Photosynthesis and Light

Background

Photosynthesis is an important process by which green plants make food for themselves. In the process, carbon dioxide and water are changed into oxygen and glucose in the presence of light and chlorophyll.

$$\text{carbon dioxide + water} \xrightarrow{\text{light + chlorophyll}} \text{glucose + oxygen}$$

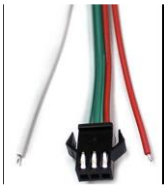
Glucose is the food produced which may further change into starch for storage.

Objective

To find out which colored light is most efficient for photosynthesis in green plants

Materials available

Material	Photo	Use
250 ml beaker		To contain other components in the set up
glass funnel		To collect any gas formed and direct it to collecting vessel
10 ml pipette		To collect and measure the amount of any gas produced
Pipette filler		To close the pipette to avoid gas going away
hydrilla		To carry out photosynthesis
Sodium hydrogen carbonate solution		To supply carbon dioxide to hydrilla soaked in it

Material	Photo	Use
Stick tape		To affix NEOPIXEL LED on other apparatus
connecting wire		To connect NEOPIXEL LED to microbit controller
NEOPIXEL LED *2		To provide different colored light
Micro:bit with extension board		To control and supply power to the NEOPIXEL LED
Black plastic bag		To cover the set up and screen out light from surrounding
Timing device		To measure time passed from the start of experiment

Task

By using the apparatus provided, design an experimental setup to compare the effect of different colored light on rate of photosynthesis.

List out the controlled, independent and dependent variables of the experiment.

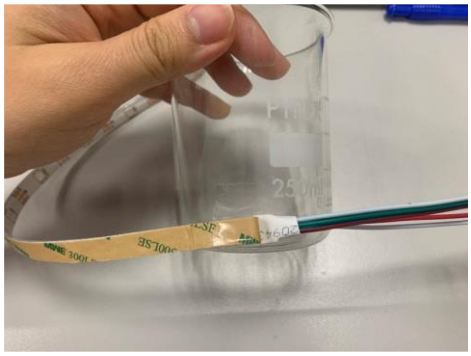
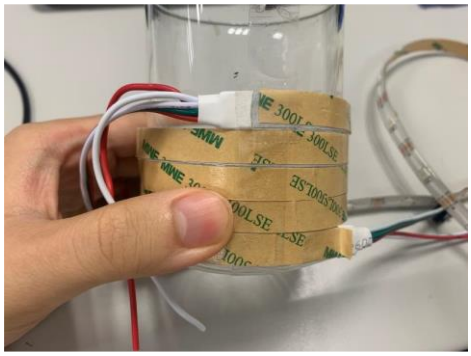
Controlled variables (Write at least TWO)	**The amount of water supplied, the amount of carbon dioxide supplied, the type of plant, etc. (any reasonable suggestion)**
Independent variable	**The colors of light supplied**
Dependent variable	**The amount of oxygen released**

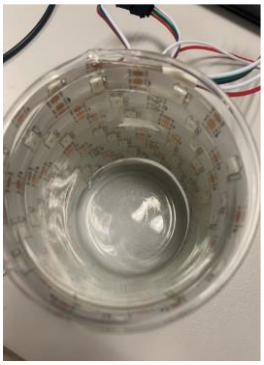
Experimental setup

Draw a setup diagram using the apparatus and materials provided in the "materials available" list above. You may use other common laboratory apparatus not found in the list.

