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VCE Biology ¾
AOS 2 Revision [2.0]
SAC 1

43 Marks. 5 Minutes Reading. 65 Minutes Writing.

Section A: Additional Random, Non-Experiment Specific Questions (43 Marks)

Question 1 (4 marks)

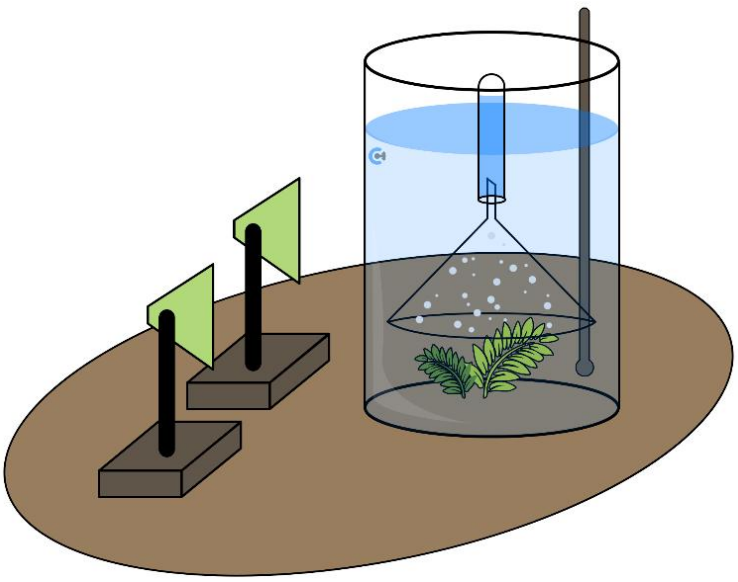
Write an introduction to photosynthesis and cellular respiration. Discuss the factors that influence these biological processes, as well as what makes these processes biochemical pathways.

Space for Personal Notes

Title: Investigating Photosynthesis in Spinach Leaves

- Aim: To investigate the rate of photosynthesis in spinach leaves under varying light intensities.
- Materials:
  - Spinach leaves.
  - Beakers.
  - Water.
  - Sodium bicarbonate (Baking soda).
  - Light source (e.g., Lamp).
  - Timer.
  - Ruler.
  - Test tubes.
  - Alcohol.
  - Boiling water bath.
- Ice bath.
- Procedure:
- Preparation of Spinach Leaves:
  - Obtain fresh spinach leaves and immerse them in water to remove any dirt or debris.
  - Cut the spinach leaves into uniform-sized discs using a hole puncher or a sharp knife.
  - Place the spinach leaf discs in a beaker filled with water to prevent them from drying out.

