Lab report on photosynthesis

The effect of different colored lights on the rate of Photosynthesis Objective: To find out which color of light provides the best consequences for the production of oxygen/ the rate of photosynthesis

Background:

In photosynthesis, there are two main parts, including light dependent and light-independent reactions. Plants use the energy from light for producing sugar, which is being converted into ATP by cellular respiration. They also are the only organisms that produce oxygen along with glucose and fructose chains within the light-independent phases of photosynthesis. This process takes place in the chloroplasts of plants, which include chlorophyll.

Chlorophyll is essential for photosynthesis, since it absorbs the sun's light. Green plants then use this light to combine CO and H_2O for making sugars and oxygen. After this process Oxygen is being released though pores called stomata. The overall reaction can be expressed as follows; $6H_2O + 6CO_2$ ☾ $C_6H_{12}O_6 + 6O_2$1

There are four variables that affect the rate of photosynthesis; light intensity, temperature, CO_2 and water. 2 However, is it possible to count in the colour of light, too, which I am going to investigate in this lab. Since the photosynthesis takes place in chloroplasts that has chlorophyll, the rate of photosynthesis can be affected by different colours of light, since the absorption of light changes within different colours. Research Question:

What colour of light is most effective on the rate of photosynthesis? Five different coloured transparencies (red, green, yellow, blue, purple) are being used for changing the light's colour. Within 5 minutes for each one of them,

they will be used in order to see oxygen bubbles rising from a used water plant. The produced oxygen (in the form of bubbles) indicates the rate of photosynthesis and is being measured by counting bubbles. The highest amount of oxygen bubbles being produced per minute is equivalent to the highest rate of photosynthesis, and the colour providing the best circumstances for the production of photosynthesis. Hypothesis:

Since Plants absorb green light, I expect the rate of photosynthesis to be the highest when red light is being used. This is due to the colour spectrum, where one can say that red is the opposite colour to green. Therefore, I expect red light to provide the most energy for the plant absorbing it.

Variables:

Variable

Type

Method

Light intensity

Controlled

At the most intense level possible (770 lux) and a distance of 50cm from the aquarium. Temperature of water

Controlled

At room temperature; adding colder water when temperature rises. pH level

Controlled

All solution has a pH of 7.

Plant type and colour

Controlled

Leaves of the same species; green

Coloured light

Independent

Changing colours with coloured slides (yellow, blue, red, green, purple) in front of the light source. The rate of photosynthesis

Dependent

Changed by the colour of light, collected with stop watch and counted by produced bubbles.

Material:

2000 cm^3 of water (~300 for every colour + water for controlling variables)

One flask/ glass cup

One test tube

One funnel

2-3 healthy water plants

One thermometer

Spotlight

Five coloured transparencies (blue, red, yellow, green, purple) Stopwatch

One lux meter

Procedure:

Before starting the experiment, the spotlight has to be placed at point on the table, 20 cm away from where the plant is to be set. Then the lux meter is to be taken for calculating the intensity of the spotlight onto the plant. Following this, the colour transparencies will be set in front of the light and the resulting light intensity will be noted by placing the lux meter on the place where the plant is to be set. For each run, under-water cut leaves from

the water plant are put carefully in the funnel, which small open end is put into the test tube. This all is to be done in the flask filled with the water provided for each run and is to be placed at the distance of 20 cm from the spotlight. 3 The water temperature is to be measured and to be kept constant at all time (+/- 1°C).

The first colour transparency is then to be placed in front of the spotlight and the oxygen bubbles rising from the plant's leaves are to be counted. After 1½ minute, the first run of the first colour is completed and following 4 runs have to be concluded the same way. In case the water temperature rises, cold water has to be added. The experiment then has to be repeated 4 more times with the different coloured transparencies in the same way. (A procedure repeating each run 5 times, would be the best for minimizing errors that could occur, due to the 5x5 rule.) The collected data is noted on paper and will be processed to determine the rate of photosynthesis at every colour.

Data collection and raw processing:

The experiment was carried out with the following order of colours: Run 1-5: Blue

Run 6-10: Green

Run 11-15: Yellow

Run 16-20: Red

Run 21-25: Purple

Raw Data

Qualitative Observations:

Run 1-5: A high number of bubbles rose up

Run 6-10: Almost no bubbles were being produced

Run 11-15: Only a few bubbles rose up

Run 16-20: A very large number of bubbles were being produced Run 21-25: Not too many bubbles were being produced by the plant * Until the first bubbles rose up, some time has had passed already; the observations are only being compared with the data processed by the plant being used in this experiment, not with those from others.

Quantitative Data:

Run

Number of Oxygen bubbles being produced with Blue light

Number of Oxygen bubbles being produced with Green light

Number of Oxygen bubbles being produced with Yellow light

Number of Oxygen bubbles being produced with Red light

Number of Oxygen bubbles being produced with Purple light

Run 1(after 90 sec.)4

2

0

0

3

2

Run 2 (after 180 sec.) 5

11

1

4

13

4

Run 3 (after 270 sec.)

12

2

4

15

6

Run 4 (after 360 sec.)

12

1

2

14

5

Run 5 (after 450 sec.)

13

1

3

15

5

For a better overview the diagram below represents the quantitative data provided.

Processed Data:

The collected data has to be processed. This will be done by calculating the mean values for all runs of each of the colours by using Excel. The results will be put in a table, as well as in a diagram for a better overview. Also, for

finding out whether the collected data is reliable or not and how different the results are to the means, the standard deviation for all runs of the colours have to be calculated using the same method.

Bule

Green

Yellow

Red

Pruple

Mean

10

1

2. 6

12

4. 4

Stand. Dev.

0. 82

0. 5

0. 96

0. 96

0. 82

Table providing the processed data

Diagram providing the processed data for a better overview

Conclusion

After all data has been collected and processed, one can say that the stated hypothesis from the beginning of the lab report, which says that red is the

colour that provides the best circumstances for the production of oxygen, is being supported by the observations and calculations made. The qualitative observations showed clearly, that the plant produced most oxygen under red light. The calculations of the means demonstrated that even though blue and red light had similar effects on the plant, the red light was most effective. Further calculations of the standard deviation showed that the data is not highly spread, standing for valuable data that has been collected.

Therefore it is to be concluded that the colour providing best light for the production of oxygen and therefore for the rate of photosynthesis is red, followed by blue. Furthermore, the data collected in this experiment is supported by sources and expectations from the IB Biology curriculum (and others), which states conclusions about the colour spectrum and the effect on plants absorbing the different wavelengths of coloured lights. However, it is to be noted that the data being collected points out some significant differences, as well as similar numbers of oxygen being produced.

This is probably due to the small protection of the light coming from the other sides onto the plant, which was not shielded and completely darkened except for the light coming from the spotlight. It is therefore more likely that the data collected was being influenced by the outside light, since there is a significant difference in the number of bubbles from the first run, in which few further light was influencing the production of oxygen. For improving the results, one could prepare the experiment in a darkened room, using more volt for the coloured lights.

Another problem can be included with pointing onto the water, which, for better results und and a higher rate of photosynthesis, should be changed to

soda water, or at least, should provide a warm temperature and not as cold as the water was within Run No. 1. Even though there were these minor problems and possible improvements to this experiment, it worked out quite well, since the results being portrayed fit to those that have been published before.