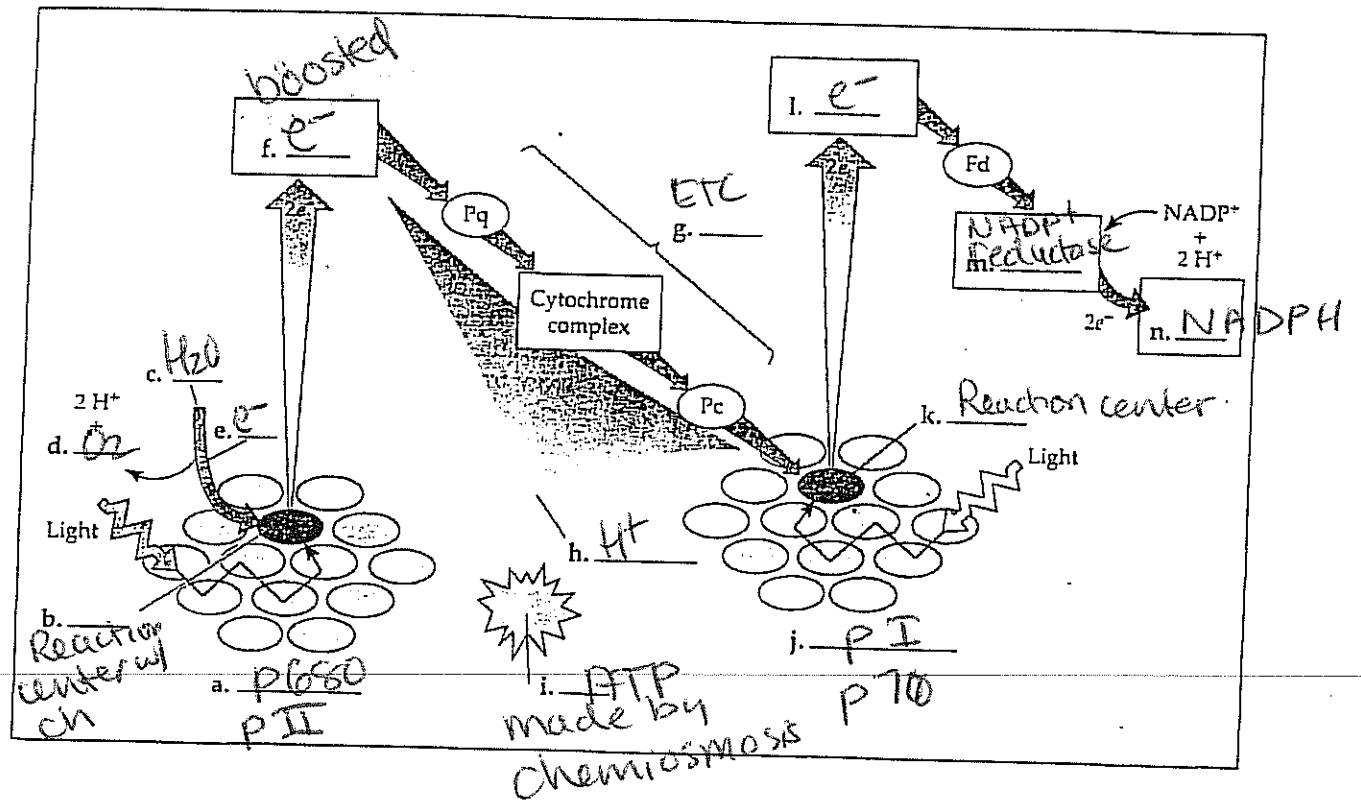
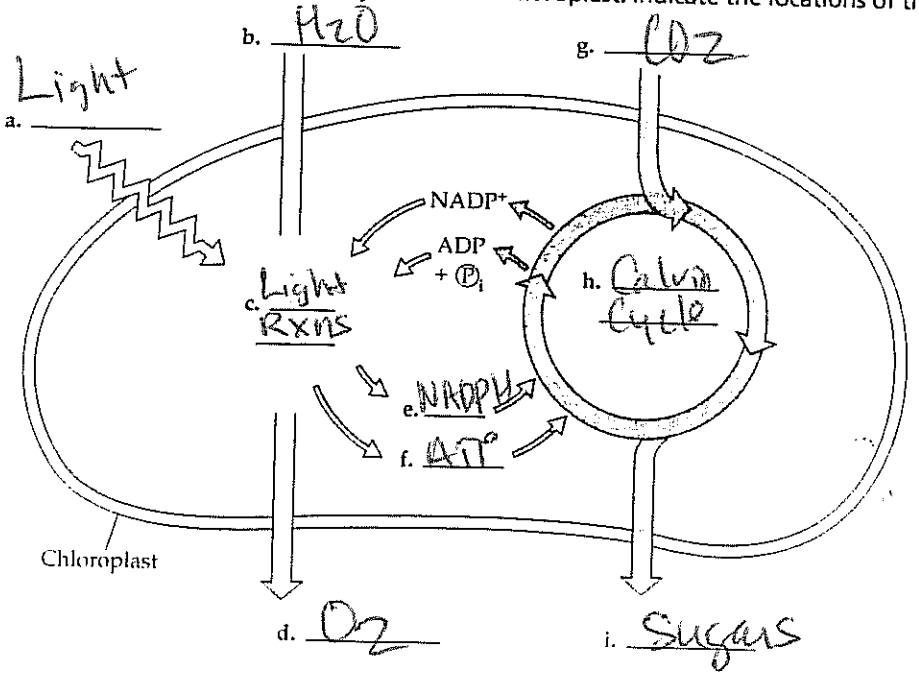
INTERACTIVE QUESTION 10.6

