Name _____ Date _____ Pd ____

Cell Energy – Photosynthesis Study Guide

Study all notes and read Ch 4.1-4.3.

Circle the word or phrase that best completes the statement.

1. All cells use adenosine triphosphate (ATP) for energy. ATP is a *molecule / organelle* that transfers energy from the breakdown of *ADP / food molecules* to cell processes.
2. ATP is a *high-energy / low-energy* molecule that is converted into *higher-energy / lower-energy* ADP when a phosphate group is removed and energy is released.
3. ADP is converted back into ATP by the addition of a *phosphate group / food molecule*.
4. Chemosynthesis is a process by which some organisms use *chemical energy / light energy* instead of *chemical energy / light energy* to make energy-storing carbon-based molecules.
5. The light-dependent reactions require *light / do not require light*, and they absorb and transfer *sugars/energy*.
6. The light-independent reactions require *light / do not require light*, and they build *sugars / energy*.
7. Some organisms are called producers because they produce the source of *chemical energy / light energy* for themselves and for other organisms.
8. Photosynthesis captures *chemical energy / light energy* to make sugars that store *chemical energy / light energy*.
9. Chlorophyll is a molecule in chloroplasts that absorbs some of the energy in *visible light / ultraviolet light.*
10. The electron transport chain is a series of *proteins / carbohydrates* in the thylakoid membrane along which energized electrons travel.
11. The first part of an enzyme's name tells you about its function. All enzymes end with the suffix *-ase.* Therefore, ATP synthase is an enzyme that *synthesizes / synchronizes* ATP.
12. The word cycle tells you that the chemical reactions of the Calvin cycle go from one to another *with a beginning and an end / with no beginning or end.*

Vocabulary Check

WORD BANK: energy, sugar, photosynthesis, capture, transfer, stroma, thylakoid, grana, 2, 3, chemical, green, molecules (2x), independent, ATP, NADPH

Fill in each blank with the word or phrase that best completes the sentence.

13. The prefix *tri-* means "three," and the prefix *di-* means "two." Therefore, adenosine triphosphate (ATP) has _____ phosphate groups, and adenosine diphosphate (ADP) has _____ phosphate groups.
14. The prefix *chemo-* means "chemical," and synthesis comes from a Greek word that means "to put together." Therefore, chemosynthesis means "to put together with chemicals." In chemosynthesis, _____ energy is used to produce carbon-based _____ that store energy.

16. Chloroplasts are membrane-bound organelles where _____ takes place in plants.

17. Photosynthesis takes place in two parts of a chloroplast: the _____ and the _____.

18. Thylakoids are coin-shaped, membrane-enclosed compartments inside the _____.

19. The prefix *photo-* means "light," and synthesis means "to put together."
    During photosynthesis, _____ from light is used to put together _____.

20. The prefix *chloro-* means "green," and the suffix *-phyll* means "leaf." Therefore, chlorophyll is the light-absorbing molecule that makes leaves look _____.

21. The prefix *in-* means "not." Therefore, the reactions in photosynthesis that do not require light are called light-_____.

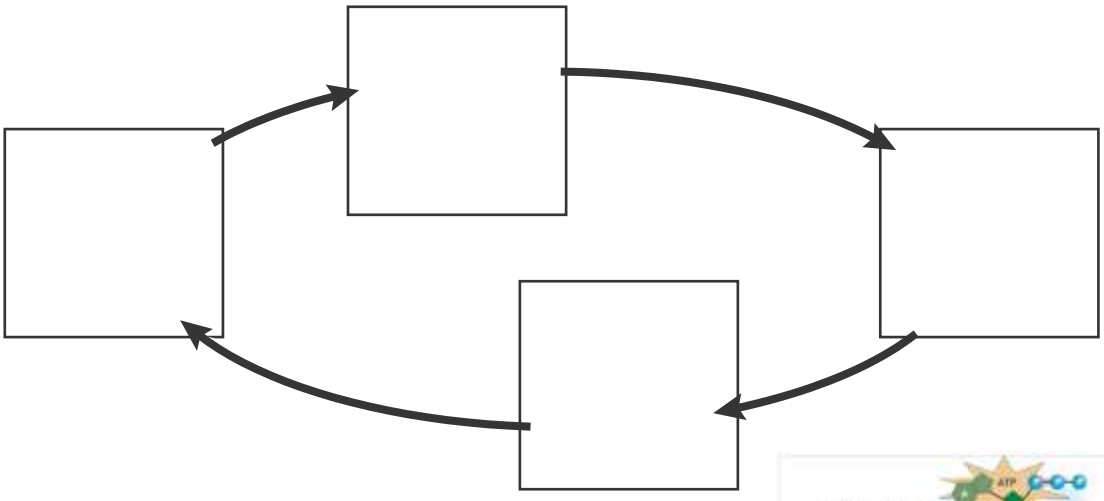
22. The function of the light-dependent reactions is to _____ and _____ energy.

