

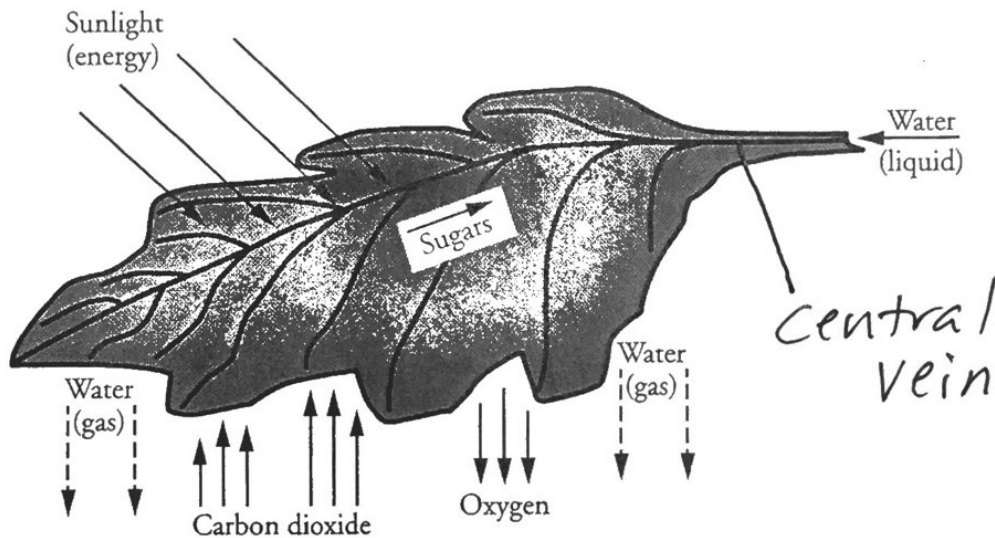
Photosynthesis: What's in a Leaf?

What is the relationship between structure and function in a leaf?

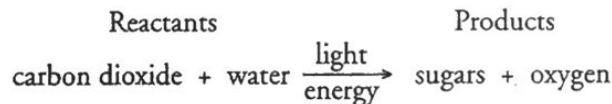
Why?

What would the world be like without leaves—no grass for ball fields, no beautiful landscaping? It would also mean no oxygen for animals and no food for heterotrophs. Leaves are like living machines that recycle the carbon and oxygen in our environment. This process, driven by the sun's energy, allows for a constant supply of oxygen and food for the inhabitants of Earth.

Model 1 – Leaf Sun-Catcher



General Equation for Photosynthesis



1. List three things entering the leaf in Model 1.

liquid H_2O , gaseous CO_2 , & light energy from sunlight.

2. List three substances leaving the leaf.

gaseous H_2O , liquid glucose, & gaseous oxygen.
(vapor)

3. Which substance is both entering and leaving?

water - in as a liquid, out as a gas/vapor.

4. Veins are important structures that carry materials through the leaf. Label the central vein in the leaf diagram.

see diagram

5. How is the substance you identified in Question 3 changed between its entry and its exit?

enters as liquid from roots, leaves as a gas due to evaporation in spongy mesophyll.

6. Use the general equation for photosynthesis and Model 1 to answer the following questions.

a. What are the reactants for photosynthesis? *6CO_2 , $6\text{H}_2\text{O}$, sunlight*

b. Where do these reactants enter the leaf?

CO_2 - stomata, H_2O - veins

c. What are the products of photosynthesis?

$\text{C}_6\text{H}_{12}\text{O}_6$ (glucose), 6O_2

d. From where do the products leave the leaf?

$\text{C}_6\text{H}_{12}\text{O}_6$ - vein, 6O_2 - stomata, H_2O vapor - stomata

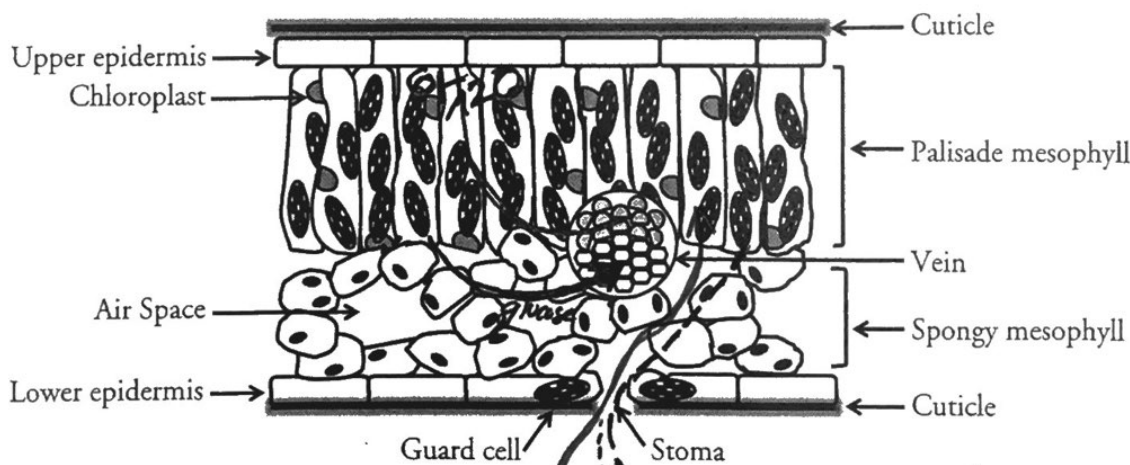
7. Categorize all the components involved in photosynthesis as either matter or energy.