Fill in the steps of noncyclic electron flow in the diagram below. Circle the important products that will be used to provide chemical energy and reducing power to the Calvin cycle.



INTERACTIVE QUESTION 10.2

Fill in the blanks in the following overview of photosynthesis in a chloroplast. Indicate the locations of the processes c and h.



Test Your Knowledge

MULTIPLE CHOICE: *Choose the one best answer.*

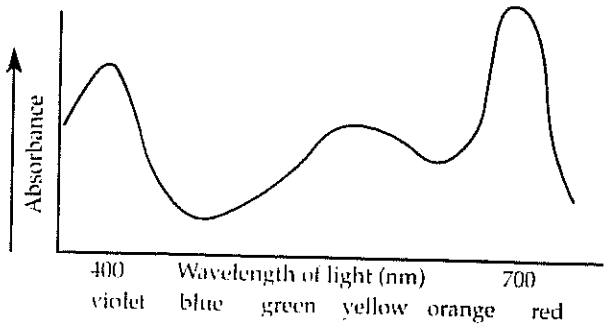
1. Which of the following processes or structures is mismatched with its location?
   a. light reactions—grana
   b. electron transport chain—thylakoid membrane
   c. Calvin cycle—stroma
   d. ATP synthase—double membrane surrounding chloroplast thylakoid membrane
   e. splitting of water—thylakoid space

2. Photosynthesis is a redox process in which
   a. CO_2 is reduced and water is oxidized.
   b. $NADP^+$ is reduced and RuBP is oxidized.
   c. CO_2, $NADP^+$, and water are reduced.
   d. O_2 acts as an oxidizing agent and water acts as a reducing agent.
   e. G3P is reduced and the electron transport chain is oxidized.

4. A spectrophotometer can be used to measure
   a. the absorption spectrum of a substance.
   b. the action spectrum of a reaction.
   c. the amount of energy in a photon.
   d. the wavelength of visible light.
   e. the efficiency of photosynthesis.

