SI Biology - Full Discipline Demo

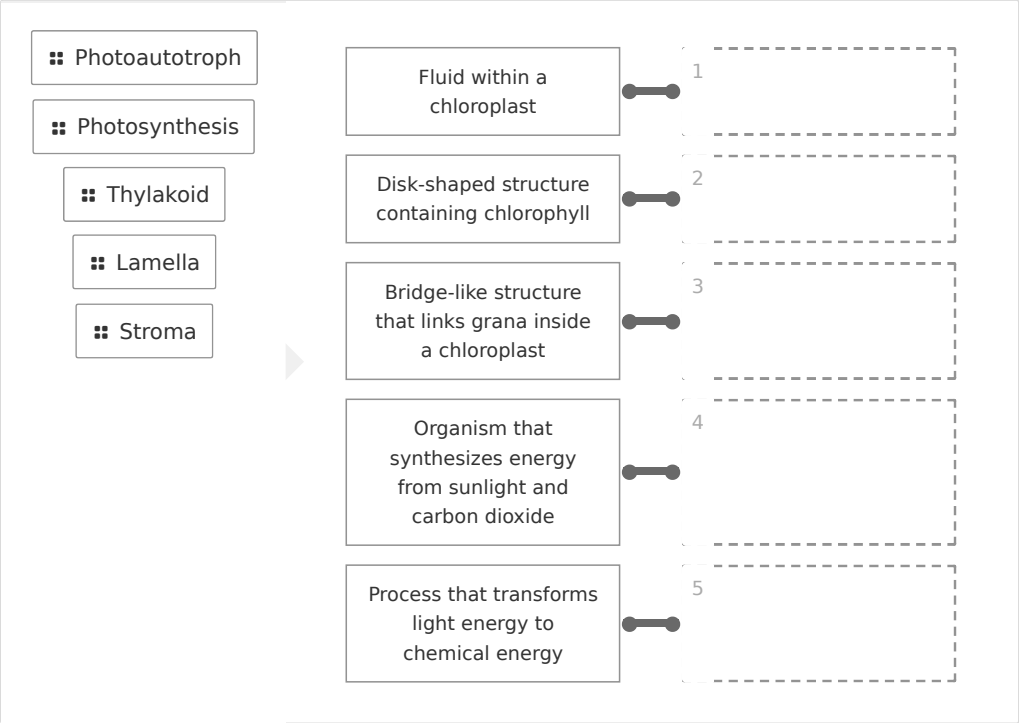
Photosynthesis-Digital

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Biology - Full Discipline Demo
Course	SI Biology - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Match each term with the best description.

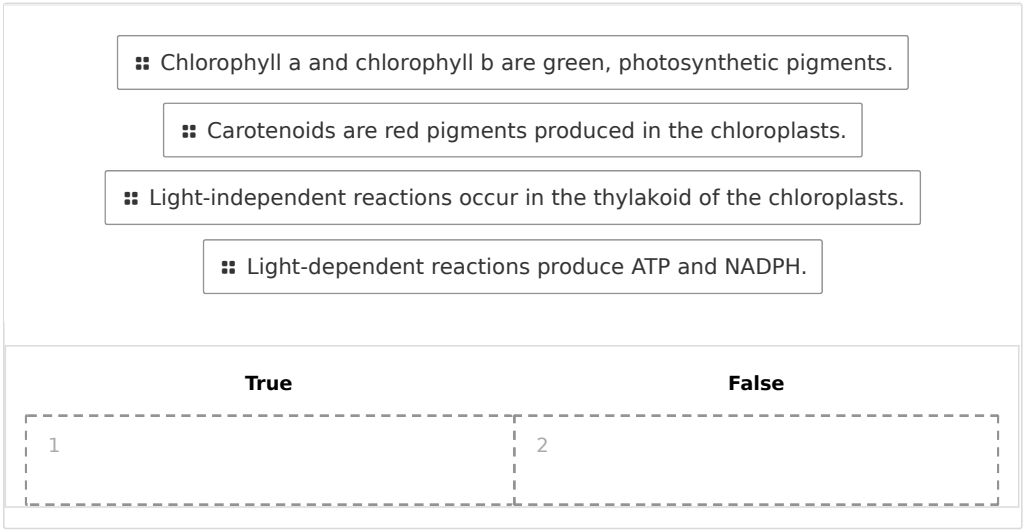


Correct answers:

1 Stroma 2 Thylakoid 3 Lamella 4 Photoautotroph

5 Photosynthesis

Categorize each statement as True or False.



