochrome, signal, Ca^{2+} channel, second messenger (cGMP), protein kinase, transcription factor,* and *DNA.*



4. Return to the figure and explain how the light signal causes the *greening response*. You may choose to number the steps, as shown in the figure in your text.

5. What are the two *second messengers in* this pathway?

Concept 39.2 Plant hormones help coordinate growth, development, and responses to stimuli

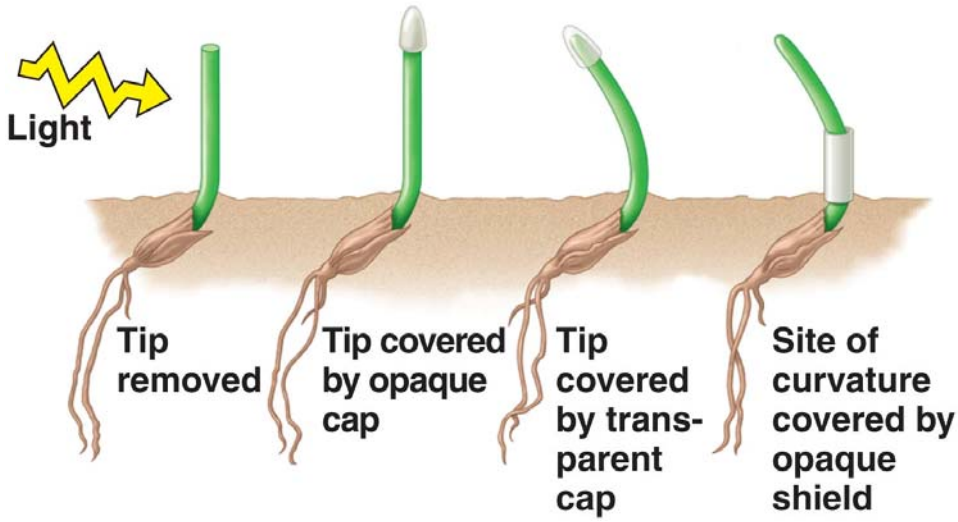
6. Both plants and animals have *hormones*. The definition of a hormone has three parts. What are they?

7. Plant physiologists think the term *hormone* as defined above doesn't quite fit plants. What term do they use instead?

8. What is a *tropism*?

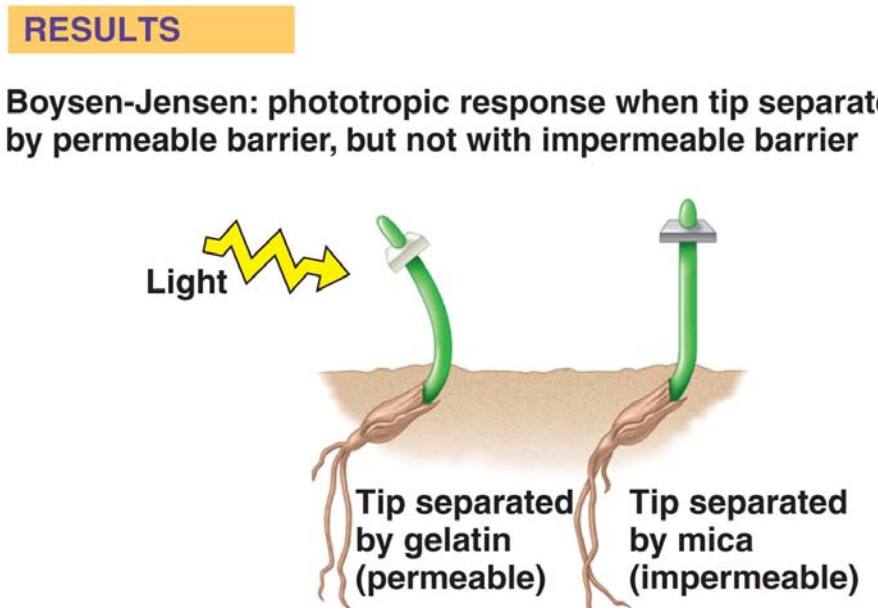
9. The sketch below describes early experiments on *phototropism* conducted by Charles and Francis Darwin. What can be concluded from these experiments?

CONCLUSION

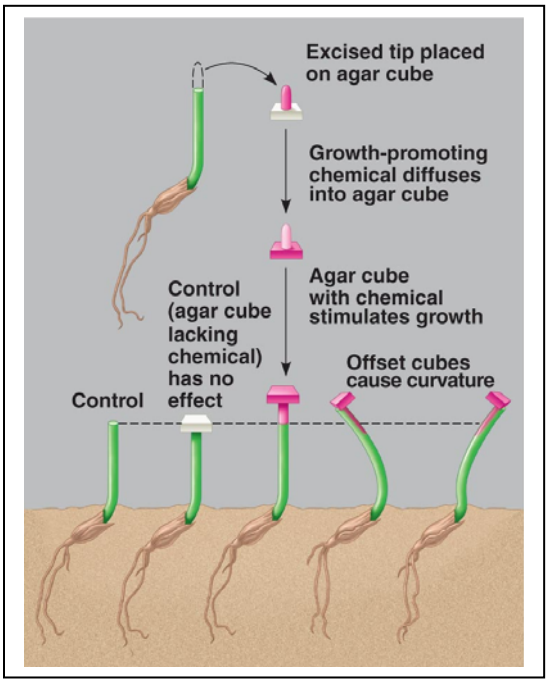


10. Here is a sketch of the *Boysen-Jensen experiment.* What conclusions can be drawn from it?

CONCLUSION



11. Boysen-Jensen's work was published in 1913. In 1926, Frits Went modified the experiment using agar cubes with a chemical from the coleoptile tips. Explain the results of this experiment.