5. Accessory pigments within chloroplasts are responsible for
   a. driving the splitting of water molecules.
   b. absorbing photons of different wavelengths of light and passing that energy to P680 or P700.
   c. providing electrons to the reaction-center chlorophyll after photoexcited electrons pass to $NADP^+$.
   d. pumping H^+ across the thylakoid membrane to create a proton-motive force.
   e. anchoring chlorophyll *a* within the reaction center.

6. The following diagram is an absorption spectrum for an unknown pigment molecule. What color would this pigment appear to you?



   a. violet
   b. blue not absorbed, so reflected
   c. green
   d. yellow
   e. red

7. Linear electron flow along with chemiosmosis in the chloroplast results in the formation of
   a. ATP only.
   b. ATP and NADPH.
   c. ATP and G3P.
   d. ATP and O_2.
   e. ATP, NADPH, and O_2.

(Cyclic flow just makes more ATP)

8. The chlorophyll known as $P680^+$ has its electron "holes" filled by electrons from
   a. photosystem I.
   b. photosystem II.
   c. water.
   d. NADPH.
   e. accessory pigments.

9. Which of the following substances is/are the final electron acceptors for the electron transport chains in the light reactions of photosynthesis and in cellular respiration?
   a. O_2 in both
   b. CO_2 in both
   c. H_2O in the light reactions, and O_2 in respiration
   d. P700 and NAD^+ in the light reactions, and NAD^+ or FAD in respiration
   e. $NADP^+$ in the light reactions, and O_2 in respiration

10. In the chemiosmotic synthesis of ATP in a chloroplast, H^+ diffuses through the ATP synthase
    a. from the stroma into the thylakoid space.
    b. from the thylakoid space into the stroma.
    c. from the intermembrane space into the matrix.
    d. from the cytoplasm into the intermembrane space.
    e. from the matrix into the stroma.

11. Which of the following parts of an illuminated plant cell would you expect to have the lowest pH?
    a. nucleus
    b. cytosol
    c. chloroplast
    d. stroma of chloroplast
    e. thylakoid space

12. A difference between electron transport in photosynthesis and respiration is that in photosynthesis,
    a. NADPH rather than NADH passes electrons to the electron transport chain.
    b. ATP synthase releases ATP into the stroma rather than into the cytosol.
    c. light provides the energy to push electrons to the top of the electron chain, rather than energy from the oxidation of food molecules.
    d. an H^+ concentration gradient rather than a proton-motive force drives the phosphorylation of ATP.
    e. Both a and c are correct.

13. How does cyclic electron flow differ from linear electron flow?
   a. No NADPH is produced by cyclic electron flow.
   b. No O_2 is produced by cyclic electron flow.
   c. The cytochrome complex in the electron transport chain is not involved in cyclic electron flow.
   (d.) Both a and b are correct.
   e. a, b, and c are correct.

14. Chloroplasts can make carbohydrate in the dark if provided with
   (a.) ATP, NADPH, and CO_2.
   b. an artificially induced proton gradient.
   c. organic acids or four-carbon compounds.
   d. a source of hydrogen.
   e. photons and CO_2.

15. How many turns of the Calvin cycle does it take to produce one molecule of glucose?
   a. 1 c. 3 e. 12
   b. 2 (d.) 6 6 carbons in, 6 carbons out

18. Rubisco
   a. reduces CO_2 to G3P.
   b. regenerates RuBP with the aid of ATP.
   c. combines electrons and H^+ to reduce $NADP^+$ to NADPH.
   (d.) adds CO_2 to RuBP in the carbon fixation stage.
   e. transfers electrons from NADPH to 1,3-bisphosphoglycerate to produce G3P.