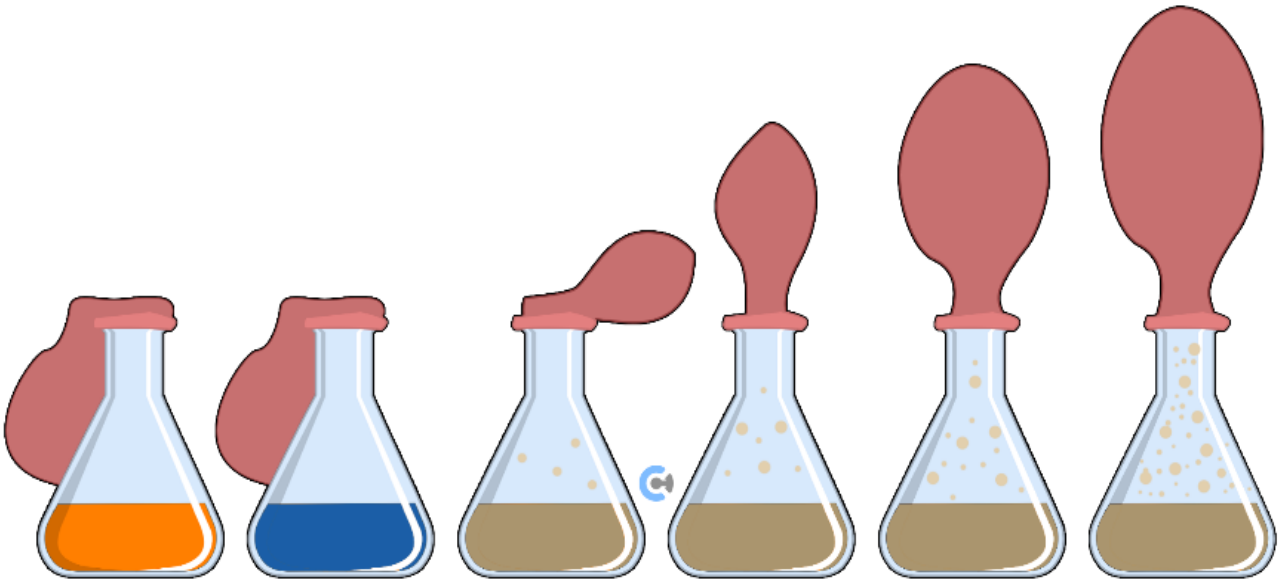
- Setup of Experimental Apparatus:
  - Fill four test tubes with water and place them in a test tube rack.
  - Add a small amount of sodium bicarbonate (baking soda) to each test tube.
  - Set up a light source (lamp) at varying distances from the spinach leaf discs to create different light intensities (e.g., $10\ cm$, $20\ cm$ and $30\ cm$), as well as placing one test tube in a box with no exposure to light.
  - Ensure that the light source is stable and directed towards the spinach leaf discs.
- Experiment:
  - Place one spinach leaf disc into each test tube containing the sodium bicarbonate solution.
  - Start the timer and immediately place the test tubes under the respective light sources, except for the negative control which will be kept in darkness.
  - Allow the spinach leaf discs to undergo photosynthesis for a set duration (e.g., 7 days).
  - After the set time, remove the test tubes from the light sources and stop the timer.
- Analysis:
  - Carefully remove the spinach leaf discs from the test tubes and blot them dry with paper towels.
  - Measure the diameter of each spinach leaf disc using a ruler and record the values.
  - Calculate the change in diameter (growth) for each spinach leaf disc.



Title: Investigating the Effect of Glucose Concentration on Balloon Diameter Due to Yeast Fermentation

- Aim:
  - To investigate how varying concentrations of glucose affect the diameter of a balloon due to yeast fermentation and the release of carbon dioxide.
- Materials:
  - Balloons (same size).
  - Glucose solutions of varying concentrations (e.g., $0\%, 1\%, 2\%, 5\%$).
  - Active dry yeast.
  - Warm water.
  - Graduated cylinder or measuring cup.
  - Funnel.
  - Timer.
  - Marker.
  - String or ruler for measuring balloon diameter.
- Procedure:
- Preparation of Glucose Solutions:
  - Prepare glucose solutions of varying concentrations (e.g., $0\%, 1\%, 2\%, 5\%$) by dissolving the appropriate amount of glucose in warm water. Ensure that each solution is thoroughly mixed.
  - Label each solution accordingly.

