The Importance of Carbon & Carbon Cycling for the Living Systems

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I CONGRESO CIENTÍFICO INTERNACIONAL
"EUROCIENCIA JOVEN„
2.-3. May 2024 Córdoba

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Introduction

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Carbon in a Nutshell

0.1

Introduction

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Carbon

- main component of the cell
- organisms obtain carbon from their environment (heterotrophs)
- plants get carbon through photosynthesis (autotrophs)

Organisms use carbon in **cellular respiration**

$$Glucose + Oxygen \longrightarrow Water + ATP + Carbon\ Dioxide$$

Fermentation

$$Glucose \xrightarrow{yeast} Ethanol + Carbon\ Dioxide$$

0.2

Introduction

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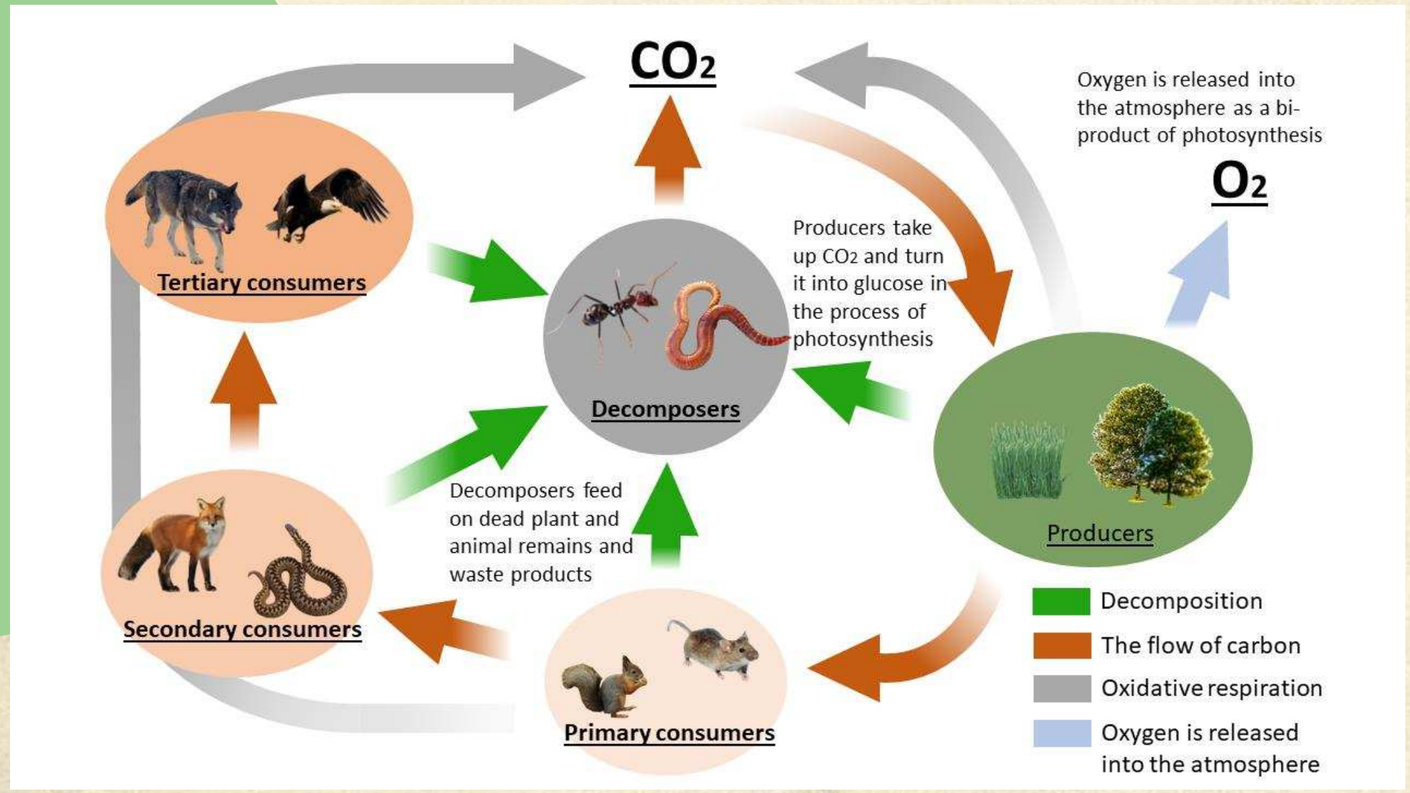
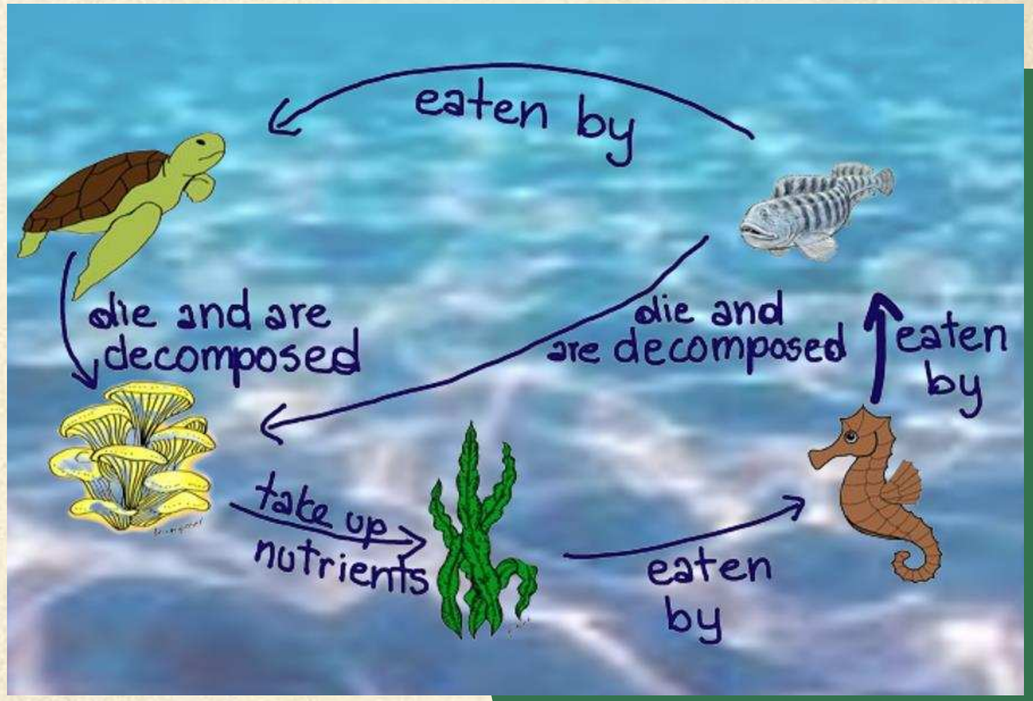
Connection between photosynthesis & cellular respiration in the carbon cycle





