

Name: KEY

Unit 6: Energetics
Part I: Respiration
AIM: How is ATP produced during Aerobic respiration

Basic Intro Vocabulary

Nutrition:

how an organism obtains and processes the materials to perform life functions

Autotrophs: (producer)

Make their own food via photosynthesis

Heterotrophs: (consumer)

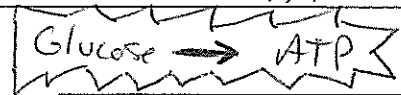
must consume other organisms to obtain food

A.) CELLULAR RESPIRATION / Not Breathing!

1. The process by which cells convert Glucose to ATP

-Energy is stored in the bonds of ATP

-ATP = Adenosine Triphosphate



Bonds:

Make Bonds:

store energy

Break Bonds:

release energy

2. Why can't cells use glucose directly for energy?

- Glucose ($C_6H_{12}O_6$) is much too complex and powerful to be used for cellular work

Lantern battery → 8 AA batteries

- ATP molecules release just the right amount of energy needed to drive cellular work

ATP → cellular energy

3. There are 2 types of Cellular Respiration:

- a. Aerobic
- b. Anaerobic

4. Aerobic Respiration

- a. converts $C_6H_{12}O_6 \rightarrow ATP$
- b. with oxygen

5. Anerobic Respiration

- a. converts $C_6H_{12}O_6 \rightarrow ATP$
- b. without oxygen

6. Plants and Animals are aerobic

7. Tiny organisms such as yeast and certain bacteria are anaerobic

Cellular Respiration = Aerobic



1. Which statement best describes cellular respiration?

- 1) ~~It occurs in animal cells but not in plant cells.~~
- 2) It converts energy in food into a more usable form.
- 3) ~~It uses carbon dioxide and produces oxygen.~~
- 4) ~~It stores energy in food molecules.~~

2. ATP is a compound that is synthesized when

- 1) chemical bonds between carbon atoms are formed during photosynthesis
- 2) energy stored in chemical bonds is released during cellular respiration
- 3) energy stored in nitrogen is released, forming amino acids
- 4) digestive enzymes break amino acids into smaller parts

3. Bacteria that can survive without oxygen are described as

- 1) aerobic
- 2) anaerobic
- 3) heterotrophic
- 4) saprophytic

4. The most ATP is produced as a result of

- 1) aerobic respiration
- 2) anaerobic respiration
- 3) photosynthesis
- 4) fermentation

5. What is a direct result of aerobic respiration?

- 1) glucose is transferred to ATP
- 2) The enzymes for anaerobic respiration are produced and stored in lysosomes.
- 3) Lactic acid is produced in muscle tissue.
- 4) Alcohol is produced by yeast and bacteria.

6. Organisms that can survive without the presence of oxygen are

- 1) aerobic
- 2) heterotrophs
- 3) anaerobic
- 4) animals

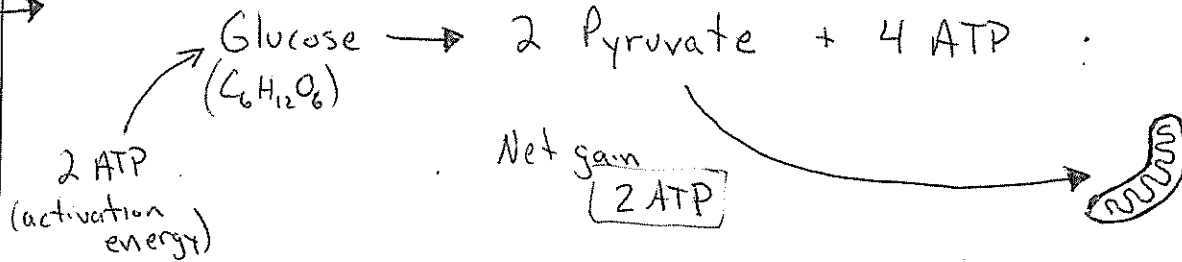
Glycolysis → Splitting of a Glucose molecule

AEROBIC RESPIRATION

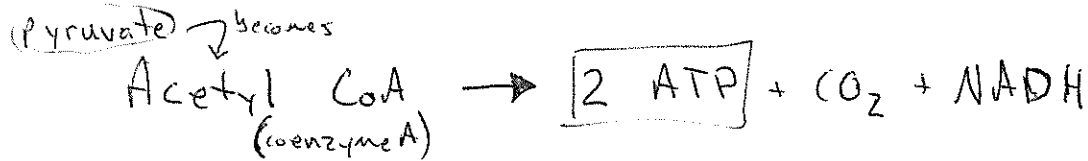
Glucose

Plant cell

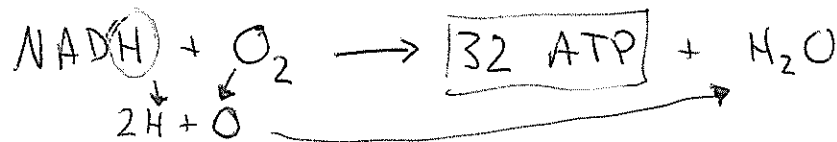
① Glycolysis (in cytoplasm) Net gain = 2 ATP