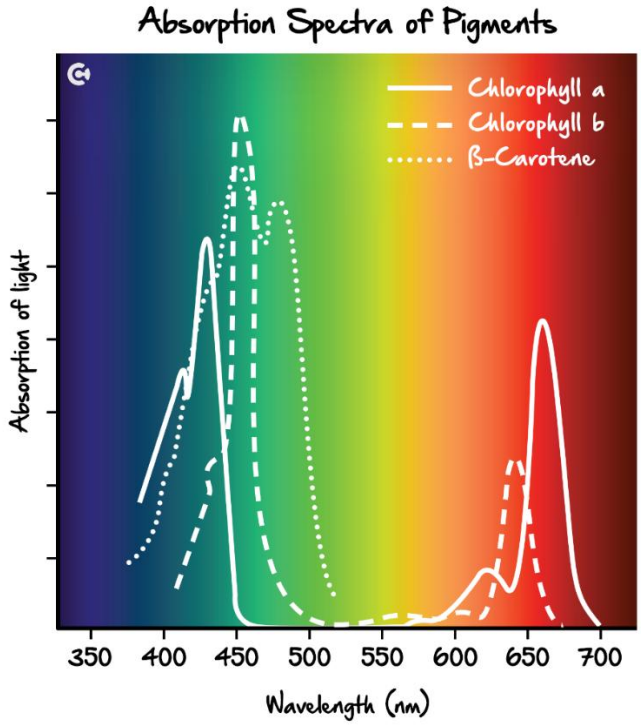
- Setup of Experimental Apparatus:
  - Inflate a balloon slightly to stretch it out, then deflate it completely.
  - Attach a funnel to the opening of each balloon.
  - Use the funnel to fill each balloon with a different glucose solution, ensuring that each balloon is filled to the same volume (e.g., halfway).
  - Carefully add a small amount of active dry yeast to each balloon through the funnel.
  - Tie off the opening of each balloon securely.
- Experiment:
  - Use a marker to mark the initial diameter of each balloon.
  - Start the timer and place all balloons in a warm, stable environment.
  - Allow the balloons to ferment for a set duration (e.g., 30 minutes to 1 hour).
- Measurement:
  - After the set fermentation period, carefully remove each balloon from the environment.
  - Measure the diameter of each balloon using a string or ruler and record the values.
  - Take care not to deflate the balloons during measurement.

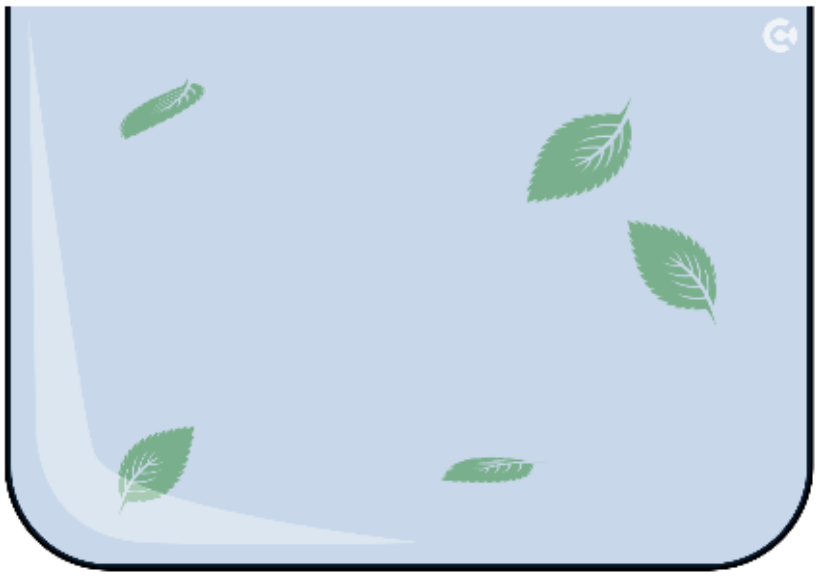


Title: Investigating the Effect of Light Colour on the Time Taken for Leaf Fragments in Coleus Plants to Rise to the Surface

- Aim:
  - To investigate how different coloured light sources impact the time it takes for leaf fragments in Coleus plants to float to the surface.
- Materials:
  - Coleus plants (with healthy leaves).
  - Shape cutter (e.g., circle).
  - Test tubes.
  - Water.
  - Light sources with coloured filters (red, blue, green).
  - Timer.
  - Ruler.
- Procedure:
- Preparation of Coleus Leaves:
  - Select healthy leaves from Coleus plants of similar size and age.
  - Use a shape cutter (e.g., heart-shaped) to cut uniform leaf fragments from the selected leaves.
  - Using a syringe, suck any air that may be present in the leaf fragment.
- Setup of Experimental Apparatus:
  - Fill six $50\ mL$ beakers with water and label them accordingly: Red light, blue light, green light, plain light, no light.
  - Place each beaker under a light source with the corresponding-coloured filter (red, blue, green).
  - Ensure that the intensity of light from each source is consistent.
  - For the "plain light" group, place a test tube under a light source without any coloured filter.
  - For the "no light" group, cover a test tube with aluminium foil to block out all light.