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Experiment 1

The Effect of Different Food Sources on the Rate of Fermentation in Yeast (Saccharomyces cerevisiae)

1.0

1.1

Research question:
What uses yeast in the process of fermentation as the main source of energy?

Hypothesis:
The mixture in the bottle, which contains sugar will rise, due to the presence of glucose.

- Bottle 1: yeast and water (control)
- Bottle2:Yeast, water and table sugar
- Bottle 3: yeast, water and table salt

Figure 2: Material Experiment 1

Materials:
- 3 plastic bottles á 500 ml
- 3 packages (á 7 gram) of baking yeast *(Saccharomyces cerevisiae)*
- 7 gram of table salt (*sodium chloride*)
- 7 gram of table sugar (*sucrose*)
- 300 ml lukewarm water (*40°C*)
- 1 funnel
- 1 stirring rod laboratory scale

1.2 Observation:

Bottle Number	Bottle content	Observation
1	yeast and water (control)	0 min: 4 cm 3 min: unchanged 6 min: unchanged 9 min: unchanged 12 min: unchanged 15 min: unchanged
2	Yeast, water and table sugar	0 min: 4 cm 3 min: level rose to 4.5 cm 6 min: foam starts to form; level rose to 6 cm 9 min: level rose to 9 cm; CO2 rises 12 min: level rose to 13 cm 15 min: level rose to 15.3 cm
3	yeast, water and table salt	0 min: 4 cm 3 min: unchanged 6 min: unchanged 9 min: unchanged 12 min: unchanged 15 min: unchanged

Table 1: showing the change in daimeter of the baloons every 3 min

Figure 3: procedure experiment 1

Conclusion:

The rate of fermentation increases the more saccharose is combined with the mixture of water and yeast

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Experiment 2

The Effect of Table Sugar (Sucrose) Amount on the Rate of Fermentation in Yeast (Saccharomyces cerevisiae). Comparing Yeast Growth at Various Sugar Concentrations.