② Krebs cycle (citric acid cycle) in mitochondrion



③ Electron Transport chain (ETC) in mitochondrion



**

Aerobic Respiration = 1 Glucose → 36 ATP

* lotto ticket example

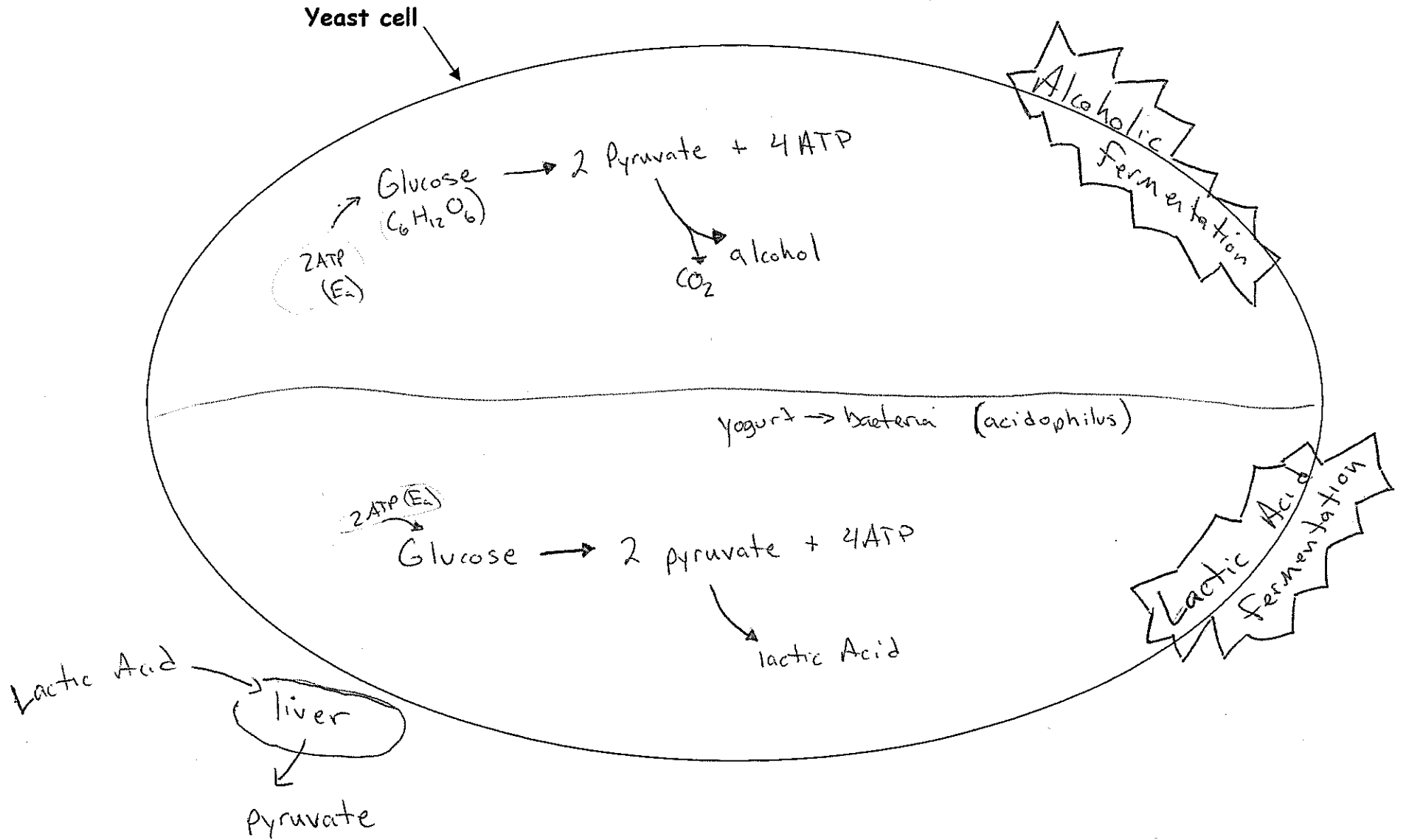
Step 1 & 2
4 ATP

Step 1 & 2 & 3
32 + 4
36 ATP

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ANAEROBIC RESPIRATION



Name: _____

Date: _____

CELLULAR RESPIRATION Worksheet

1. Define cellular respiration: Process by which a cell transforms Glucose into ATP

2. List the two types of cellular respiration:
Aerobic Anaerobic

3. What function does **ATP** serve in cellular respiration?
Activation Energy

4. Another word for anaerobic respiration is: fermentation

5. Define **glycolysis**: the splitting of a glucose molecule

6. The total net gain of ATP molecules in anaerobic respiration is 2 ATP

7. Write the simplified equation for glycolysis: Net gain 2ATP
Glucose $\xrightarrow{2ATP}$ 2 Pyruvate + 4ATP

8. How is **aerobic** respiration different from **anaerobic** respiration?
Aerobic involves Oxygen, anaerobic does not

9. Write the simplified equation for aerobic respiration:
Glucose + O₂ \longrightarrow 36 ATP + CO₂ + H₂O

10. List the three steps of aerobic respiration:
Glycolysis, Krebs cycle, Electron Transport chain

11. Briefly describe what is occurring in each step of aerobic respiration:

Step 1 - glycolysis

Glucose splits into 2 pyruvate releases 2 ATP

Step 2 - Krebs Cycle

Acetyl CoA becomes NADH and CO₂ releases 2 ATP

Step 3 - Electron Transport Chain

NADH and Oxygen make 32 ATP and water

12. Describe the function of **ATPase**: enzyme

aids in ATP/ADP reaction

13. Where in the cell does glycolysis take place?

cytoplasm

14. Where in the cell does the Krebs Cycle take place?

mitochondrion

15. Where in the cell is the Electron Transport Chain?

mitochondrion

Complete the table with the appropriate information:

	AEROBIC	ANAEROBIC
Oxygen required	yes	No
Net gain of ATP	36	2
More efficient	✓	
Reactants	$C_6H_{12}O_6 + O_2$	$C_6H_{12}O_6$
Products	$36 ATP + CO_2 + H_2O$	lactic acid / alcohol & CO ₂
Example organism	human	yeast / bacteria (E. coli)

B.) AEROBIC RESPIRATION (see handout)

C.) ANAEROBIC RESPIRATION (see handout)

1. Alcoholic Fermentation in Yeast (see handout)
2. Lactic Acid Fermentation in Animal Muscle Cells

D.) OVERALL EQUATIONS

<p>1. Aerobic Respiration:</p> $C_6H_{12}O_6 + O_2 \longrightarrow 36 ATP + H_2O + CO_2$
<p>2. Alcoholic Fermentation:</p> $C_6H_{12}O_6 \xrightarrow{2 ATP} \text{alcohol} + 4 ATP + CO_2$ <p style="text-align: right;">Net gain 2 ATP</p>
<p>3. Lactic Acid Fermentation:</p> $C_6H_{12}O_6 \xrightarrow{2 ATP} \text{lactic Acid} + 4 ATP$ <p style="text-align: right;">Net gain 2 ATP</p>