Correct answers:

1 Chlorophyll a and chlorophyll b are green, photosynthetic pigments.

Light-dependent reactions produce ATP and NADPH.

2 Carotenoids are red pigments produced in the chloroplasts.

Light-independent reactions occur in the thylakoid of the chloroplasts.

Exploration

____ is released as a byproduct of photosynthesis.

- Carbon dioxide
- Oxygen ✔
- Water
- Glucose

The _____ of a chloroplast can be described as a stack of disk-like compartments.

- granum ✔
- stroma
- thylakoid
- lamella

Carotenoids are yellow-orange accessory pigments produced in the plastids.

- True ✔
- False

Light-independent reactions produce _____.

- water
- oxygen
- ATP
- glucose ✔

Exercise 1

Describe the importance of adding sodium bicarbonate to the carbon treatments in this exercise.

Carbon dioxide rapidly diffuses out of water, becoming unavailable for photosynthesis. Sodium bicarbonate, which has carbon available in the form of bicarbonate ions (HCO_3^-), filled the role of CO_2 in the experiment by donating carbon to the process of photosynthesis, as does CO_2.

Explain how a floating leaf disk could be used as an indicator of photosynthesis.

Oxygen is produced as a product of photosynthesis, and the added gas caused the leaf disks to become more buoyant. Thus, when photosynthesis occurred at a great enough rate, the leaf disks floated.

Describe the reactions that utilize the resources provided in these procedures to produce oxygen and glucose.

The light-dependent reactions of photosynthesis use light energy and water to produce chemical energy, in the form of ADP and NADPH, and water. The chemical energy produced in the light-dependent reactions fuels the synthesis of glucose from CO_2 that occurs in the light-independent reactions of photosynthesis.

What do your results suggest about the importance of carbon and light for photosynthesis? Reference Data Table 1 and Graph 1 in your answer.

Both light energy and a carbon source are required for photosynthesis. Only the treatment involving both the bicarbonate solution and bright light resulting in excess oxygen production and floating by the leaf disks as recorded in Data Table 1 and illustrated by Graph 1. All other treatments resulted in no floating disks, suggesting that only light or only carbon is insufficient for photosynthesis to occur. Furthermore, photosynthesis stopped in the bicarbonate and bright light treatment when it was placed in the dark, as evidenced by the disks sinking over time.

Data Table 1: Photosynthesis in Light and Dark Environments

(SAMPLE ANSWER BELOW)

Time (min)	dH_2O/Light (# of floating disks)	Carbon/Light (# of floating disks)	dH_2O/Dark (# of floating disks)	Carbon/Dark (# of floating disks)
0	0	0	0	0
2	0	1	0	0
4	0	3	0	0
6	0	6	0	0

8	0	9	0	0
10	0	10	0	0
12	0	10	0	0
14	0	10	0	0
16	0	10	0	0
18	0	10	0	0
20	0	10	0	0
22	0	10	0	0
24	0	10	0	0
26	0	10	0	0
28	0	8	0	0
30	0	5	0	0
32	0	2	0	0
34	0	0	0	0
36	0	0	0	0
38	0	0	0	0
40	0	0	0	0

Graph 1: Time and Number of Floating Disks

(SAMPLE ANSWER BELOW)