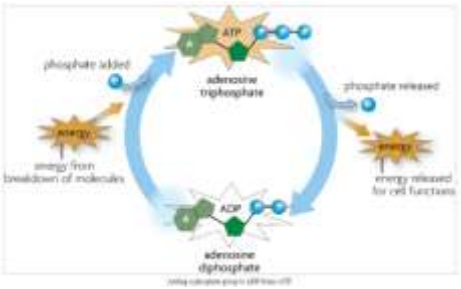
23. Photosystems are groups of _____ that capture and transfer energy.

24. The two molecules that carry energy to the light-independent reactions are _____ and _____.

Diagrams and Drawings

25. Put the letter of the appropriate statement into each box of the cycle diagram below to show the relationship between ATP and ADP.
    a. High-energy adenosine triphosphate (ATP)
    b. Lower-energy adenosine diphosphate (ADP)
    c. Energy added from breakdown of carbon-based molecules, phosphate added
    d. Phosphate removed, energy released





Put the letter for each of the following six statements into the appropriate list to identify the roles of different types of molecules when they are broken down to make ATP.

a. molecules least likely to be broken down

b. molecules most commonly broken down

c. molecules that store most of the energy in a person's body

d. triglyceride yields about 146 ATP

e. glucose yields about 36 ATP

f. store about the same amount of energy as carbohydrates

	Type of Molecule	**Role in ATP Production**
26.	Carbohydrates	• • • 4 calories per mg (4 Calories per gram)
27.	Lipids	• • • 9 calories per mg (9 Calories per gram)
28.	Proteins	• • • 9 calories 4 calories per mg (4 Calories per gram)

29. The overall process of photosynthesis can be written as a chemical equation. Fill in the blanks in the equation below using the appropriate compound from the box.

$6O_2$	$6CO_2$	$6H_2O$	$C_6H_{12}O_6$

_____ + _____ → _____ + _____

30. The two reactants in the photosynthesis equation are _____ and _____.

31a. The two products in the photosynthesis equation are _____ and _____.