2.0

2.1

Research question:
How does the amount of table sugar (sucrose) affect the rate of fermentation in yeast?

Hypothesis:
The more sugar is added, the faster the balloon fills with CO2

- Bottle 1: 7 grams of yeast
- Bottle 2: 7 grams of yeast & 1 gram of sugar
- Bottle 3: 7 grams of yeast & 3 grams of sugar
- Bottle 4: 7 grams of yeast & sugar

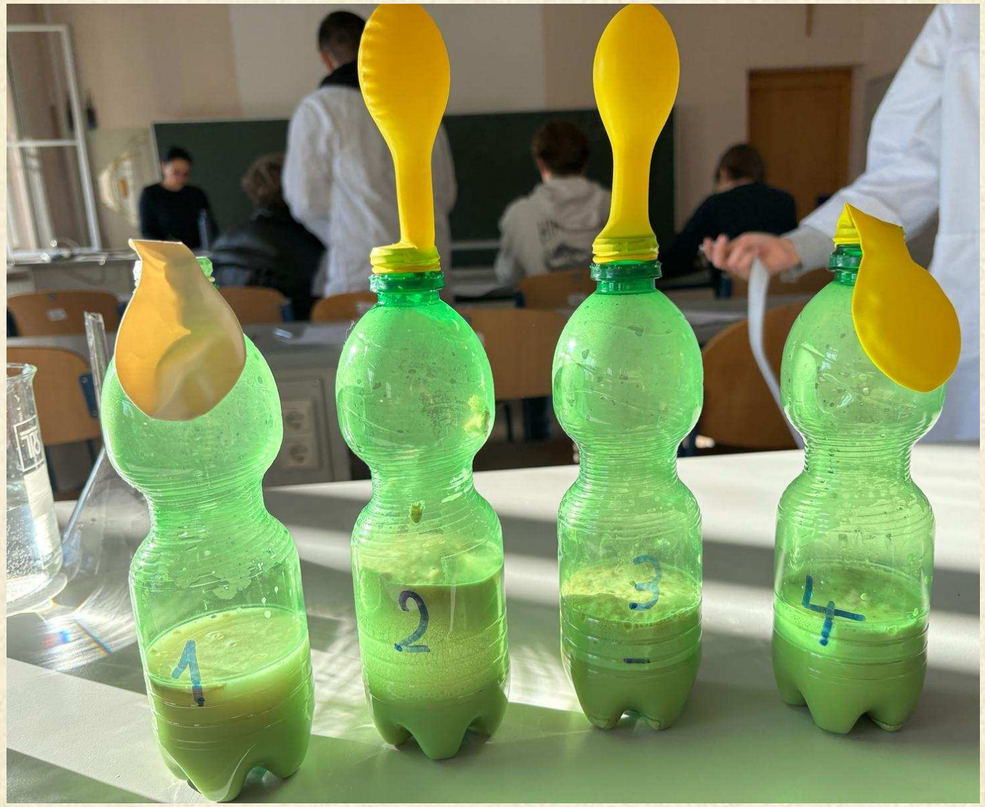
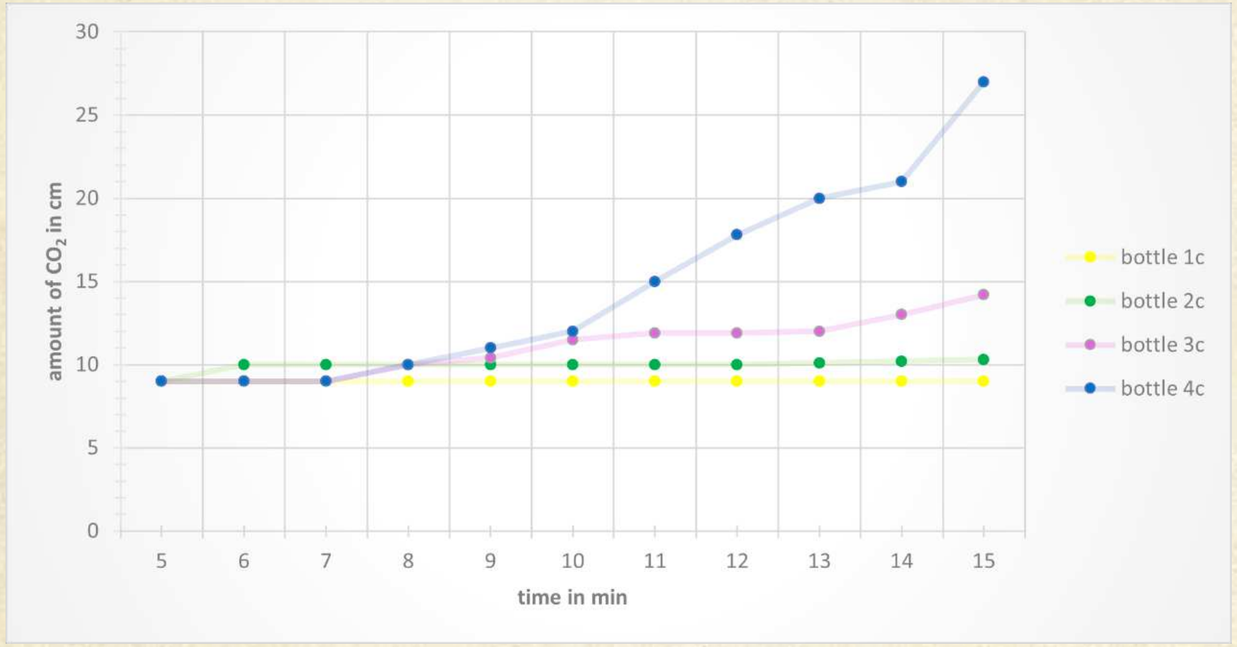


