

PHOTOSYNTHESIS STARTS WITH

1. Molecules that collect light energy are called P _____ .
2. Chlorophyll a and b absorb B _____ - V _____ and R _____ wavelengths of light best.
3. C _____ is the main light absorbing pigment found in green plants.
4. Plants “look” green because chlorophyll R _____ green light.
5. Organisms, like green plants, that can make their own food using energy from the sun are called A _____ .
6. The gel-filled space inside the chloroplast surrounding the thylakoid stacks is called the S _____ .
7. P _____ I and II contain chlorophyll and absorb light energy during the L _____ D _____ reactions.
8. During the light dependent reactions, H^+ ions build up in the T _____ space when W _____ molecules are split.
9. The enzymes for the light dependent reactions are found in the T _____ M _____ , while the Calvin cycle happens in the S _____ .
10. The stacks of thylakoids found inside chloroplasts are called G _____ .
11. The light independent reactions are also called the C _____ C _____ .
12. Carbon and oxygen from C _____ D _____ end up as part of a G _____ molecule following the Calvin cycle.
13. A _____ and N _____ are made during the L _____ dependent reactions and carry energy and high energy electrons that are used during the Calvin cycle to produce S _____ , like glucose.
14. The O in H_2O is given off as O _____ gas to the atmosphere when water is split during the light dependent reactions.
15. Proteins in living things that help chemical reactions happen are called E _____ .
16. Electrons are transferred along the membrane from Photosystem II to Photosystem I using the E _____ T _____ S _____ .
17. Orange and yellow colored pigments called C _____ absorb different wavelengths of light and help chlorophyll use more of the sun’s energy.
18. T _____ , amount of W _____ , and L _____ intensity are all factors that affect the rate of photosynthesis.
19. C _____ pushes H^+ ions from the stroma across the membrane into the thylakoid space.

* * * * *

ENERGY AND LIFE

MULTIPLE CHOICE: CIRCLE ALL THE STATEMENTS THAT ARE TRUE OR COMPLETE THE STATEMENT. THERE MAY BE MORE THAN ONE CORRECT ANSWER.

1. Which molecule stores more than 90 times the energy in an ATP molecule?
 - A. ADP
 - B. water
 - C. glucose
 - D. adenine

2. All organisms get the ENERGY they need to regenerate ATP from _____
 - A. phosphates
 - B. foods like glucose
 - C. organelles
 - D. ADP

3. Which of the following are TRUE about ATP?
 - A. ATP consists of ribose sugar, adenine, and 3 phosphate groups
 - B. ADP forms when ATP loses a phosphate and releases energy.
 - C. Used ATP is discarded by the cell as waste.
 - D. ATP provides energy for active transport in cells.

What is it called?	DESCRIPTION	GIVE 2 EXAMPLES
	Organisms that can make their own food	
	Organisms that obtain energy from the food they eat	

What is the ultimate source of energy autotrophs use to produce their own food? _____

On the line below each picture, classify the organism as either an AUTOTROPH or a HETEROTROPH.

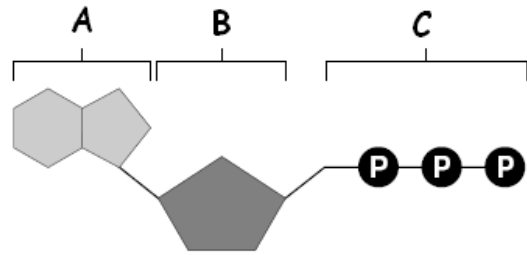


_____ Hint: What color are mushrooms?

NAME THE CHEMICAL COMPOUND SHOWN BELOW THAT CELLS USE TO STORE ENERGY. _____

LABEL THE PARTS THAT MAKE UP THIS MOLECULE:

A= _____
 B= _____
 C= _____



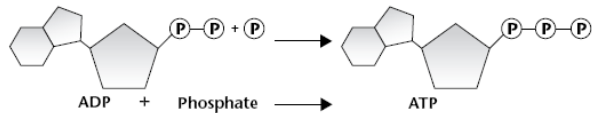
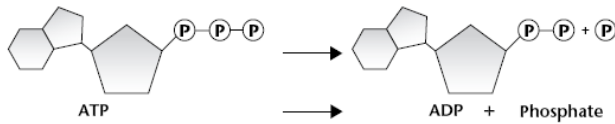
WHAT DOES ATP STAND FOR?