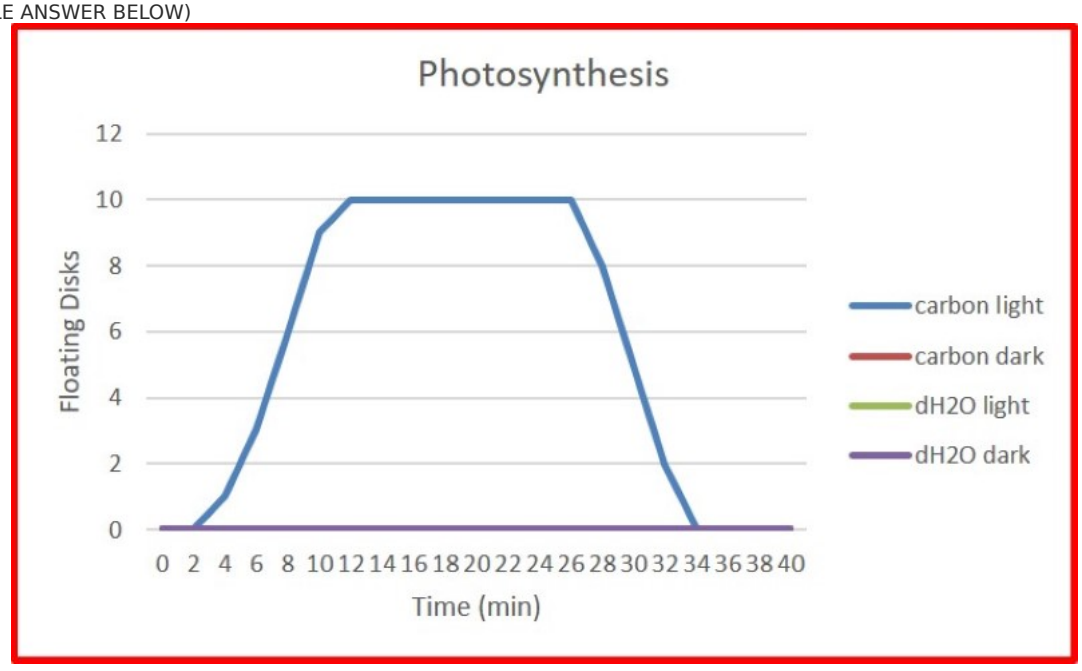


Photo 1: Time 40 Minute Results

(SAMPLE ANSWER BELOW)

Exercise 2

Explain how paper chromatography is useful for separating leaf pigment.

Paper chromatography separates leaf pigment based on their molecules' solubility in the solvent and affinity for the paper. The molecules of each type of plant pigment vary in these properties resulting in their separation when traveling up the chromatography paper with the solvent.

What is an Rf factor? How is this value used to identify unknown compounds?

Rf factors are the ratio of the distance a molecule travels during chromatography to the distance the solvent travels (solvent front). The Rf value can be used to identify a molecule by comparing it to published values for molecules.

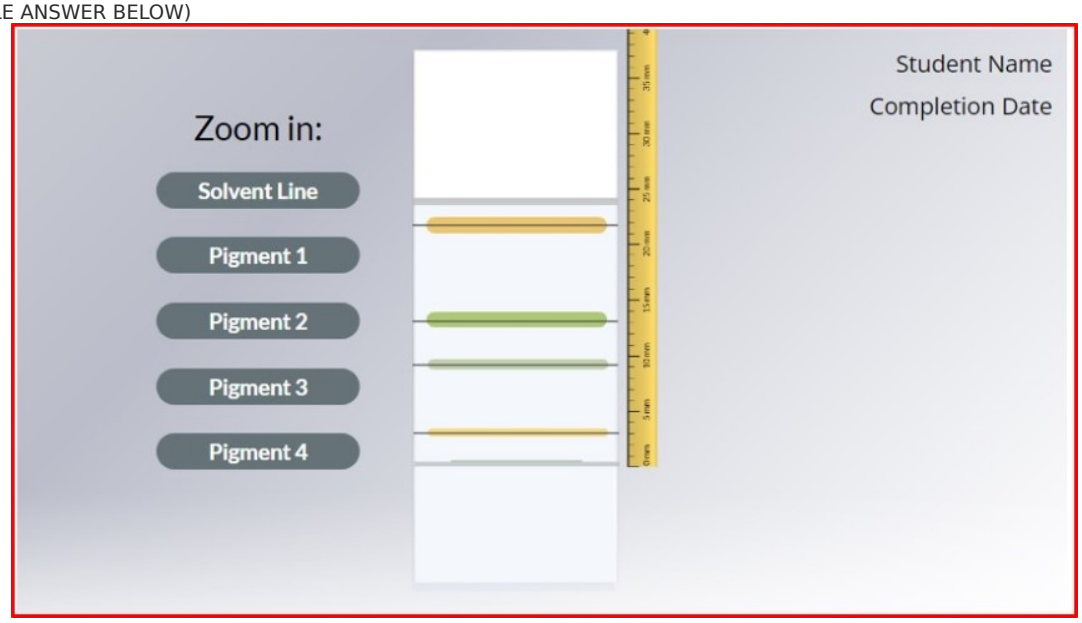
Describe the function and appearance of the pigments separated from the spinach leaves in this exercise. Reference Data Table 2 and Photo 2 in your explanation.