19. In C_4 plants,
   (a.) initial carbon fixation takes place in the mesophyll cells.
   b. photorespiration requires more energy than it does in C_3 plants.
   c. the Calvin cycle, which takes place in the bundle-sheath cells, uses PEP carboxylase instead of rubisco because of its greater affinity for CO_2.
   d. a and b are correct.
   e. a and c are correct.

in C4 plants calvin cycle still uses Rubisco, but its kept away from the O_2 build up

20. CAM plants avoid photorespiration by
   a. keeping their stomata closed during the day. true but not answer to Q
   b. performing the Calvin cycle at night.
   c. fixing CO_2 into four-carbon compounds in the mesophyll, which then release CO_2 in the bundle-sheath cells. C4 plants
   d. storing water in their succulent stems and leaves.
   (e.) fixing CO_2 into organic acids during the night, which then provide CO_2 during the day.

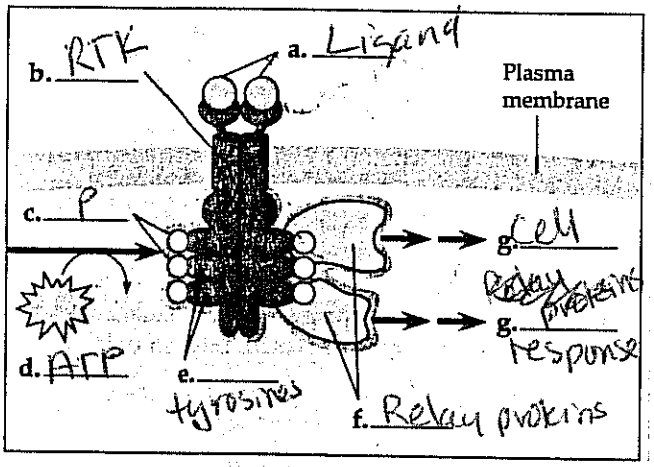
21. In green plants, most of the ATP for synthesis of proteins, cytoplasmic streaming, and other cellular activities comes directly from
   a. photosystem I.
   b. photosystem II.
   c. the Calvin cycle.
   (d.) oxidative phosphorylation. Mitochondria
   e. photophosphorylation.

For each of the events listed in questions 22 through 27, indicate whether the event occurs during
   a. respiration
   b. photosynthesis
   c. both respiration and photosynthesis
   d. neither respiration nor photosynthesis

22. Chemiosmotic synthesis of ATP C
23. Reduction of oxygen $O_2 \rightarrow H_2O$ A
24. Reduction of CO_2 CO_2 to sugar B
25. Reduction of NAD^+ $NAD^+ \rightarrow NADH$ A
26. Oxidation of $NADP^+$ D already oxidized
27. Oxidative phosphorylation A

INTERACTIVE QUESTION 11.3

Label the parts in the following diagram of an activated receptor tyrosine kinase dimer.



INTERACTIVE QUESTION 11.4

a. What does a protein kinase do?

b. What does a protein phosphatase do?

c. What is a "phosphorylation cascade?"