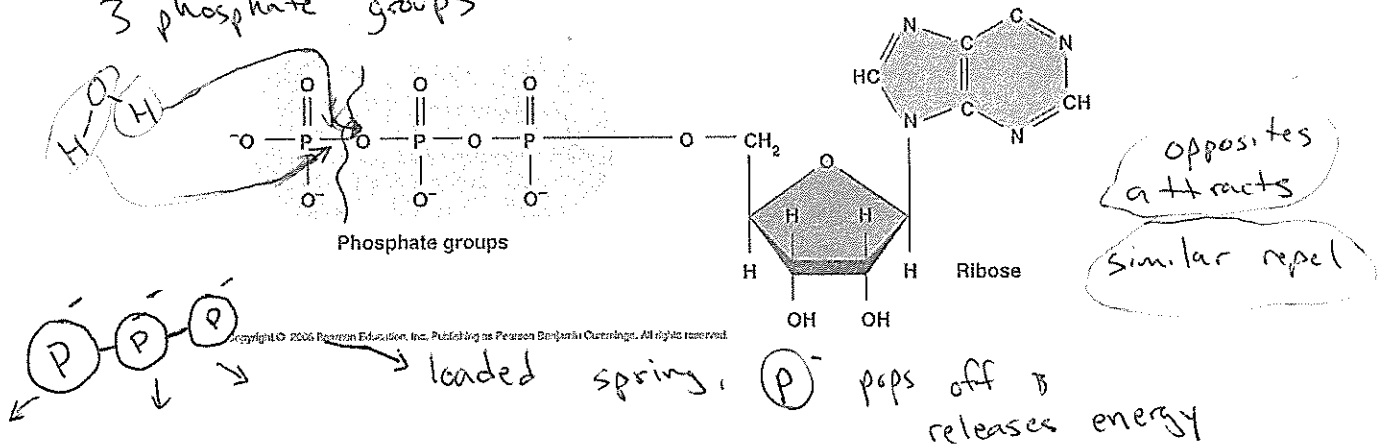
E.) ATP and CELLULAR WORK

1. Cells need energy to drive reactions

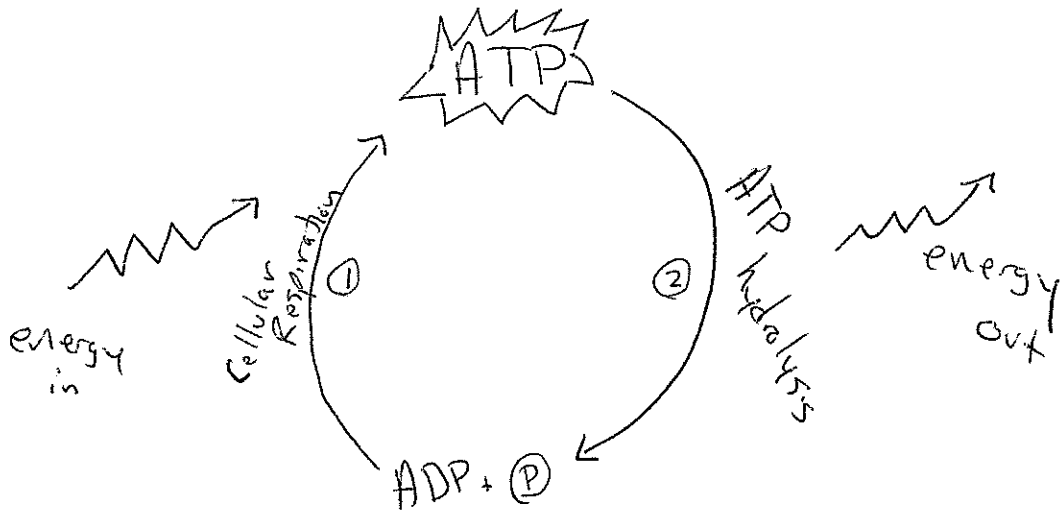
The molecule that supplies that energy is ATP

2. The reaction that releases energy is called ATP hydrolysis → (break ATP w/ H₂O)

3. ATP is a unique molecule because of the 3 phosphate groups



4. ATP Hydrolysis and the ATP Cycle

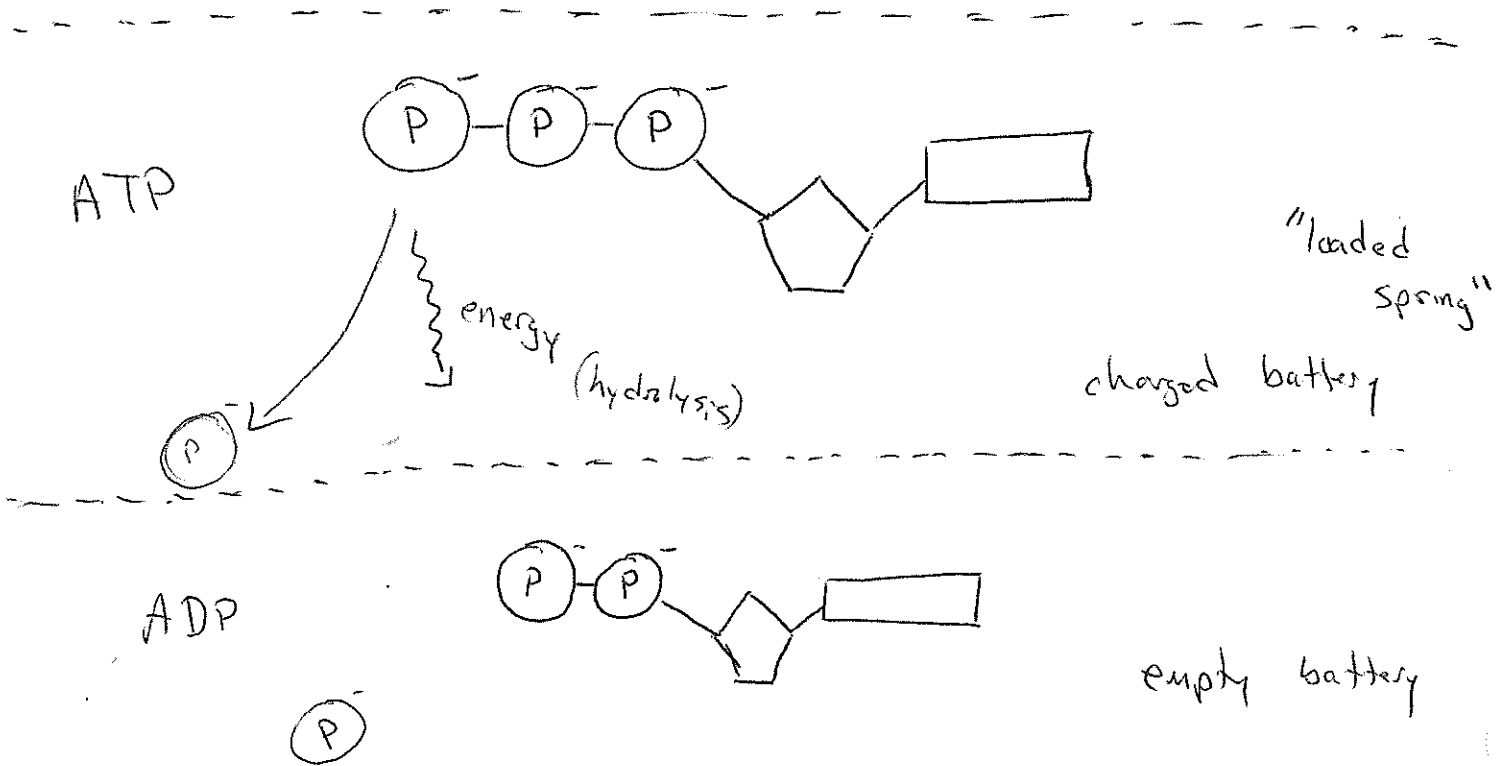


5. What type of cellular work is ATP used for?

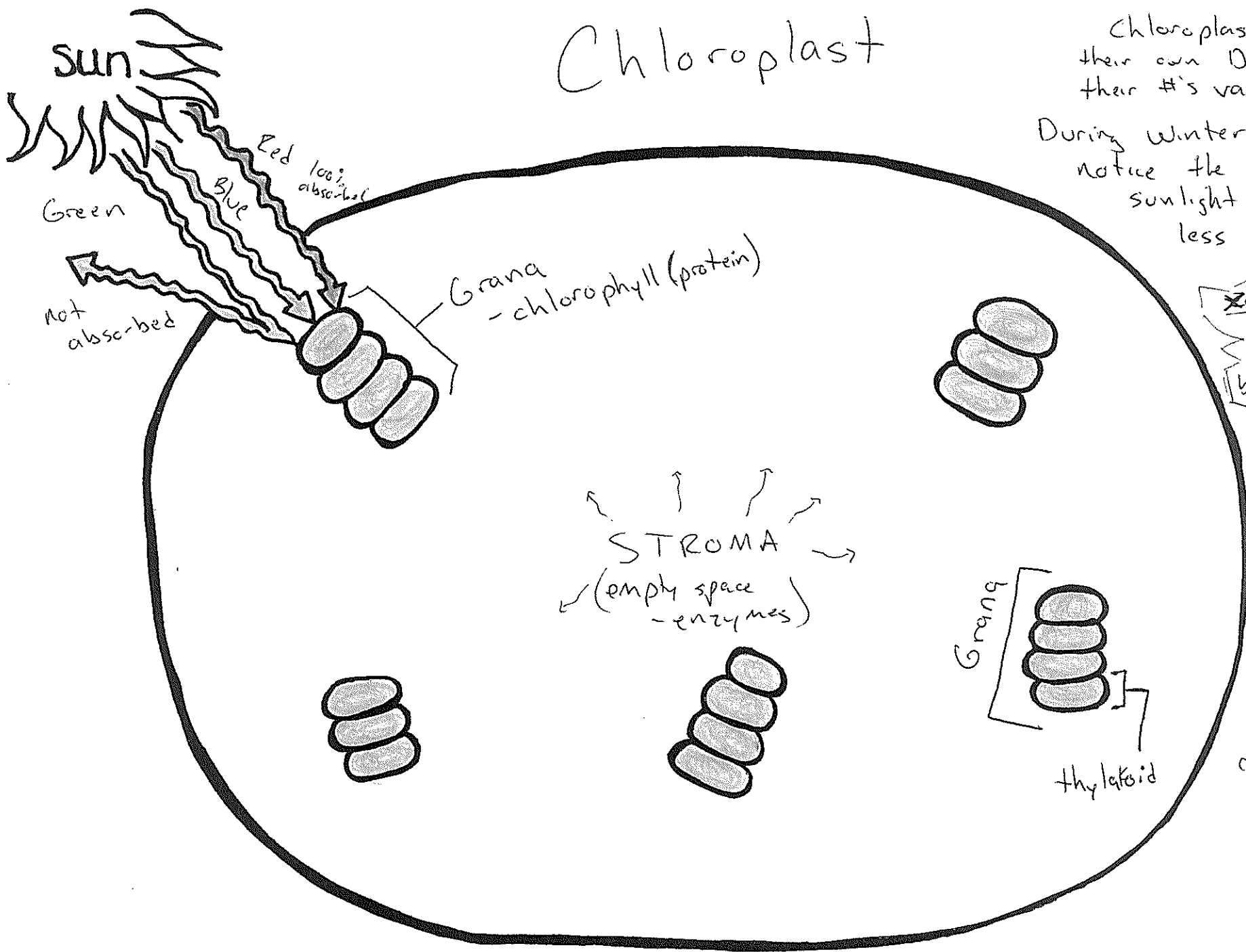
- a) Transport (active transport)
- b) Mechanical (sperm swimming)
- c) Chemical (activation energy)
E_a