Chlorophylls a and b were the green pigments that separated in the center of the chromatography paper as referenced in Data Table 1 and illustrated in Photo 2. Chlorophylls function to capture light energy for photosynthesis and are located in the chloroplasts. Carotenoids (β-carotene and xanthophylls) appeared as yellow-orange pigments below and above the chlorophylls in Photo 2. These pigments function as accessory pigments by transmitting light energy to the chloroplasts where it is absorbed by chlorophyll.

Data Table 2: Pigment Separation
(SAMPLE ANSWER BELOW)

Separated Pigment #	Solvent front (mm)	Pigment distance (mm)	R_f value	Identification
1	22.0	21.6	0.98	B-carotene
2	22.0	13.0	0.59	Chlorophyll a
3	22.0	9.2	0.42	Chlorophyll b
4	22.0	3.2	0.15	Xanthophylls

Photo 2: Chromatography Results
(SAMPLE ANSWER BELOW)



Competency Review

During photosynthesis, light energy reacts with _____ to produce glucose.

- oxygen and carbon dioxide
- water and carbon dioxide ✔
- nitrogen and oxygen
- carbon dioxide and anthocyanin

The fluid that is located inside of a chloroplast is called the _____.

- chlorophyll
- granum
- thylakoid
- stroma ✔

_____ are photosynthetic pigments containing magnesium and nitrogen.

- Chlorophylls ✔
- Carotenoids
- Xanthophylls
- Anthocyanins

Photosynthetic processes occur in the stroma and thylakoid of the chloroplast.

- True ✔
- False

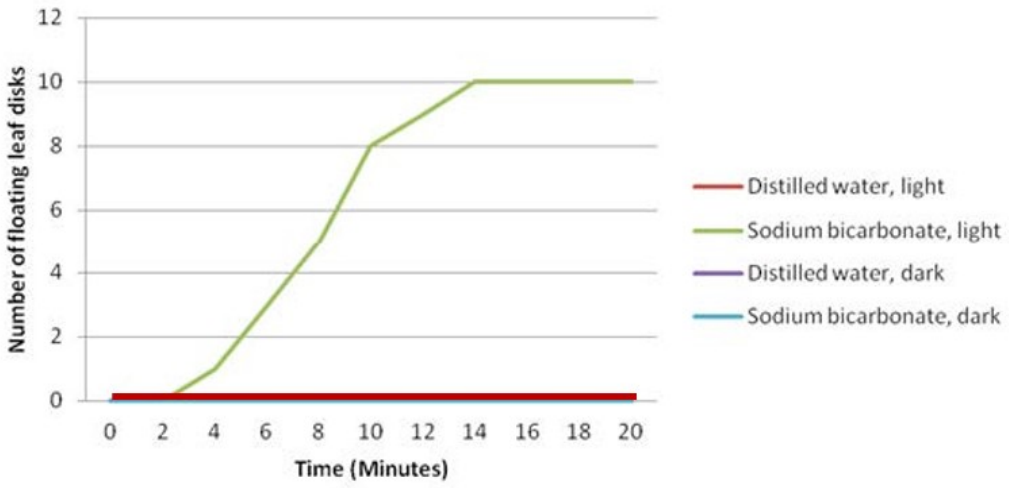
Light-independent reactions synthesize glucose from ____ .

- oxygen
- water
- carbon dioxide ✔
- nitrogen

Floating spinach leaf disks are confirmation that photosynthesis is occurring.

- True ✔
- False

The graph illustrates that only light is necessary for photosynthesis to occur.



- True
- False ✔

_____ pigments migrate the greatest distance when separated by paper chromatography.

- Chlorophyll a
- Chlorophyll b
- β-carotene ✔
- Xanthophyll

Extension Questions

The rate of photosynthesis in plants is influenced by factors such as water availability, light intensity, carbon dioxide concentration, and population density.
Sam is a horticulturist working in a commercial greenhouse. Apply your knowledge gained from this lab to suggest how Sam should manipulate each of these factors in order to maximize photosynthesis?

- **Water availability**
- **Light intensity**
- **Carbon dioxide concentration**
- **Plant population density**

(SAMPLE ANSWER BELOW)

Sam should maximize water availability, light intensity, and carbon dioxide concentrations. Lastly, Sam should minimize population density to avoiding shading of leaves.