matter - CO_2 , H_2O , $\text{C}_6\text{H}_{12}\text{O}_6$, O_2

energy - sunlight (radiant), $\text{C}_6\text{H}_{12}\text{O}_6$ (chemical)



Model 2 – Cross Section of the Internal Structure of a Leaf



8. List the layers of the leaf starting at the upper cuticle all the way to the lower cuticle.

*cuticle
upper epidermis
palisade mesophyll
spongy mesophyll
lower epidermis
cuticle*

← veins are at this border!

Read This!

Inside plant veins are two different types of tissues. **Xylem** carries water and minerals up from the roots of the plant and **phloem** carries the sugars (nutrients) away from the leaf to areas where the plant is growing or to storage areas in the plant.

9. Describe the position of the vein(s) in each model.

a. In the leaf in Model 1.

in center of the leaf, looks like pattern of roads.

b. Within the leaf cross section in Model 2.

at border between palisade & spongy mesophyll

10. How does the placement of veins help to carry out their function of transporting materials to and from the leaf?

Placement gives H_2O easy access to palisade mesophyll, the place where photosynthesis occurs.

11. Look back at your answers to Questions 1-3 and the photosynthesis equation. In the appropriate locations on Model 2, mark with labels and arrows what is entering the leaf and what is exiting the leaf.

See Model

12. Which kind(s) of cells have chloroplasts in them?

Palisade mesophyll

13. Remembering the function of chloroplasts, in which part(s) of the leaf is photosynthesis taking place?

upper surface where light energy is at its highest intensity.

14. The green color of chloroplasts is due to a pigment in them that absorbs light energy. Knowing this, infer which layer inside a leaf gives the whole leaf its green color. Write one complete sentence to express your reasoning.

The palisade mesophyll contains densely packed chlorophyll, this is responsible for making the leaf green.



15. Through which layer(s) does light energy travel to reach the palisade mesophyll?

Through the cuticle and upper epidermis

16. List at least three differences between the cells of the palisade mesophyll and the cells that make up the other areas within the leaf.

1. shape - columns
2. densely packed with chloroplasts
3. dense & long arrangement of columnar-shaped cells.

17. How would the cylindrical shape of the palisade mesophyll cells increase the amount of photosynthesis that the leaf can carry out?

The long cylinder will capture the most amount of radiant energy. If any shorter, light may pass through unabsorbed.

18. What would be the advantage(s) to having no chloroplasts in the cells of the spongy mesophyll?

cells would be smaller, giving room for air spaces for gas exchange. Would also need

19. Suppose there were many chloroplasts in the cells of the upper epidermis. How would that change the amount of sunlight reaching the chloroplasts in the palisade layer?

It would reduce the amount seen by the palisade layer.

veins there.

20. Considering its locations and your previous knowledge of the word, what do you think might be the function of the epidermis?

protection and allow for opening/closing of pores (stomata).

Read This!

The cuticle covering the upper and lower epidermis of land plants is made of a waxy substance that repels water in much the same way as wax on a paper cup.

21. What is the purpose of having a water-tight covering?

so water is not lost by evaporation and can maximize photosynthesis, reactants won't be

22. Look carefully at the lower surface of the leaf in Model 2.

- a. What structure is found between guard cells?

Stoma - pore/opening.

taken from inside cells, which would cause plant to wilt.

- b. How would you describe this structure?

it is a pore that forms as a gap between guard cells.

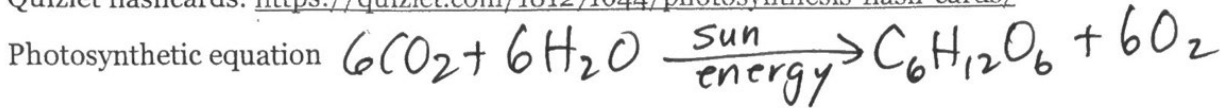
- c. How would this affect the ability of the leaf to retain water especially in dry conditions?

when closed, water retention is at its highest. It is the safest arrangement for stomata in dry conditions.