12. What name did Went give to this chemical messenger? What was its chemical structure found to be?

13. In jest, we tell our students that when in doubt about which plant hormone causes which plant response, just answer *auxin*. Auxin has so many functions, this answer often works. List and describe four functions of auxin.

Auxin Functions	Description

14. Did you catch the discussion of auxins as herbicides? Perhaps you have used Weed-B-Gone to kill dandelions in your lawn. Explain how this product kills dandelions without killing the grass.

15. How did *cytokinins* get their name?

16. List and describe three functions of *cytokinins.*

Cytokinin Functions	Description

17. *Gibberellins* occur naturally in plants, and like the previous two hormones, they have several effects. Describe three of them.

Gibberellin Functions	Description

18. *Abscisic acid (ABA)* is misnamed. Why?

19. Describe three effects of *abscisic acid*.

Abscisic Acid Functions	**Description**

20. *Ethylene* is the only hormone in our group that is a gas. Under what conditions is *ethylene* produced?

21. The effects of ethylene are many and varied. Describe them here.

Ethylene Functions	**Description**

22. You have just finished a very complex look at plant hormones. Let's try to summarize it by completing the following chart.

Hormone	**Action**
	leaf abscission

	breaking seed dormancy
	maintaining apical dominance
	making internodes of grape bunches elongate to obtain larger fruit
	gravitropism
	drought tolerance
	senescence
	phototropism
	cell elongation
	increased cell division

Concept 39.3 Responses to light are critical for plant success

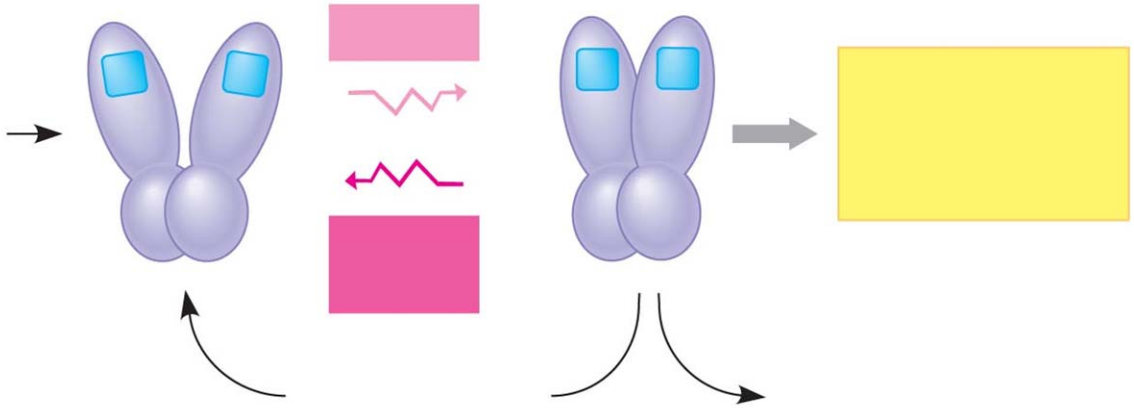
23. Researchers have determined that plants have two major classes of light receptors. List each class.

24. What wavelengths of light are absorbed by *phytochromes*?

25. What are three different responses initiated by blue light?

26. Read carefully the discussion of *phytochromes* and how they work. Pay attention to the two types of red light. What is the wavelength of *red light*? _____ Of *far-red light*? _____

27. Phytochromes are photoreceptors that have two isomer forms, P_r and P_{fr}. Sketch the conversion of P_r to P_{fr} on this figure. Label all of the boxes, and also *chromophore, phytochrome*.



28. What is the active form of phytochrome, P_r or P_{fr}?

29. Look again at the effect of light exposure on lettuce seed germination. What determines the seed's response?

30. To make sense of all this, you will want to read carefully the "Phytochromes and Shade Avoidance" section. Which type of red light is more common in a shaded area? Why?

31. What is a *circadian rhythm*? Give one plant example and one human example.

32. What is the *photoperiod*?

33. Plants detect photoperiod, and in many species it affects their time of flowering. Explain each of the following, and give an example of a plant that is in the group.

short-day plant

long-day plant

day-neutral plant

34. The plant in the sketch below is a short-day plant. Label *R*, *FR*, and *critical dark period*. For each line, explain why flowering occurs or does not occur.

35. What is *florigen*?

Concept 39.4 Plants respond to a wide variety of stimuli other than light

36. What is *gravitropism*? How may a plant detect gravity?

37. What is *thigmotropism*? How is it adaptive?

38. Describe an example of a *rapid leaf movement*. What do these *action potentials* resemble?

39. List six different ways in which a plant responds to water deficit.

40. Select any other stress situation besides water deficit, and explain plant mechanisms for dealing with this.

Concept 39.5 Plants respond to attacks by herbivores and pathogens

41. What are the two ways in which a plants combat excess herbivory?

42. Describe two examples of a plant producing chemicals to deal with herbivory.

Testing Your Knowledge: Self-Quiz Answers
Now you should be ready to test your knowledge. Place your answers here:

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

8._____ 9._____ 10._____