A _____ T _____

HOW MANY PHOSPHATES ARE IN ONE MOLECULE OF ADP? _____

HOW IS ATP MADE FROM ADP?

USE the words: **ENERGY STORING** and **ENERGY RELEASING** to label what is happening in the reactions shown below:



Name 3 cellular activities that use the energy stored in ATP:

* * * * *

PHOTOSYNTHESIS: An Overview

CIRCLE ALL THAT ARE TRUE.

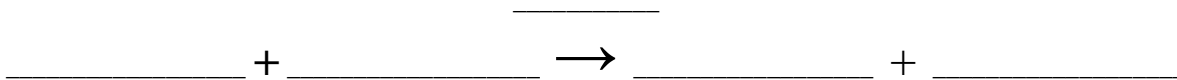
1. Plants gather the sun's energy with light-absorbing MOLECULES called _____.
 - A. thylakoids
 - B. pigments
 - C. chloroplasts
 - D. glucose

2. Chlorophyll absorbs light very well in the _____ regions of the visible spectrum.
 (Circle all that are true)
 - A. blue-violet
 - B. green
 - C. red
 - D. yellow

3. Most plants appear green because chlorophyll _____.
 - A. reflects green light
 - B. absorbs green light

4. A student conducts an experiment by collecting the gas given off by a green plant in bright sunlight at room temperature. The gas being collected is probably _____.
- ATP
 - water vapor
 - carbon dioxide
 - oxygen

Write the complete overall chemical equation for photosynthesis using chemical symbols instead of words:



How many molecules of carbon dioxide (CO₂) are used to make 1 molecule of glucose (C₆H₁₂O₆) ?

- 1 2 3 6 12

In addition to water and carbon dioxide, what two things are required for photosynthesis to happen?

_____ and _____

* * * * * * * * * * * * * *

REACTIONS OF PHOTOSYNTHESIS

MULTIPLE CHOICE: Circle the letter of the answer that best completes the statement or answers the question.

- Where are Photosystems I and II found?
 - in the stroma
 - in the thylakoid space
 - in the thylakoid membrane
 - in the Calvin cycle
- The Calvin cycle is another name for _____.
 - photosynthesis
 - the electron transport chain
 - light-dependent reactions
 - light-independent reactions
- Why does the space inside the thylakoid become positively charged during the light-dependent reactions?
 - ATP synthase pushes H⁺ ions from the stroma across the membrane into the space
 - H⁺ ions build up in the space as water is split
 - Electrons have a + charge and are released here by Photosystem II
 - Carbon dioxide builds up in the stroma
- CIRCLE ALL THAT ARE TRUE** about the **LIGHT DEPENDENT REACTION**.
 - High-energy electrons move through the electron transport chain.
 - Pigments in photosystems II and I absorb light.
 - ATP synthase helps H⁺ ions in the thylakoid space to pass through the membrane to the stroma.
 - ATP and NADPH are used to produce high-energy sugars.