① make bond
store energy

② break bond
release energy



Chloroplast

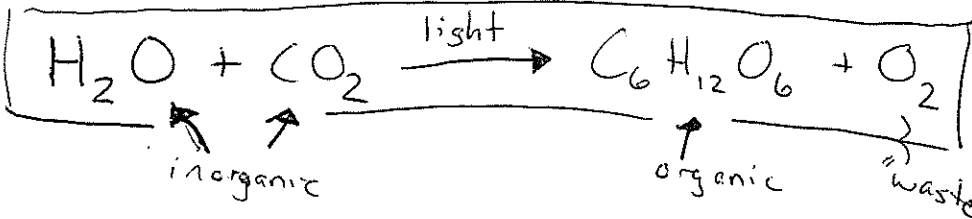


Chloroplasts have their own DNA & their #'s vary -

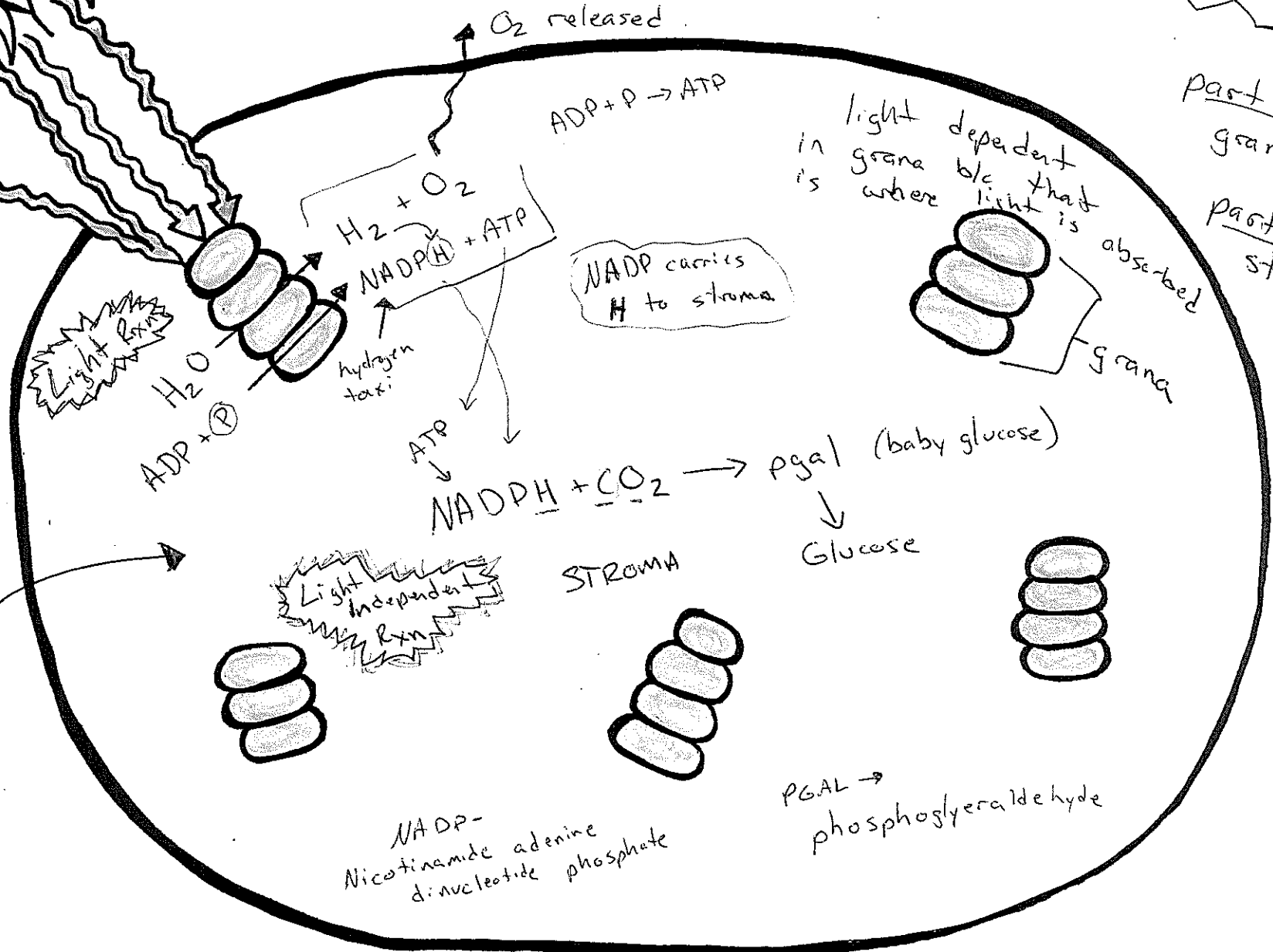
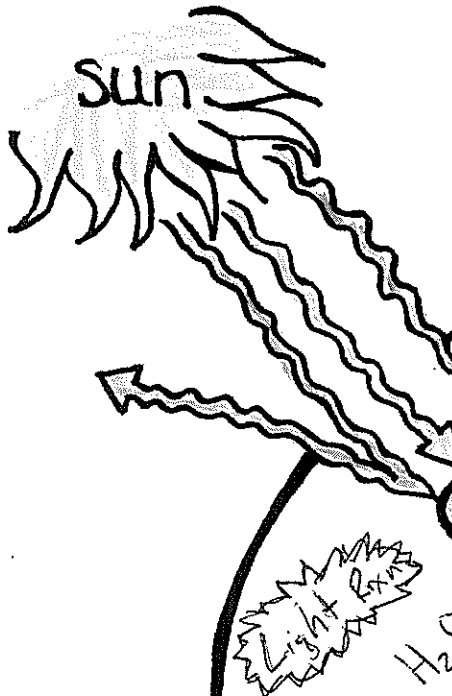
During winter plants notice the reduced sunlight & have less chloroplasts