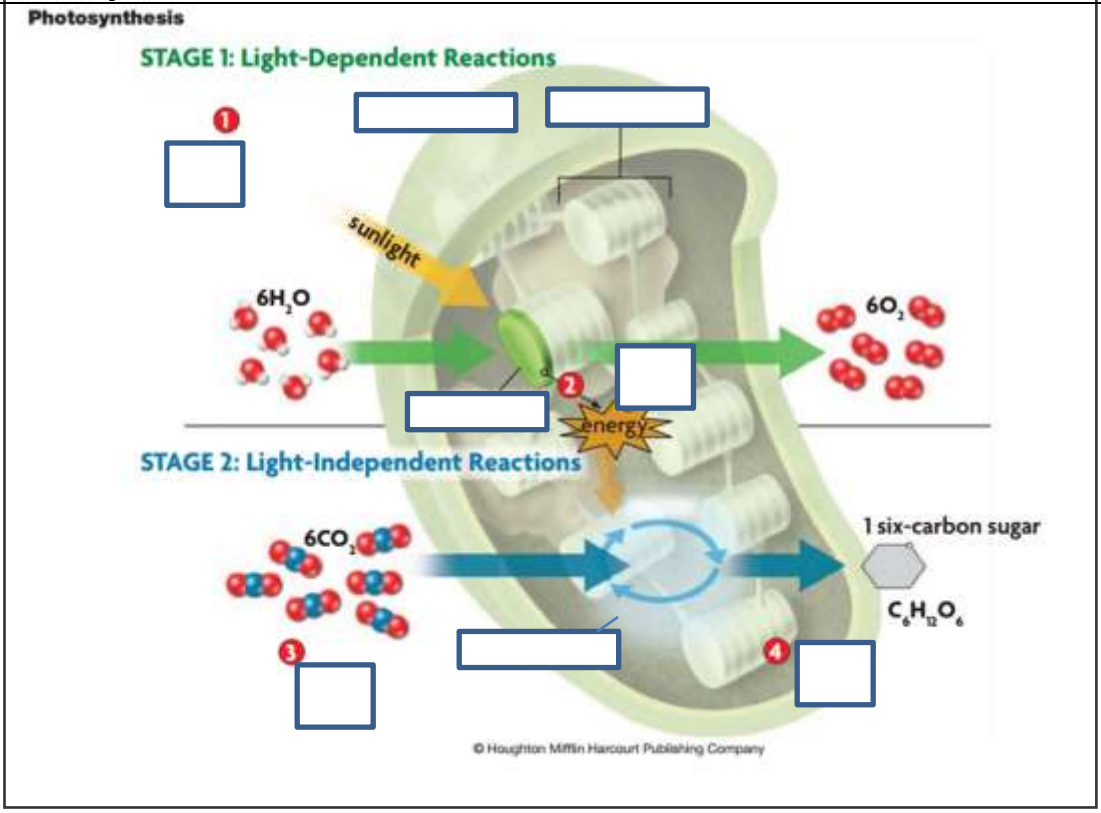
b. Which product is the organic molecule? _____

c. Which product is released as waste to the atmosphere? _____

32. Why is the photosynthesis equation often written with several arrows?
    a. Because many enzymes are added to the reactants to make the products.
    b. Because many chemical reactions occur with the help of many enzymes.
    c Because many reactants can enter into the photosynthesis reaction.
    d. Because many products can be made from the photosynthesis reaction.

33. Use the space below to sketch a **chloroplast**. Label the **grana, thylakoids, and stroma**. Indicate where each of the following steps of the photosynthetic process occurs. Use the letters below to mark the processes.
    a. Energy carried along the thylakoid membrane is transferred to molecules that carry energy to the light-independent reactions.
    b. Carbon dioxide is added to a cycle of chemical reactions to build larger molecules.
    c. A six-carbon simple sugar (usually glucose; $C_6H_{12}O_6$) is formed.
    d. Energy from sunlight is absorbed and transferred along the thylakoid membrane. Water molecules are broken down and oxygen is released.

Photosynthesis



34. Using the diagram below, put each letter from the statements below into a box to show the seven steps of the **light-dependent reactions**.

a. ATP synthase produces ATP.

b. Chlorophyll (in the thylakoid membrane) absorbs energy from sunlight, and energized electrons enter the electron transport chain.

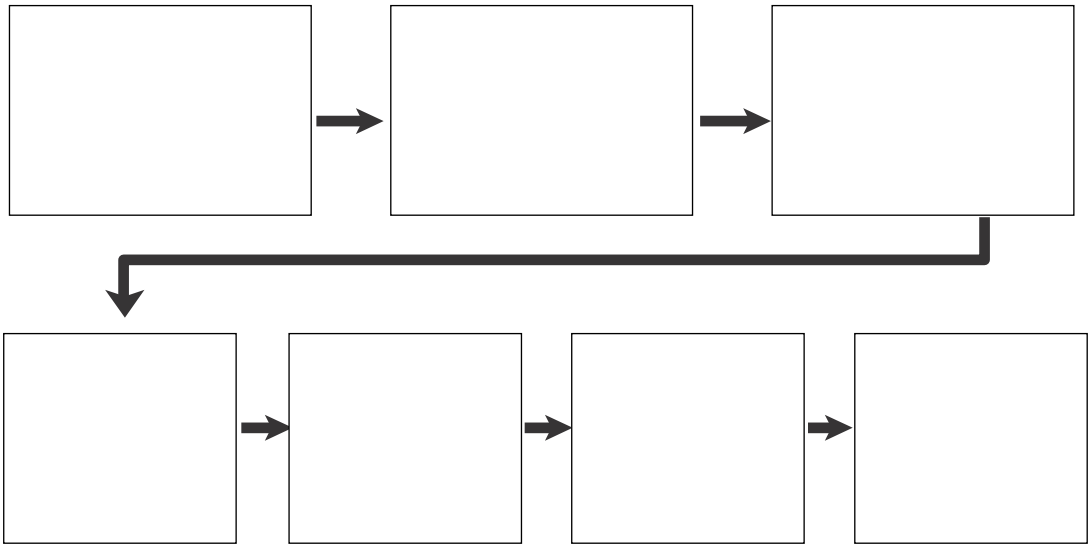
c. Energized electrons leave the electron transport chain and are used to produce NADPH.