5. **CIRCLE ALL THAT ARE TRUE** about the **CALVIN CYCLE**
- A. ATP is produced by ATP synthase and oxygen is released
 - B. It is also called the light-independent reaction.
 - C. ATP and NADPH from the light-dependent reactions are used here
 - D. High energy sugar compounds are made from CO₂
6. Which step is the beginning of photosynthesis?
- A. Pigments in photosystem I absorb light.
 - B. Pigments in photosystem II absorb light.
 - C. High energy electrons move through the electron transport chain.
 - D. ATP and NADPH produce high energy sugars.
7. **CIRCLE ALL OF THE FOLLOWING THAT ARE FOUND INSIDE THE THYLAKOID MEMBRANE.**
- A. electron transport chain
 - B. photosystem I
 - C. photosystem II
 - D. ATP synthase
8. Which molecule acts as a carrier for high energy electrons during photosynthesis?
- A. ATP
 - B. H₂O
 - C. NADP⁺
 - D. CO₂
9. How is the Calvin cycle different from the light-dependent reactions?
- A. It takes place in chloroplasts.
 - B. It takes place in the stroma.
 - C. It requires light.
 - D. It takes place in the thylakoid membrane
10. Oxygen produced during the light-dependent reaction is _____.
- A. used in the Calvin cycle to make sugar
 - B. joined with the NADPH to make water
 - C. is released into the atmosphere
 - D. None of these, oxygen is NOT produced by the light-dependent reaction

* * * * *

How does NADP⁺ become NADPH?

Name 3 factors that affect the rate at which photosynthesis occurs.

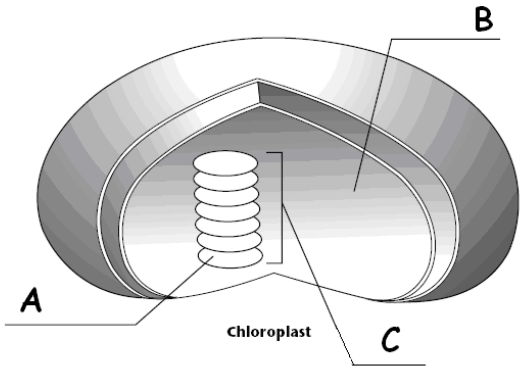
- 1. _____
- 2. _____
- 3. _____

MODIFIED TRUE or FALSE

Circle T if the statement is TRUE.

Circle F if the statement is FALSE and use the blank provided to correct the underlined word/phrase.

- T F Increasing light intensity decreases the rate of photosynthesis. _____
- T F Carbon dioxide molecules enter the light-dependent reactions from the atmosphere. _____
- T F Photosynthesis uses energy from ATP and high energy electrons from NADPH produced in the light-dependent reactions to make glucose in the Calvin cycle. _____
- T F The light-dependent reaction produces ATP, NADPH, and carbon dioxide. _____
- T F ATP synthase spins like a turbine as H⁺ ions pass through it to generate ATP. _____
- T F Electrons are energized twice during photosynthesis. _____

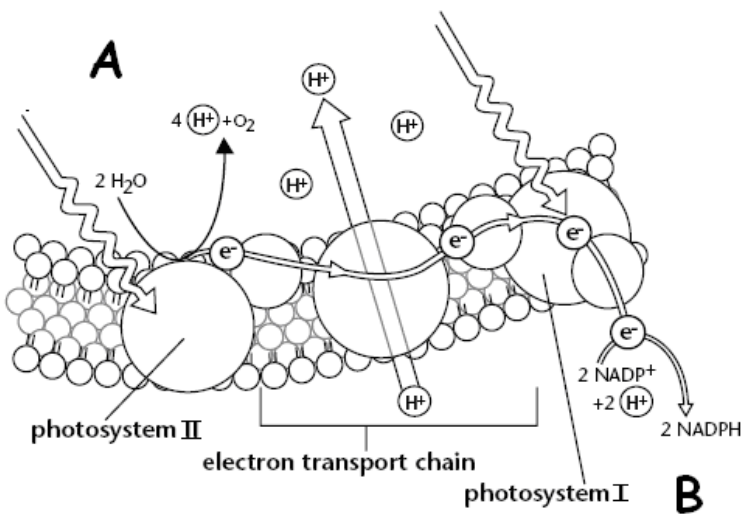


USE THE LETTERS IN THE DIAGRAM AT THE LEFT TO IDENTIFY:

- _____ stroma
- _____ thylakoid
- _____ granum

* * * * * * * * *

* * * * * * *



COLOR THE DIAGRAM AS DESCRIBED:

Color the energy from sunlight **YELLOW**

Color the two places where light energy enters the reactions **ORANGE**

Color the hydrogen ions **RED**

Color the electrons **GREEN**

Color the thylakoid membrane **BLUE**

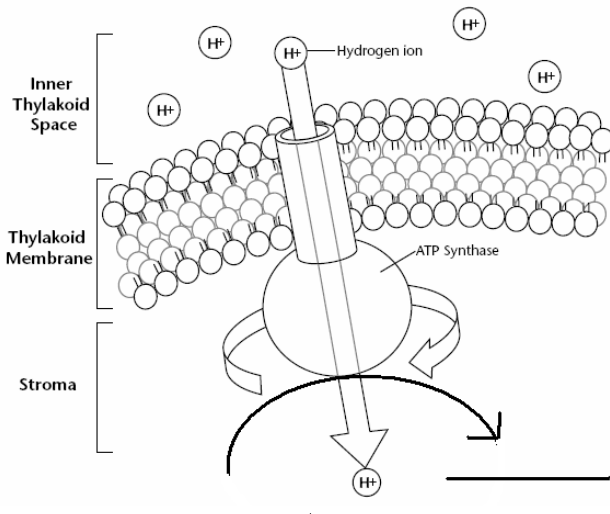
On which side of the membrane would you find the **STROMA**? **A** or **B**

(Hint: look to see where NADPH is being made)

On which side of the membrane is the **INNER THYLAKOID SPACE**? **A** or **B**

(Hint: look to see where water molecules are being split)

* * * * * * * * *



Where does ATP formation happen?

Stroma **inner thylakoid space**

Add an equation to the diagram in the correct location that shows the formation of ATP from ADP.

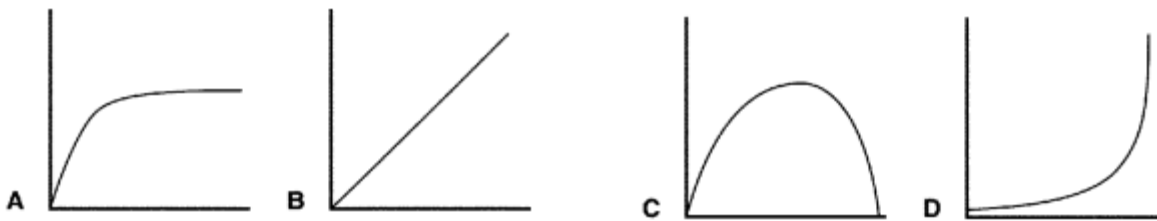
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USE WORDS FROM THE WORD BANK TO FILL IN THE CHART COMPARING AND CONTRASTING THE LIGHT-DEPENDENT REACTIONS AND THE CALVIN CYCLE: (You can use them more than once!)

in stroma	in thylakoid membrane	O ₂	ATP	CO ₂	H ₂ O	NADPH
Requires light		Doesn't require light		SUGARS (glucose)		

	LIGHT-DEPENDENT REACTIONS	CALVIN CYCLE
LOCATION		
REACTANTS		
PRODUCTS		
LIGHT?		

THINK ABOUT IT



Which of these graphs represents the effect of temperature on the rate of photosynthesis? _____
 (Hint: Many molecules that help with photosynthesis are enzymes)

EXPLAIN YOUR ANSWER. _____

Which of these graphs represents the effect of light intensity on the rate of photosynthesis? _____

EXPLAIN YOUR ANSWER. _____

Modified from: <http://brookings.k12.sd.us/biology/photosynthesis.htm>