Xanthophyll (yellow)
beta-carotene (Dark orange)

easier to see w/ less chlorophyll & leaves change color



plants are so important b/c they turn inorganic molecules & make them organic

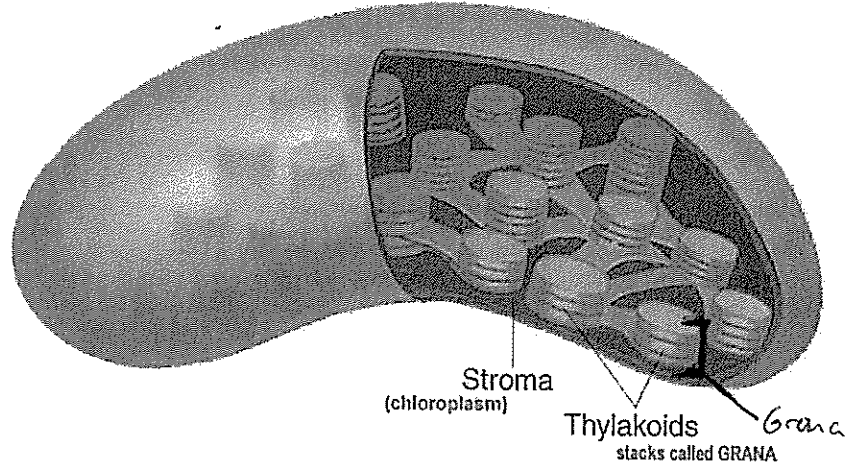


NADP - Nicotinamide adenine dinucleotide phosphate

PGAL → phosphoglyceraldehyde

F.) PHOTOSYNTHESIS "Feeding the World"

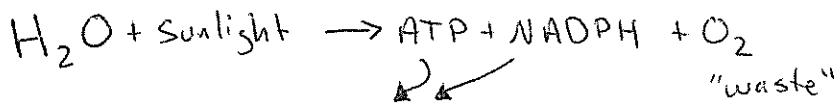
1. The process that converts light energy into the energy bonds of Glucose (C₆H₁₂O₆)
2. Where does photosynthesis take place?
 - Within organelles called chloroplasts



G.) The Light Dependent Reactions

1. Occur in the Grana
2. Light energy is used for 2 reactions:
 - a) Photolysis - splitting of H₂O w/ light energy → NADPH
 - b) Convert ADP → ATP
3. NADPH and ATP go into the stroma to synthesize Glucose
4. Oxygen gas is released as a waste of photolysis

Photolysis



NADPH carries H⁺

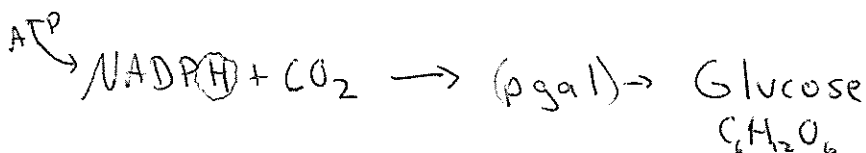
H.) The Light Independent Reactions (The Calvin Cycle)

1. Occur in the stroma
2. The NADPH(H⁺) from the grana is combined with carbon dioxide (CO₂)
3. Where does the CO₂ come from?

The atmosphere
4. What about the ATP from the grana? Why is it needed in the stroma?

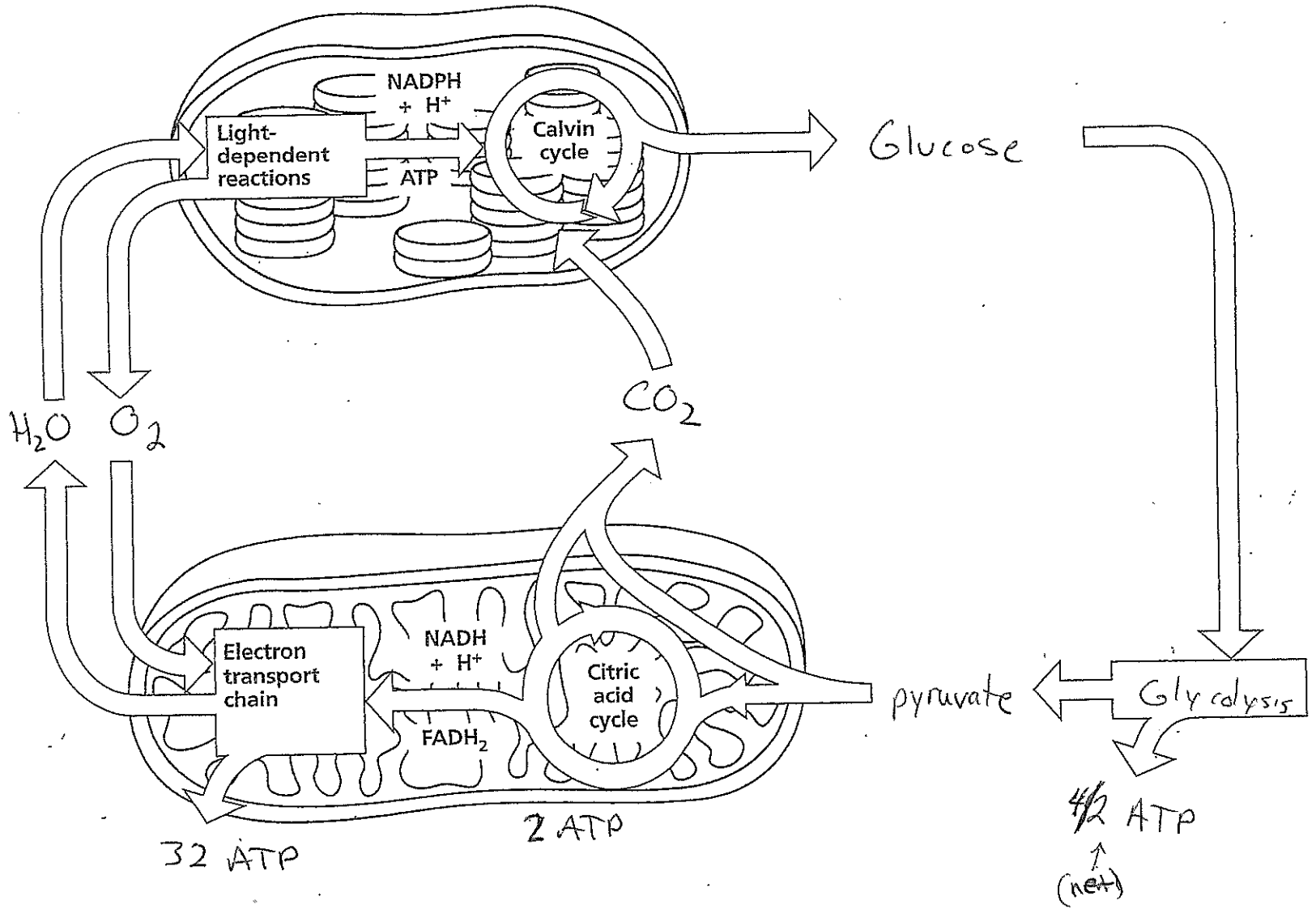
Activation Energy

The rxns in the stroma will not occur w/o ATP



D INTERDEPENDENCY

Cellular Respiration and Photosynthesis have a special relationship. (see handouts)