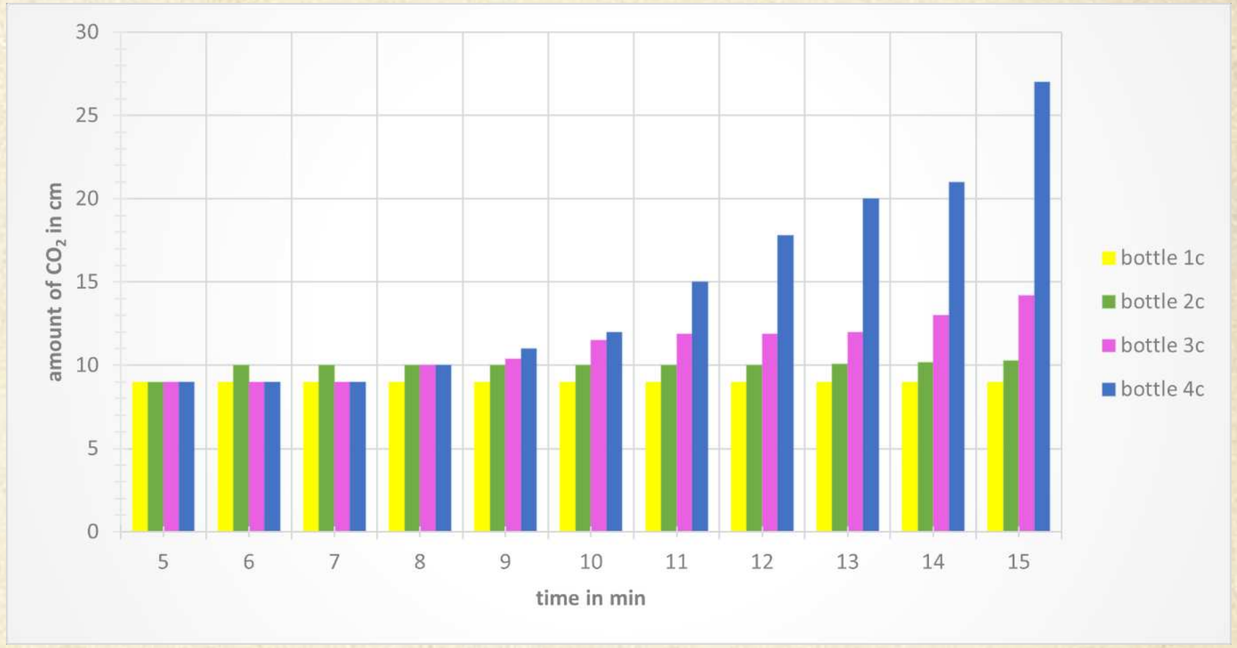
Figure 4: Set up of equipment of experiment 2