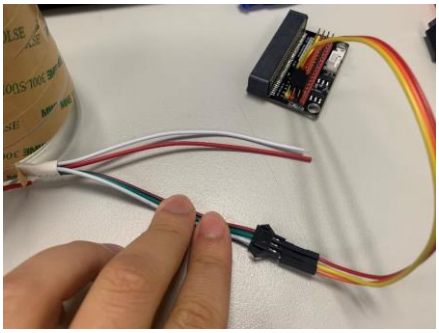
Procedure

1. Coil NEOPIXEL LED strips around the beaker with sticky tape affixing them firmly on the wall of beaker.

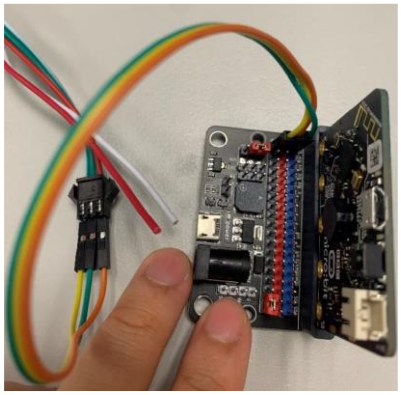





2. Connect the NEOPIXEL LED strips to the extension board using connecting wire provided.

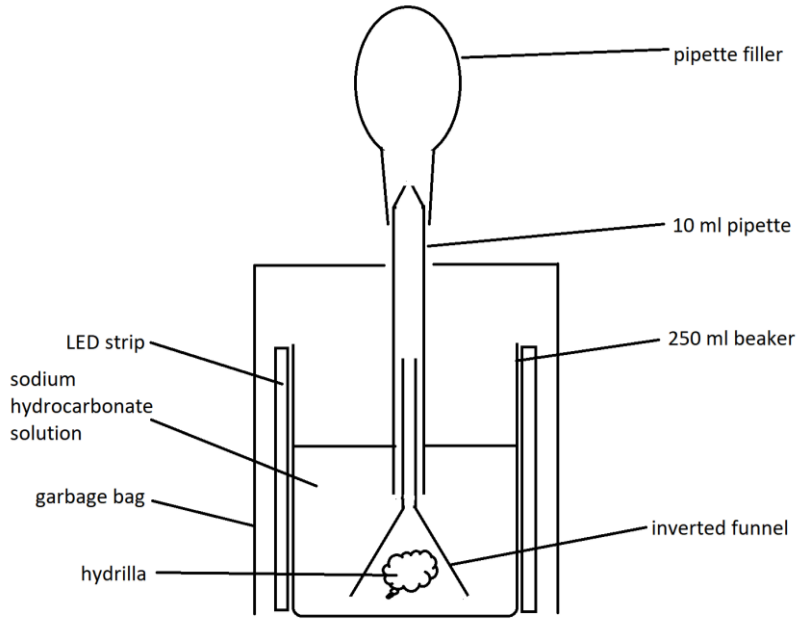


3. Insert the micro:bit into the extension board.



4. Write coding for micro:bit such that different colored light can be produced by the LED strips upon different buttons pressed.

5. Assemble the setup as shown below:



(Reminder: the root of the hydrilla should be pointed up in the stem of the funnel for effective collection of gas produced.)

6. Start the experiment by switching on the LED strips for a specific-colored light. (Different group will use different colored light.) Mark down the starting time on the memo with your names, class and group number on it. Affix this memo to the pipette filler for easy recognition.