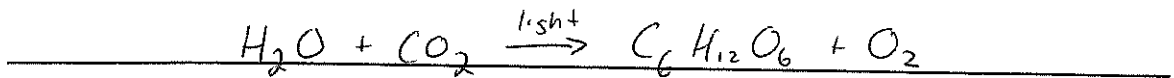
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PHOTOSYNTHESIS Worksheet

1. Define **photosynthesis**: Converting solar energy into chemical energy (bonds) in glucose.

2. Explain the difference between **photosynthesis** and **cellular respiration**:
Photosynthesis converts light energy to chemical
Respiration converts glucose to ATP

3. Write the simplified chemical equation for **photosynthesis**:



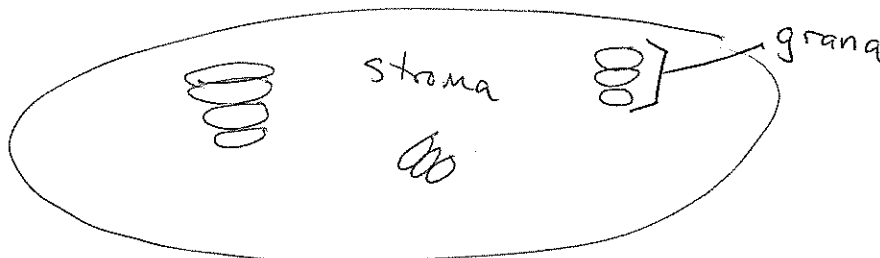
4. Most cells that carry out photosynthesis have organelles called chloroplast which contain a pigment called chlorophyll that absorbs light.

5. Which wavelengths of light are absorbed by chlorophyll?

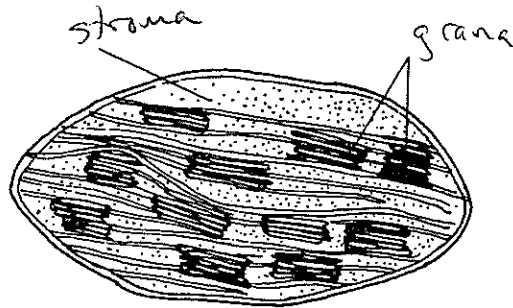
Blue & Red 100% and most others but not green and a little yellow.

6. Why are plants green in color? The chlorophyll reflects green light

7. In the space below, draw a **chloroplast** and label the **grana** and **stroma**:

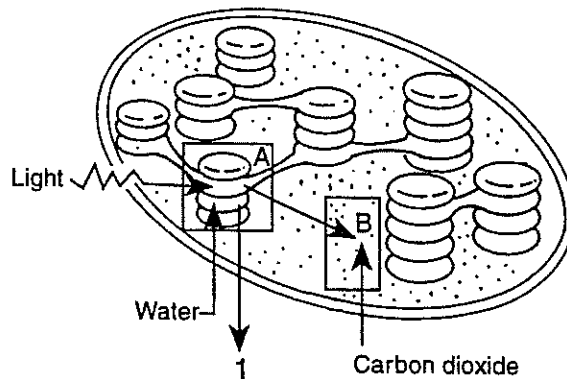


8. In the diagram below, label the **grana** and **stroma**:



9. The reactions that occur in the grana are called the light reaction rxn
or photolysis.
10. The reactions that occur in the stroma are called the light independent rxn
or calvin cycle.

Base your answers to questions 11 - 14 on the diagram below:



11. Which substance diffuses in the direction of arrow 1 after it is formed in the structure represented by letter A?

Oxygen O₂

12. Which substance acts as an immediate energy source for the reactions that occur in the part of the diagram labeled B?

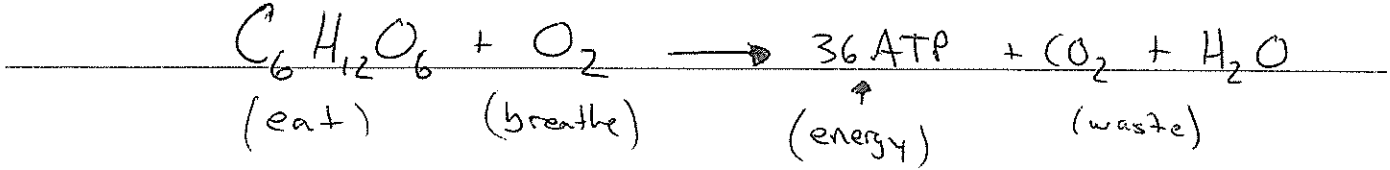
ATP

13. What part of the chloroplast is represented by letter A? Grana

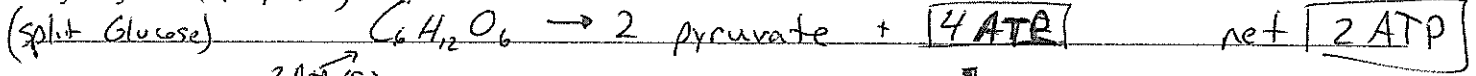
14. What part of the chloroplast is represented by letter B? Stroma

Do Now:

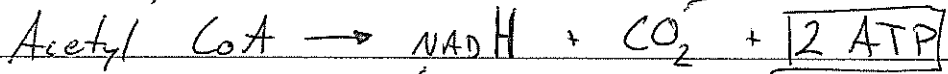
Overall simplified Respiration



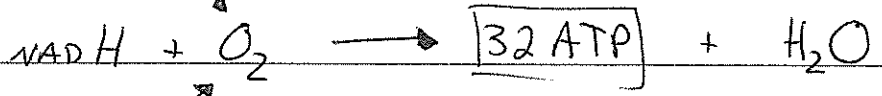
Glycolysis - (Cytoplasm)



2 ATP (ea)

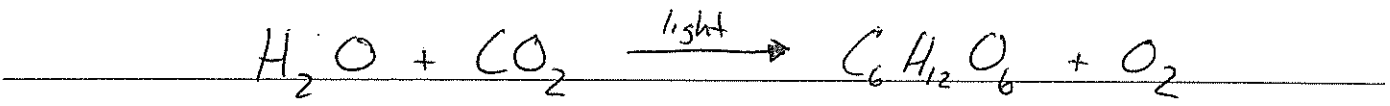


Mitochondrion
Kreb's
Electron transport change

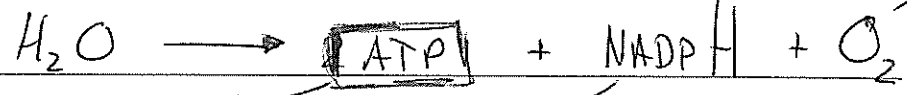


$\text{ADP} + \text{P} \rightarrow \text{ATP}$ (energy is stored in the bond)

Overall simplified Photosynthesis



Light reaction (Grana)



Light independent reaction (Stroma)