Materials:
- 4 plastic bottles (á 500 ml)
- 4 packages (á 7 gram) of baking yeast (Saccharomyces cerevisiae) 11 gram of table sugar (sucrose)
- 400 ml lukewarm water (40°C)
- 4 rubber balloons
- 1 stirring rod
- 1 funnel
- measuring tape
- laboratory scale

2.2 Observation:



Graph 1: showing the amount of carbon in cm per min



Graph 2: showing the amount of carbon in cm per min

Conclusion:

The diameter of each balloon states that the more saccharose is combined with the mixture of water and yeast, the more CO2 is being produced by fermentation.

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Experiment 3

3.0

The Effect of Sugar Types on the Rate of Fermentation in Yeast (Saccharomyces cerevisiae)

3.1

Research question:
How does the type of sugar affect the carbon dioxide production in yeast?

Hypothesis:
We expect saccharose to have the best reaction as it contains glucose which is the best sugar for fermentation in yeast cells.

- Bottle 1: 7 grams of yeast
- Bottle 2: 7 grams of yeast & Lactose
- Bottle 3: 7 grams of yeast & Fructose
- Bottle 4: 7 grams of yeast & Saccharose

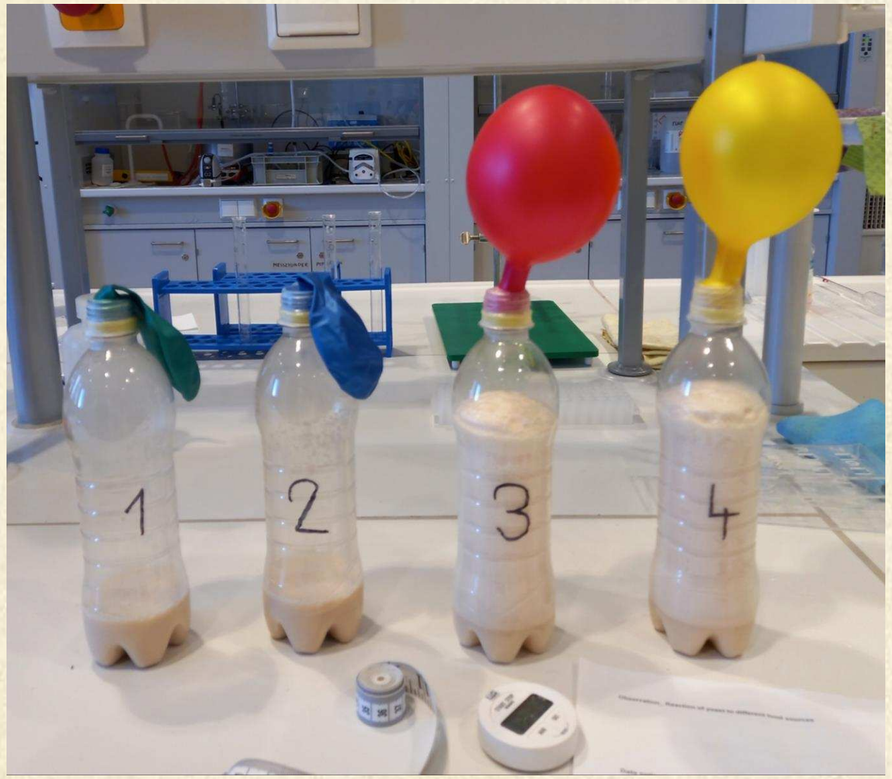
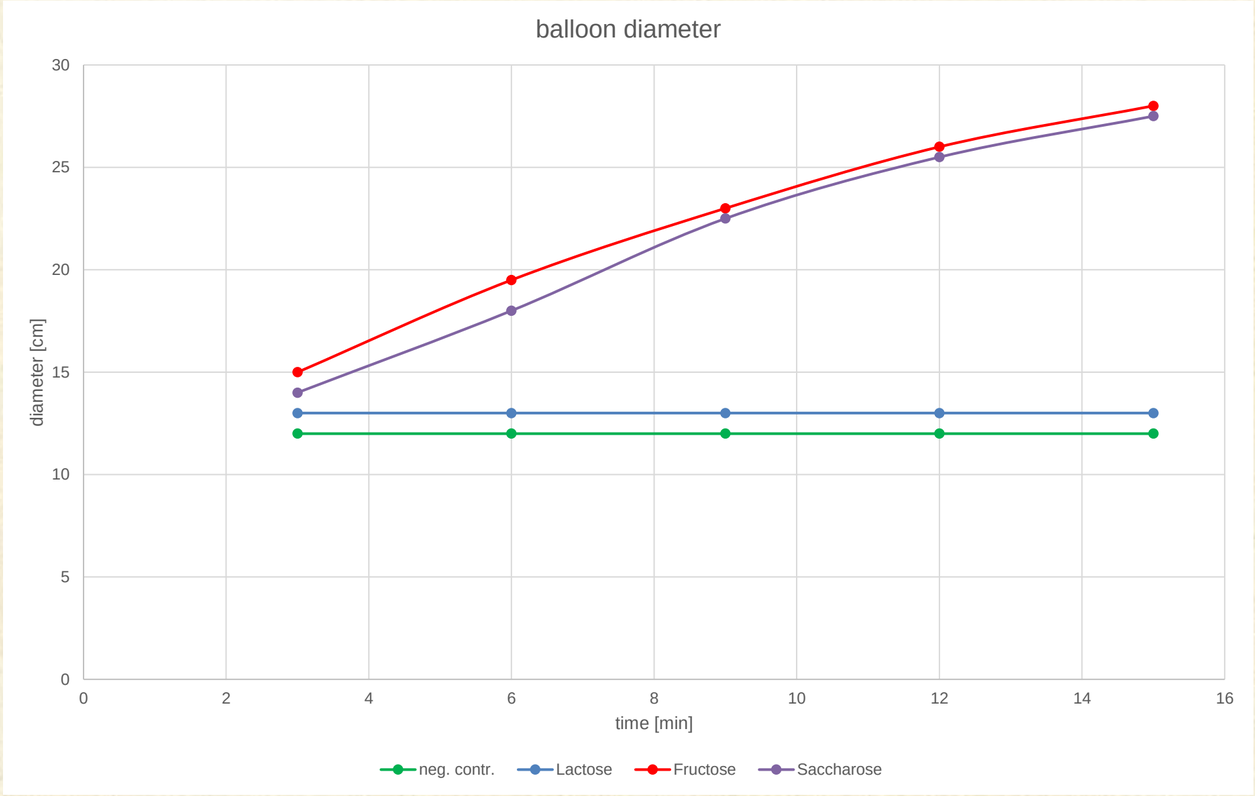


Figure 5: Reaction Experiment 3

Materials:
- 4 empty bottles
- 7 grams of yeast per bottle
- 3 grams of fructose
- 3 grams of saccharose
- 3 grams of lactose
- 100 ml of warm water (45°C) per bottle
- 4 beakers
- a funnel
- a thermometer
- parafilm
- marker
- timer
- fine scale
- measuring boat
- 4 balloons
- measuring tape
- stirring rod
- pen & paper

3.2 Observation:



Graph 3: showing the diameter of the balloon in min

Conclusion:

Fermentation is bound to happen with saccharose and fructose, however not with lactose as yeast does not contain the enzyme lactase. Due to the absence of lactase the glycosidic bond between glucose and galactose cannot be broken down.