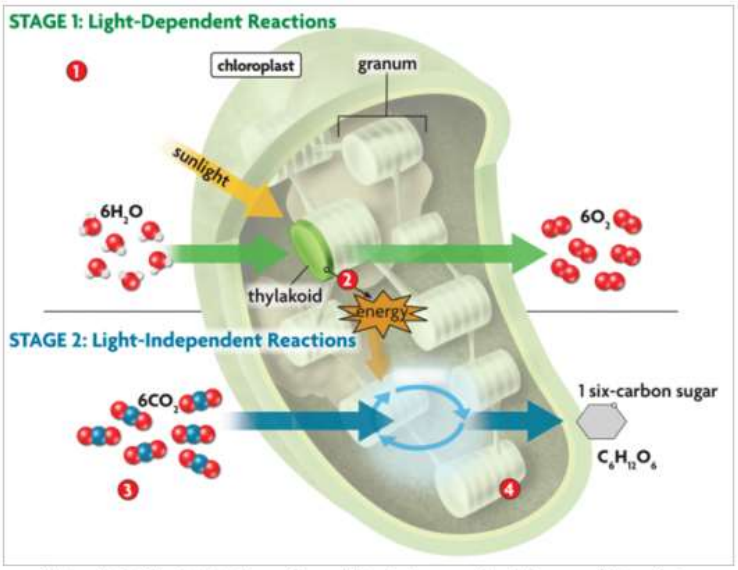
d. Energy from electrons in the transport chain is used to pump hydrogen ions across the thylakoid membrane.

e. Hydrogen ions flow through a channel coupled to ATP synthase.

f. More energy is absorbed and transferred to electrons.

g. Water molecules are broken down. Oxygen is released as waste and electrons enter chlorophyll.





Photosynthesis Chloroplasts absorb energy from sunlight and produce sugars through the process of photosynthesis.

35. The Calvin cycle uses energy from the light-dependent reactions to convert _____ into sugars.

36. Using the diagram below, put the letter from each of the following statements into the appropriate box to show the four steps of the Calvin cycle.

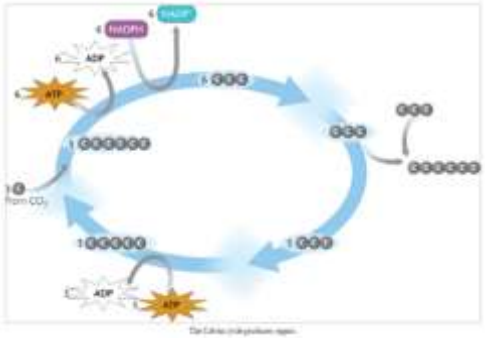
a. A three-carbon molecule exits the cycle. Other three-carbon molecules stay in the cycle.