- Experiment:
  - Place 10 leaf fragments in each test tube filled with water, ensuring the fragments sink to the bottom of the test tube.
  - Start the timer and immediately place the test tubes under their respective light sources.
  - Observe the leaf fragments at regular intervals and record the time it takes for all 10 fragments to rise to the surface.





Question 2 (10 marks)

Experiment 1: Investigate the rate of photosynthesis in spinach leaves under varying light intensities.

a. Light intensity is generally directly correlated with another factor affecting photosynthesis. What factor is this? (1 mark)

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b. Which tube is the negative control group? What is the purpose of the negative control group in this experiment? (2 marks)

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c. What is the relationship established between light intensity and the rate of photosynthesis? Why is this the case, referring to the light-dependent and light-independent stages of photosynthesis? (3 marks)

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It is proposed that increasing light intensity can only be useful to a certain extent, due to two reasons.

d. At one point, the rate of photosynthesis plateaus. Explain why this may be the case. (2 marks)

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e. At a later point, the rate of photosynthesis plummets. Explain why this may be the case. (2 marks)

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Question 3 (15 marks)

Experiment 2: Investigating the effect of glucose concentration on balloon diameter due to yeast fermentation.

a. Where is the main reaction that is being measured in this experiment occurring within the yeast cell? (1 mark)

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b. What causes the balloons in this experiment to rise? Name any other products of fermentation. (2 marks)

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c. At the beginning of the experiment an error was made which affected the first trial group. Prior to the experiment, the lab technician filled the bottle labelled as "glucose solution" with distilled water. This error was later noticed and the results were voided. How would this have affected the results of the first trial group? (2 marks)

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d. John proposes that another variation of this experiment would be "Investigating the effect of oxygen concentration on alcohol production in yeasts". Would this be a valid proposal? Why/why not? (2 marks)

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e. What cellular processes can instead be measured in yeasts in the presence of oxygen? List an example of a way to observe this process. (2 marks)

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It was noted after the data collation that the measurement of the diameter of the balloons may have been inaccurate.

f. Suggest a reason as to why this may have been the case. (1 mark)

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g. Suggest another way such that the rate of anaerobic fermentation can be measured in this experiment. (1 mark)

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h. Would this yield more accurate/precise/reliable results? Explain. (2 marks)

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i. Active Yeasts operate optimally between 25-38 degrees Celsius. What is the purpose of using warm water, and how does it increase the validity of the experiment? (2 marks)

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Question 4 (14 marks)

Experiment 3: Title: Investigating the effect of light colour on leaf senescence in Coleus plants.

a. Which colour (trial group) would you expect to take the longest time to rise in this experiment? Explain. (2 marks)

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b. Which colour (trial group) would you expect to take the shortest time to rise in this experiment? Explain. (2 marks)

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c. Sam suggests that 20 leaf discs should be used in each trial instead of 10 - maximising the full capacity of the beaker (to the point where the leaf discs are touching against the test tube walls). Suggest one benefit of this suggestion, as well as one negative. (2 marks)

An alternative method of data collection is to use an ET50 time, as opposed to waiting for all the leaves to rise to the surface. The time required for 50% of the leaves to float to the surface represents the Effective Time (ET50). The rate of photosynthesis (ROP) can be calculated using the following formula:

$$\text{ROP} = \frac{1}{\text{ET50}}$$

d. Calculate the rate of photosynthesis using sample results. Express your answers as fractions. (3 marks)

	Plain light	Red light	Blue Light
ET50 (minutes)	3.2	6.5	7.2
Rate of Photosynthesis			

e. Does using the ET50 (time taken for 5 leaves to rise to the surface) improve accuracy or precision of the results obtained? Explain. (2 marks)

The ET50 of the red trial group is indicative of a faster rate of photosynthesis compared to the ET50 of the blue trial group. However, using the original method of waiting until all 10 leaves had risen to the surface suggested that the use of blue light yielded a greater photosynthetic rate than red light.

f. What type of error is likely to cause this (random or systematic)? (1 mark)

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g. Suggest a practical example as to how this may have happened, detailing the impact of this error on the rate of photosynthesis. (2 marks)

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