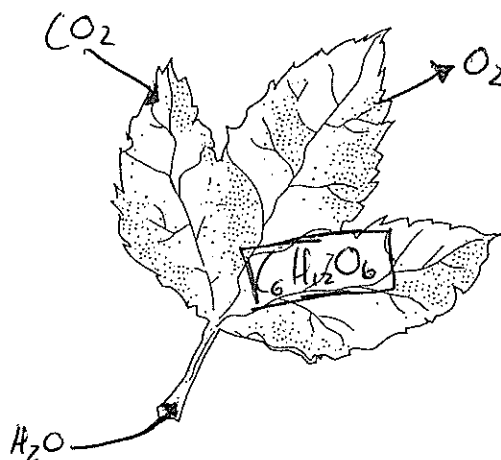
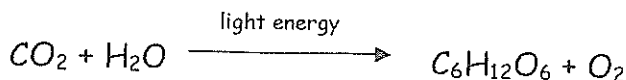
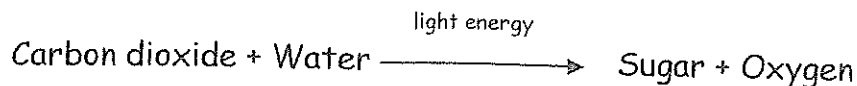


[Energy is not created or destroyed - it is transformed from one form to another]

light energy \rightarrow chemical (Glucose) \rightarrow chemical (ATP) \rightarrow heat (work)

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PHOTOSYNTHESIS Worksheet



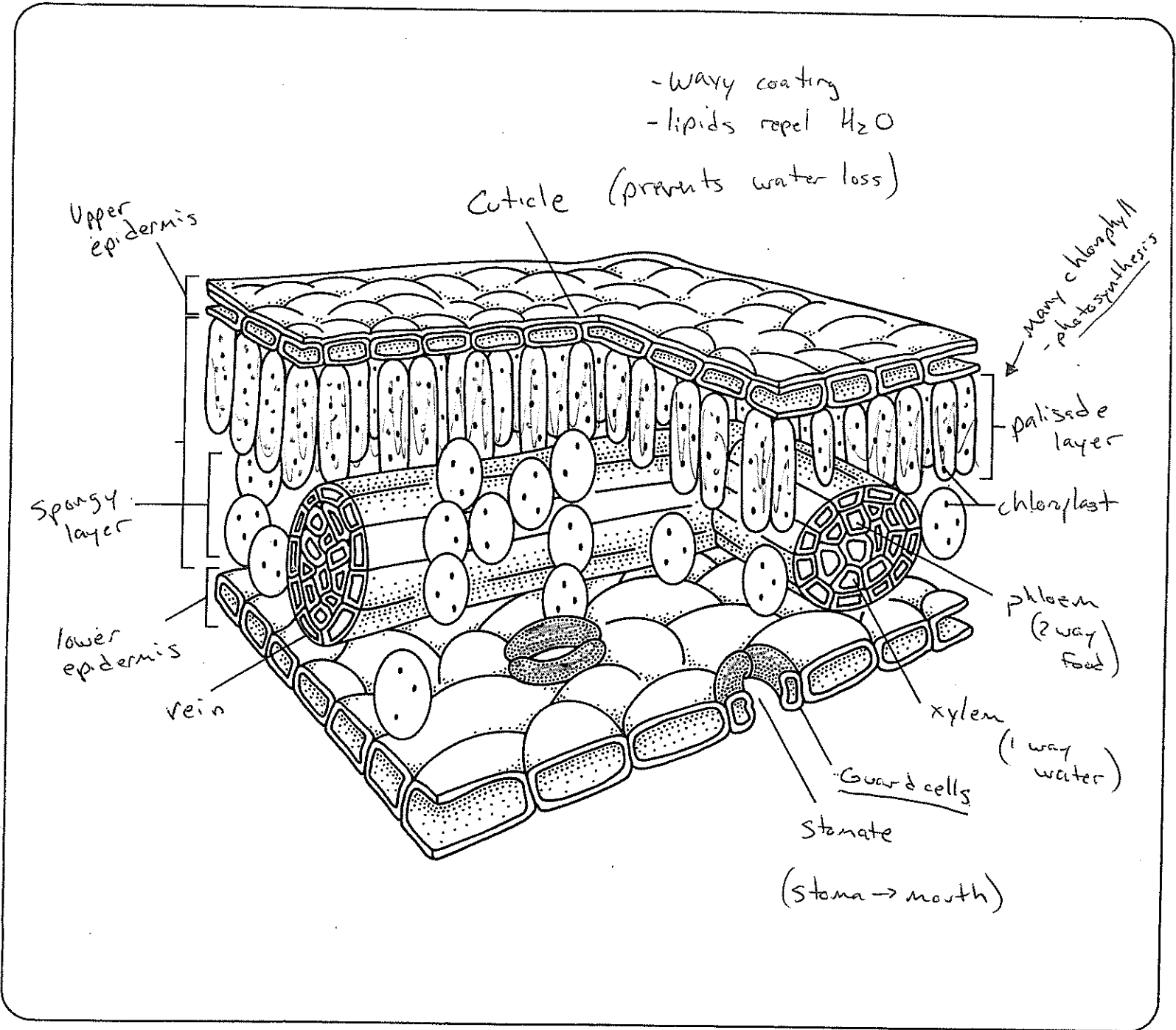
1. What is the source of energy for photosynthesis? the sun
2. What kinds of organisms perform photosynthesis? Autotrophs
3. What are the reactants for the photosynthesis reaction?
CO₂ & H₂O
4. What are the products for the photosynthesis reaction?
C₆H₁₂O₆ & O₂
5. What chemical substance needed by most organisms is produced as a result of photosynthesis?
Glucose → aerobic & anaerobic respiration
O₂ → only aerobic respiration