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Experiment 4

Testing the Uptake of Carbon Dioxide from Water by Plants & Observing the Presence and Cytoplasmic Streaming of Chloroplasts in Egeria densa

4.0

4.1

Research question:

Will the content of carbon dioxide be reduced in the aqueous environment in the presence of the water plant (Egeria densa)?

Hypothesis:

In the bottle with plants, which is exposed to light the carbon content is reduced as photosynthesis can take place.

Figure 6: procedure

Materials:

- Three bottles (250-ml) with caps
- Universal pH indicator (pH 3-10)
- Soda water (soft carbon dioxide increases the pH value making the water slightly acidic)
- Scissors
- Aluminium foil or black paper
- Table lamp
- Stems of Egeria densa

4.2 Observation:

Time	Reference		Egeria densa illuminated		Egeria densa covered with aluminium foil	
	colour	pH	colour	pH	colour	pH
0 min	orange	5,5	orange	5,5	orange	5,5
50 min	orange	5,5	dark yellow	6	orange	5,5

Table 2: showing the different rate of photosynthesis under different circumstances

Conclusion:

The experiment proved that by adding the water plant (Egeria densa) to soft carbonized water (slightly acidic with a pH value of 5.5) the amount of carbon dioxide decreases, due to the water plant (Egeria densa) performing photosynthesis.

4.3

Research question:
Does cytoplasmic streaming occur in plant cells? Why is it happening? How are the chloroplasts moving through the cell?

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Hypothesis:
Cytoplasmic streaming occurs in plant cells to evenly distribute nutrients, organelles, and essential molecules, promoting efficient cellular processes. This movement is driven by interactions between the cytoskeleton, motor proteins, and fluid cytoplasm, optimizing cellular function and overall plant health.

Materials:
- Leaves of Egeria densa
- Microscope
- Microscope slides
- Cover slips
- Tweezers
- Scissors
- Paper towel

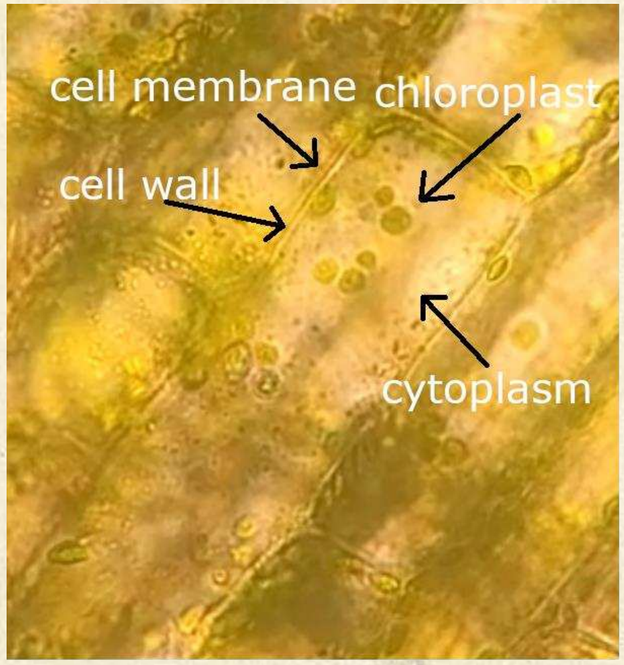

Figure 7: labelled diagram of an elodea densa leave under the light microscope

Conclusion:
Cytoplasmic streaming is occurred because the chloroplast wants to absorb as much light energy as possible, which is why chloroplast wants to move where the concentration of light is the highest.

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Summary

5.0

Long Story Short

5.1

Conclusion

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- A deep study of carbon cycling on the example of yeast (Saccharomyces cerevisiae) fermentation has been performed

- The cycling of carbon could be observed by producing carbon dioxide through yeast fermentation using different types of sugars, e.g. monosaccharides (fructose) and disaccharides (saccharose, lactose)

- Water plant Egeria densa uses the energy of sunlight to power the process of photosynthesis which converts carbon dioxide into glucose – the source of energy in plants

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