Photosynthesis & Basic Chemistry Review

Quizlet flashcards: <https://quizlet.com/181271644/photosynthesis-flash-cards/>



Reactants of photosynthesis $6CO_2 + 6H_2O + \text{sunlight (radiant energy)}$

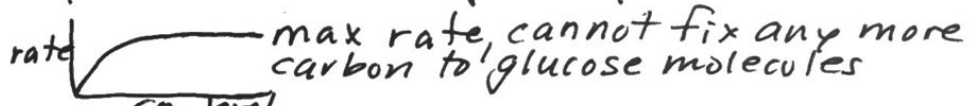
Products of photosynthesis $C_6H_{12}O_6 + 6O_2$

Photosynthetic pigment chlorophyll, a green pigment designed to absorb the sun's radiant energy to use in the leaf.

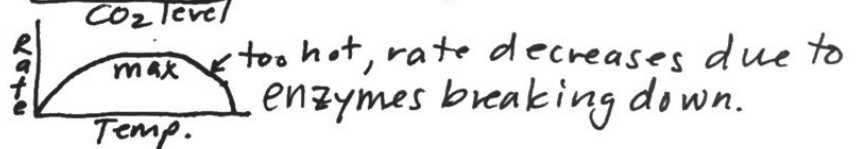
Photolysis "cut" with "light". Cutting of H_2O molecules using light energy. In light reaction of photosynthesis.

Photosynthetic rate (remember Elodea lab...) how fast reactants are converted to products. The more O_2 created, the faster the photosynthetic rate.

CO_2 level vs. photosynthetic rate
 CO_2 increases rate



Temperature vs. photosynthetic rate
Temp. increases rate to a point. Then declines.



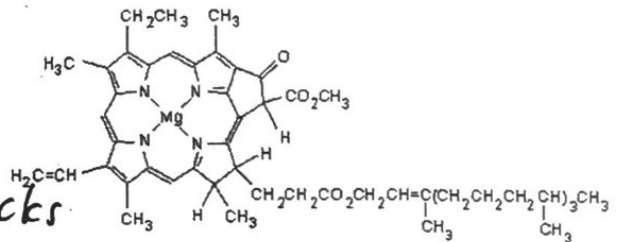
Guided questions:

1. What factors may influence the rate of photosynthesis?

1. Temperature
2. amount of CO_2 available to plant
3. light intensity
4. Wind

2. What is the role of nitrogen in plants? What category of compounds did you see nitrogen within during our chemical structure lab?

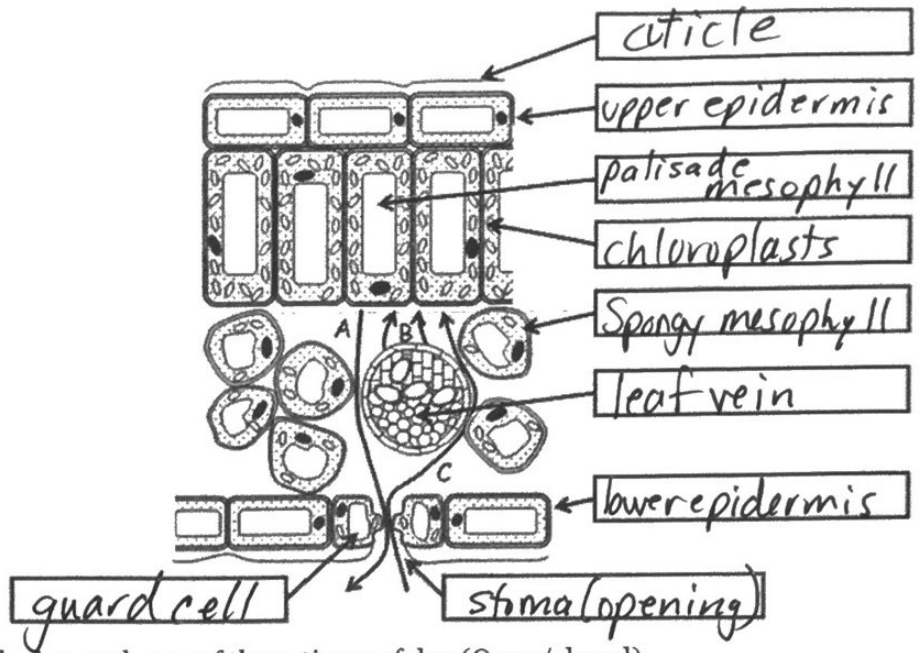
Nitrogen is a key element in amino acids, or the building blocks of proteins.



3. What is the function of stomata? Which gases enter and exit the leaf through stomata, and at what time of day, generally?

Function of Stomata	Gases that enter the plant through stomata	Gases that exit the plant through stomata
Control entry and exit of gases into and out of the leaf. Retain water, minimize H_2O -loss.	CO_2	O_2 & H_2O

4. Label the structure of a leaf below:



5. Describe how the stomata will look during each one of these times of day (Open/closed)

Condition	Stomata position (open/closed)
Cloudy	open
Intensely sunny	closed
Windy	closed
Low humidity	closed
High humidity	open

6. Fill in the chart by calculating the magnification of lenses

Ocular lens	Objective lens	Total power (total magnification)
10	4	40
5	40	200
12	10	120

7. Label the diagram of the microscope to the right