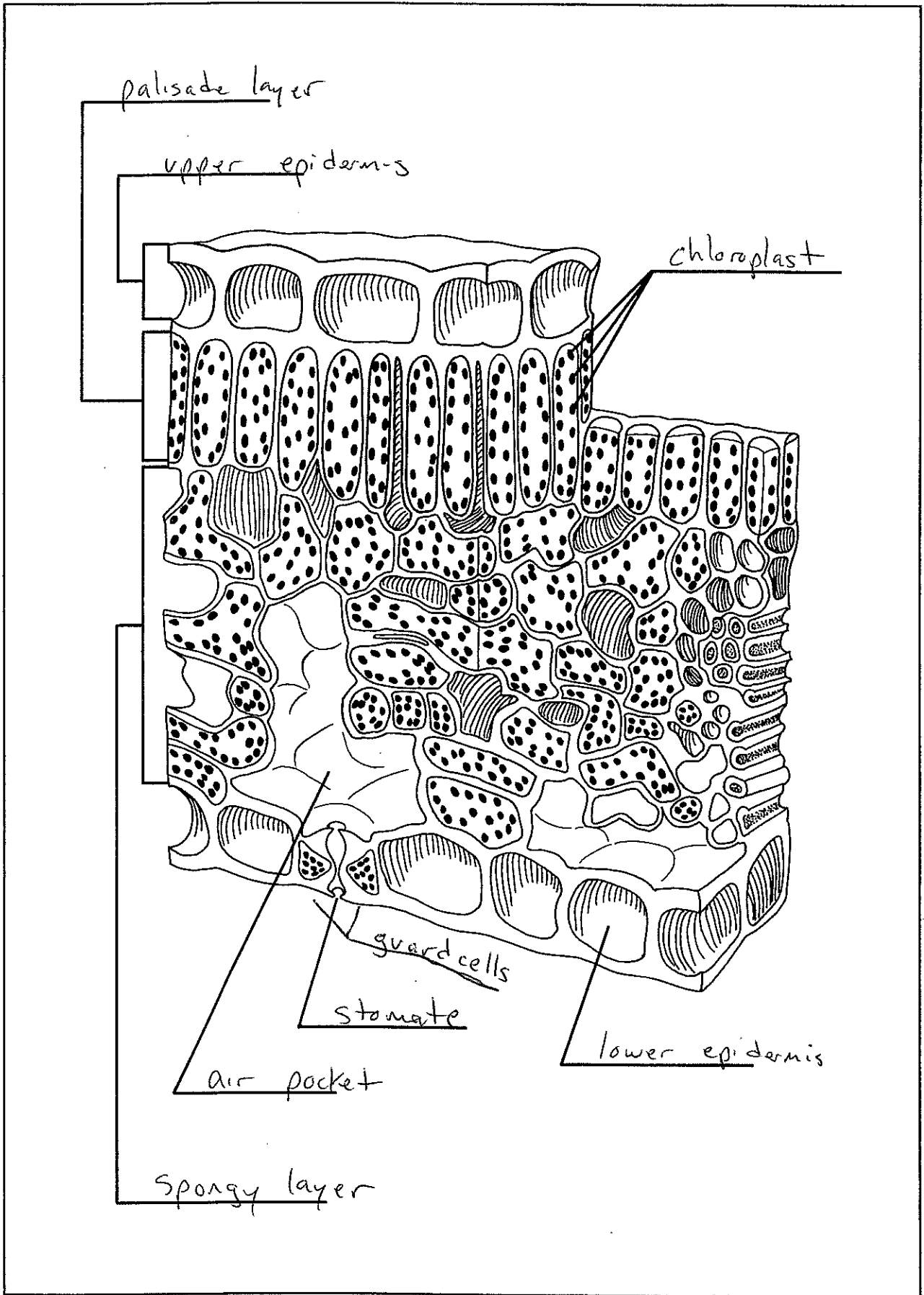
OVERHEAD TRANSPARENCY MASTER

CHAPTER

18

Cross Section of a Leaf





K. Factors affecting rate of photosynthesis

1. Increase the level of CO_2 tends to Increase the rate of photosynthesis
2. Limiting the amount of water will limit the rate of photosynthesis
3. Increasing the temperature from 0-35 C tends to increase the rate of photosynthesis
4. Increasing the temperature past 35C will decrease the rate of photosynthesis
5. Increasing the light intensity will Increase the rate of photosynthesis until a certain point and then level off

L. Adaptations for photosynthesis

1. Unicellular autotrophs

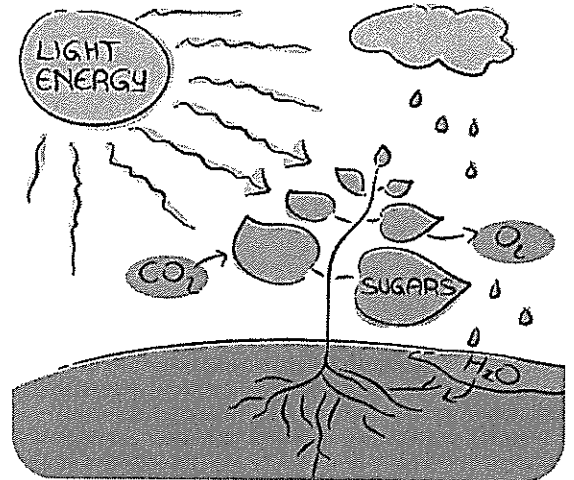
- a. Nearly all chlorophyll-containing single cellular organisms are aquatic

- b. The raw materials for photosynthesis are absorbed directly from the water into the cell

2. Terrestrial plants (land dwelling)

- a. Photosynthesis occurs in the leaves.

- b. Maximizes the surface area to absorb light

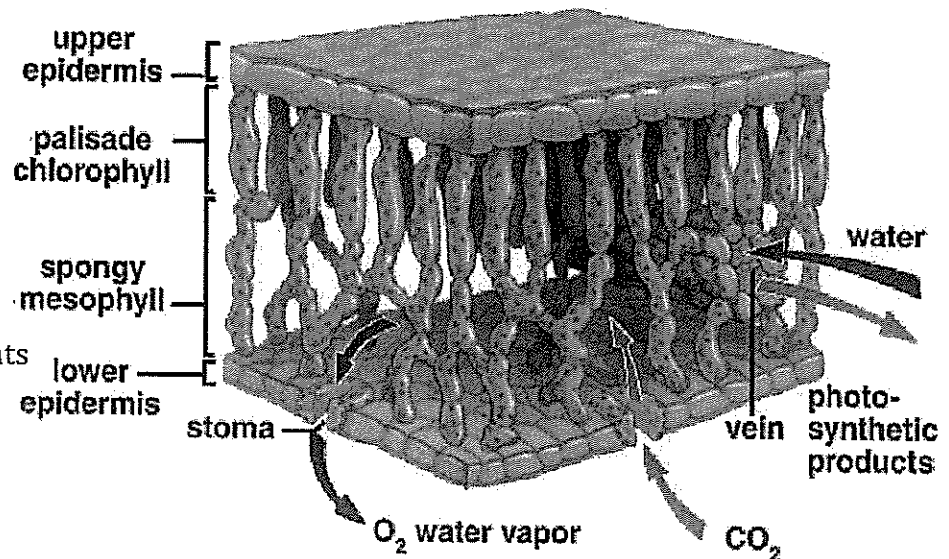


M. Leaf Structure

1. Outermost layer is called the

epidermis

- a. It is covered by a waxy protective layer that prevents excess water loss - the Cuticle



2. Palisade layer is where most of the photosynthesis takes place

3. Stomate - allows the exchange of O₂ and CO₂ in and out of the leaf

4. Guard cells control the opening and closing of the stomates

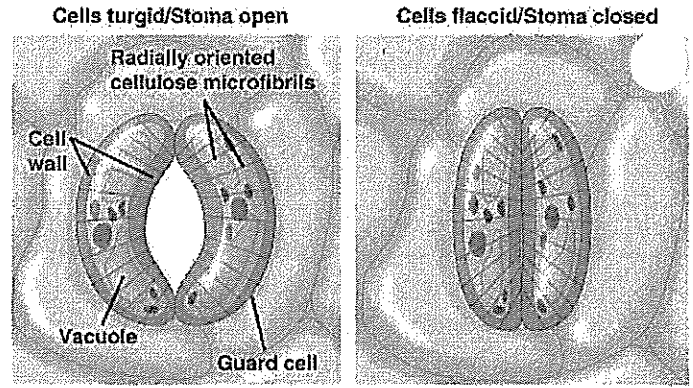
* full of H₂O → open

* less H₂O → closed

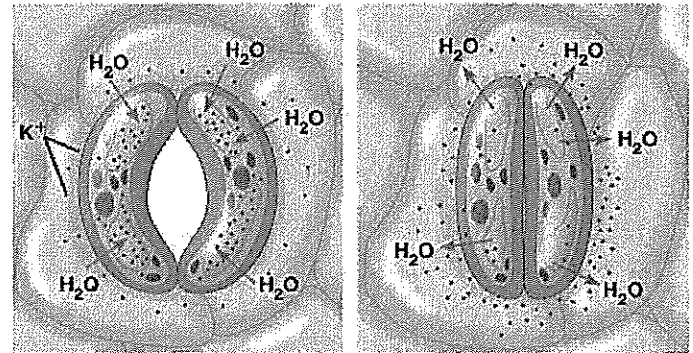
5. Plants contain 2 types of veins

a. Xylem is one directional ^(water)

b. phloem is two directional ^(glucose)



(a) Changes in guard cell shape and stomatal opening and closing (surface view)



(b) Role of potassium in stomatal opening and closing