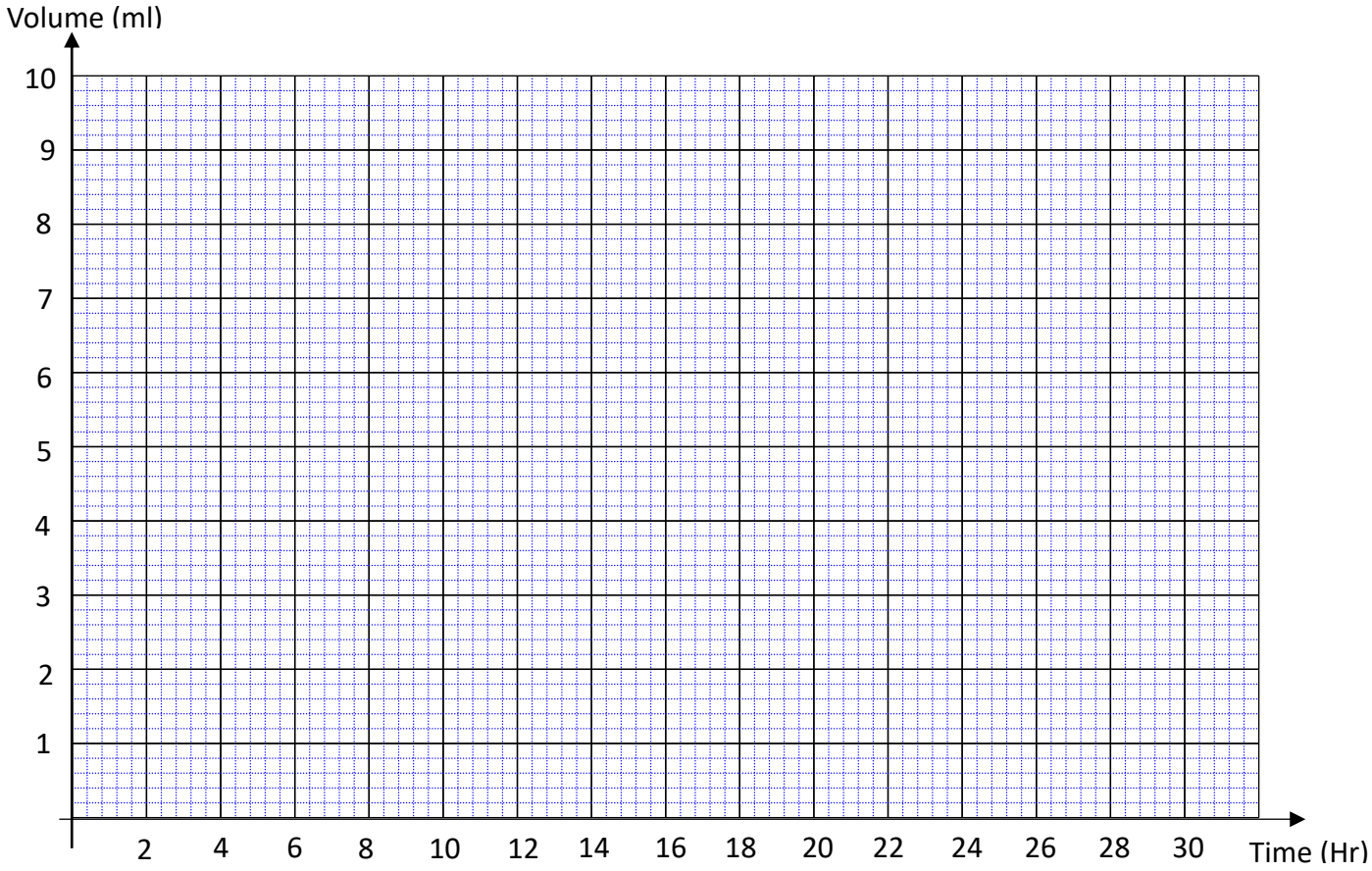
Colour of light used: _____

Result and Data Treatment

7. Record the result in the following table.

Time	liquid level (mL or cm^3)	volume of gas collected (mL or cm^3)
		0

8. Plot a graph of volume of gas collected against time.



9. Determine from the graph the average rate of gas formation in the first 24 hours.

Total volume (cm^3) of gas collected in 24 hours: _____

Average rate of gas formation (volume per hour cm^3/hr) = _____

10. Fill in the following table with the results from other groups working with different colored light.

Color of light used	Average rate of gas formation (cm^3/hr)
(my group)	

Conclusion

_____ light is most efficient for green plants to carry out photosynthesis.

Questions for further though

1. What are possible sources of errors for the experiment? Hence, suggest ways of improvement.

Source of error	Improvement

2. Comment on whether it is a good idea to use colored glass window to get the most efficient light for green plants in green house.

Questions for further though

3. What are possible sources of errors for the experiment? Hence, suggest ways of improvement.

Suggested answers:

- **Some of the oxygen gas produced has not been collected in the pipette.**
  (Use a larger inverted funnel such that the hydrilla is completely covered by it.)
- **Hydrilla used by different groups may vary in size or capability of doing photosynthesis.**
  (Use hydrilla from the same batch for comparison among different colored lights and use same amount (e.g. same mass) of hydrilla for comparison.)
- **The setup has not been completely covered with the black plastic bag.**
  (Use sticky tape to affix the black plastic bag firmly to the bench / pipette)
- **The arrangement of led lights may be different for different groups.**
  (Repeat the experiment with same setup but with different colored light.)
- **Any other reasonable answers.**

4. Comment on whether it is a good idea to use colored glass window to get the most efficient light for green plants in green house.

Suggested answer:

No

Components of white light other than the most efficient light can still be used in photosynthesis. It is a waste of light energy if it is blocked out by the colored glass window.