**An Investigation of the Carbon Cycle and Metabolic Rates**

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**Introduction**

This report explores how light, photosynthesis, and cellular respiration impact the concentration of carbon dioxide (CO2) in a system. The flow of CO2 throughout a system is called the carbon cycle, and it is greatly impacted by the metabolic rates of many organisms. An organism’s metabolic rate is all the chemical reactions that occur within it, and because it of this, it would be difficult to directly measure the metabolic rates of organisms, so instead, the end product of CO2 is measured instead (Krane, 2019). CO2 flows from being in the environment to being fixed in glucose through the process of photosynthesis. CO2 is released by the process of cellular respiration as many organisms, including photosynthetic organisms, back into the environment where it can freely float in the atmosphere or be absorbed by water causing the water to be more acidic.

In this experiment we tested how the concentration of CO2 would change in a closed environment with neither, either, or both algal beads and snails with and without light (Krane, 2019). The hypothesis is that if there are algal beads exposed to light then the CO2 concentration will only go down.

**Methods**

8 cuvettes were labeled LI, LIB, LIS, LIBS, DI, DIB, DIS, DIBS respectively, with L standing for light, D standing for dark, I standing for indicator, B standing for algal beads, and S standing for snails (Krane, 2019). 10 algal beads were added to cuvettes labeled “algal bead” and 3 snails were added to the cuvettes labeled “snail” (Krane, 2019). 1.5ml of CO2 indicator solution is then added to each of them and they are covered with parafilm (Krane, 2019). pH at this point was recorded for time 0 and all the “dark” cuvettes were covered with aluminum foil (Krane, 2019). All the cuvettes were placed under the same lighting conditions and their pH recorded every 5 minutes in table 8.1 (Krane, 2019).

**Results**

Table 8.1. pH of various algal bead & snail combinations with and without light

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Time** | **LI pH** | **LIB pH** | **LIS pH** | **LIBS pH** | **DI pH** | **DIB pH** | **DIS pH** | **DIBS pH** |
| 0 | 8.1 | 8.3 | 6.9 | 8.1 | 7.9 | 8.3 | 7.3 | 7.7 |
| 5 | 8.1 | 8.5 | 7.1 | 8.3 | 7.9 | 8.5 | 7.3 | 7.5 |
| 10 | 8.1 | 8.9 | 7.1 | 8.3 | 7.9 | 8.3 | 7.3 | 7.1 |
| 15 | 8.1 | 8.9 | 7.1 | 8.7 | 7.9 | 8.1 | 7.3 | 7.1 |
| 20 | 8.1 | 8.9 | 7.1 | 8.9 | 7.9 | 8.1 | 7.1 | 6.9 |
| 25 | 8.1 | 9.1 | 6.9 | 8.9 | 7.9 | 7.9 | 6.9 | 6.9 |
| 30 | 8.1 | 9.1 | 6.9 | 8.9 | 7.9 | 7.7 | 6.9 | 6.7 |
| 35 | 8.1 | 9.1 | 6.9 | 8.9 | 7.9 | 7.7 | 6.9 | 6.5 |
| 40 | 8.1 | 9.1 | 6.9 | 8.9 | 7.9 | 7.7 | 6.9 | 6.5 |
| 45 | 8.1 | 9.1 | 6.9 | 8.9 | 7.9 | 7.7 | 6.9 | 6.3 |



Figure 8.1. pH of cuvettes under various conditions over a period of 45 minutes

**Conclusion**

The results show that overall, the pH (and as a result, inversely for the CO2 concentration) went up only for the cuvettes with both algal beads and light, the pH otherwise decreased or remained the same. The results do support the hypothesis as pH only increased with both algal beads and light, excluding the pH increase for dark with algal beads at 5 minutes. The results make sense as photosynthesis could only occur with algal beads and light resulting in the cuvettes satisfying those requirements being the only ones where CO2 concentration decreased, and pH increased. The other results also make sense as the two cuvettes without any organisms didn’t have a pH change as there was nothing to change the concentration of CO2 and the remaining cuvettes having a pH decrease as the algal beads could not do photosynthesis with the lack of light, and both the algal beads and snails being able to do cellular respiration. Based on the results of the experiment, it can be concluded that the rate of photosynthesis and cellular respiration need to be equal in order to recycle the products from photosynthesis, which is mainly glucose, and cellular respiration, which is mainly ATP that is used to power metabolism and CO2 as a waste product.

Some limitations of this experiment is that we did not test what would happen if more algal beads, or snails were present in the cuvettes with both algal beads and snails under both light and dark environments (LIBS and DIBS environments). However, based on the results of the experiment, it can be predicted that under the LIBS environment, if more algal beads were added, then pH would go up as photosynthesis is occurring and removing CO2 from the environment. It can also be predicted that under the DIBS environment, if more algal beads were added, then pH would go down as photosynthesis is not occurring, but cellular respiration would be occurring and causing CO2 to increase in the environment. It can also be predicted that under both LIBS and DIBS environments that if snails were added, pH would go down as snails can only do cellular respiration and increase the amount of CO2 in the environment.

**References**

Krane, D. (2019). *Bio 1120: A Laboratory Perspective*. Cincinnati, OH: Van-Griner Publishing.