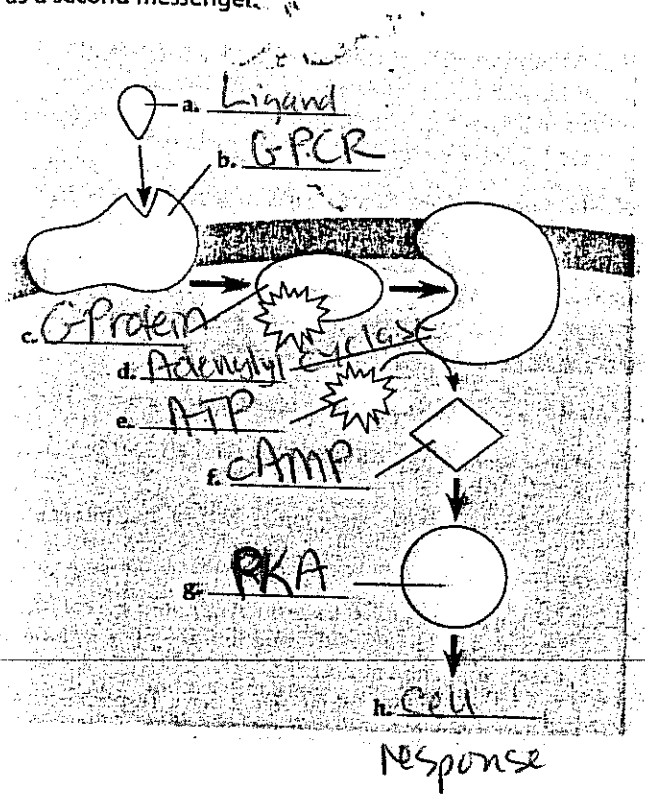
Test Your Knowledge

MULTIPLE CHOICE: *Choose the one best answer.*

1. What is a key difference between a local regulator and a hormone?
   a. Local regulators are small, hydrophobic molecules; hormones are either larger polypeptides or steroids.
   b. Local regulators diffuse to neighboring cells; hormones usually travel throughout the plant or animal body to distant target cells.
   c. Local regulators initiate short-term responses; hormones trigger longer-lasting responses to environmental stimuli.
   d. The signal transduction pathways of local regulators do not involve second messengers; pathways triggered by hormones do involve second messengers.
   e. Local regulators often open ligand-gated channels and affect ion concentrations in a cell; hormones bind with intracellular receptors and affect gene expression.

INTERACTIVE QUESTION 11.5

Label the components in the following diagram depictin the steps in a signal transduction pathway that uses cAMP as a second messenger.



4. A G protein is
   a. a specific type of membrane-receptor protein.
   b. a protein on the cytoplasmic side of a membrane that becomes activated by a receptor protein.
   c. a membrane-bound enzyme that converts ATP to cAMP.
   d. a membrane-bound protein that cleaves phospholipids to produce second messengers.
   e. a guanine nucleotide that converts between GDP and GTP to activate and inactivate relay proteins.

5. How do receptor tyrosine kinases transduce a signal?
   a. They transport the signaling molecule into the cell, where it binds to and activates a transcription factor. The transcription factor then alters gene expression.
   b. Signaling molecule binding causes a shape change that activates membrane-bound tyrosine kinase relay proteins that then phosphorylate serine and threonine amino acids.
   c. Their activated tyrosine kinases convert ATP to cAMP; cAMP then acts as a second messenger to activate other protein kinases.
   d. When activated, they cleave a membrane phospholipid into two second-messenger molecules, one of which opens Ca^{2+} ion channels on the endoplasmic reticulum.
   e. They form a dimer; they phosphorylate each other's tyrosines; specific proteins bind to and are activated by these phosphorylated tyrosines.

7. Which of the following compounds can activate a protein by transferring a phosphate group to it?
   a. G protein
   b. phosphodiesterase
   c. protein phosphatase
   d. protein kinase
   e. both a and c

8. Many signal transduction pathways use second messengers to
   a. transport a signaling molecule through the hydrophobic center of the plasma membrane.
   b. relay a signal from the outside to the inside of the cell.
   c. relay the message from the inside of the membrane throughout the cytoplasm.
   d. amplify the message by phosphorylating cascades of proteins.
   e. dampen the message once the signaling molecule has left the receptor.

Don't like the wording

ATP? Kinases?

9. A function of the second messenger IP_3 is to
   a. bind to and activate protein kinase A.
   b. activate transcription factors.
   c. activate other membrane-bound relay molecules.
   d. convert ATP to cAMP.
   e. bind to and open ligand-gated calcium channels on the ER.

10. Signal amplification is most often achieved by
   a. an enzyme cascade involving multiple protein kinases.
   b. the binding of multiple signaling molecules.
   c. branching pathways that produce multiple cellular responses.
   d. the activation of transcription factors that affect gene expression.
   e. the action of adenylyl cyclase in converting ATP to ADP.