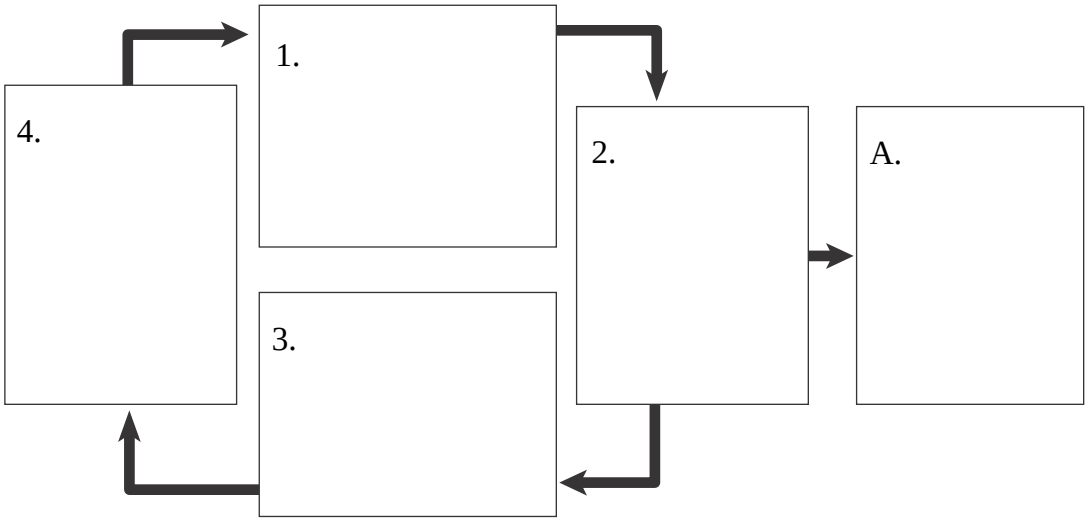
b. Carbon dioxide is added to the Calvin cycle.

c. Energy is used to convert the remaining three-carbon molecules into five-carbon molecules.

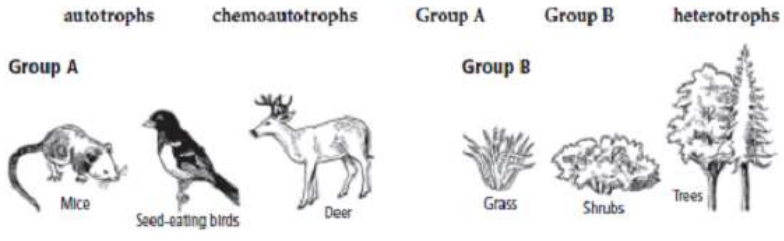
d. Energy is used to split six-carbon molecules. Three-carbon molecules are formed and rearranged.

e. When two three-carbon molecules have left the cycle they bond to form a six-carbon sugar (glucose)





37. Complete the statements below. Use the pictures and word bank.



The group that makes their own food is _____. The organisms in this group are called _____. The group that must eat other organisms for food is _____. The organisms in this group are called _____. Some organisms get their energy from inorganic substances, such as hydrogen sulfide. These organisms are called _____.

38. Match the word to the definition.

_____1. All the chemical reactions in a cell	a. Energy
_____2. Anabolic pathway that converts energy from the Sun to chemical energy for use by cells.	b. Metabolism
_____3. Ability to do work.	c. Photosynthesis
_____4. Biological molecule that provides chemical energy	d. Sunlight
_____5. Source of nearly all energy for life	e. Adenosine triphosphate (ATP)

39. List and explain how photosynthetic organisms can adapt to their environment. _____

_____

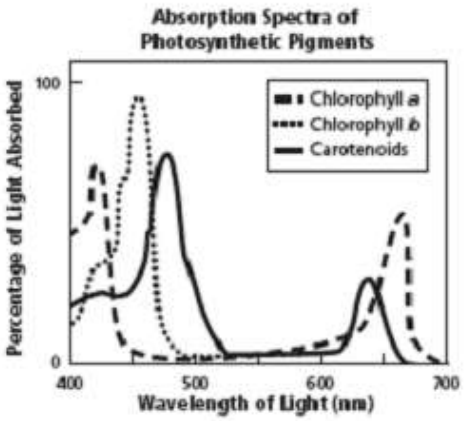
40. Why do leaves change color in the fall? _____

_____

41. Why do plants have many different pigments? _____

_____

42. Use the graph. Which pigment absorbs the most light at 450 nm? _____



42. Do we see reflected light or absorbed light? _____

44. What other pigments are available to photosynthetic organisms? Describe the various colors. _____

_____

45. How much energy is passed on to each trophic level? _____

46. Describe the flow of energy from the Sun. _____

_____