

The Dynamics of Carbon Dioxide in the Aquarium

Purpose: Students will explore the complex relationship of carbon dioxide in the aquatic environment. Students will see first hand how the element carbon cycles through a pond ecosystem.

Standards Addressed:

6th Grade Standard 2: Life Science

Organisms interact with each other and their environment in various ways that create a flow of energy and cycling of matter in an ecosystem

- a. Develop, communicate, and justify an evidence-based explanation about why there generally are more producers than consumers in an ecosystem (DOK 1-3)
- b. Design a food web diagram to show the flow of energy through an ecosystem (DOK 1-2)
- c. Compare and contrast the flow of energy with the cycling of matter in ecosystems (DOK 2)

Background Information

Through the support of Pets in the Classroom our 6th Grade Science Class at Steamboat Springs Middle School, in Steamboat Springs, Colorado has been able to create and maintain a live planted aquarium over the past three years. In 6th grade, environmental science and ecology are major themes in our curriculum and our aquarium is used to visualize the dynamics of an aquatic environment.



Our Aquarium

One of the understandings we explore through the use of our aquarium is how the element carbon is cycled in an aquatic environment.

Implementation

In the beginning of our Ecology Unit we discussed what air is made of. Students discover that the air we breathe is primarily made of oxygen, nitrogen, and some carbon dioxide. Our students coming in from 5th Grade have a grasp of these elements/compounds but do not understand their interactions in the environment.

We focused on the compound carbon dioxide and looked at its effects on the environment. We used our aquarium to model an increase of carbon dioxide to examine the effects on the plants and animals in the aquarium.

Creating CO₂

Our first task was to build a contraption that would produce carbon dioxide that we could add to the aquarium. I showed students that when certain acids like citric acid and a solution of baking soda were combined carbon dioxide was produced. They took this knowledge and came up with ways that the CO₂ could be added to the aquarium. We created a device, a carbon dioxide reactor, that would mix the citric acid and baking soda and then dose small amounts into the aquarium.



CO₂ Reactor

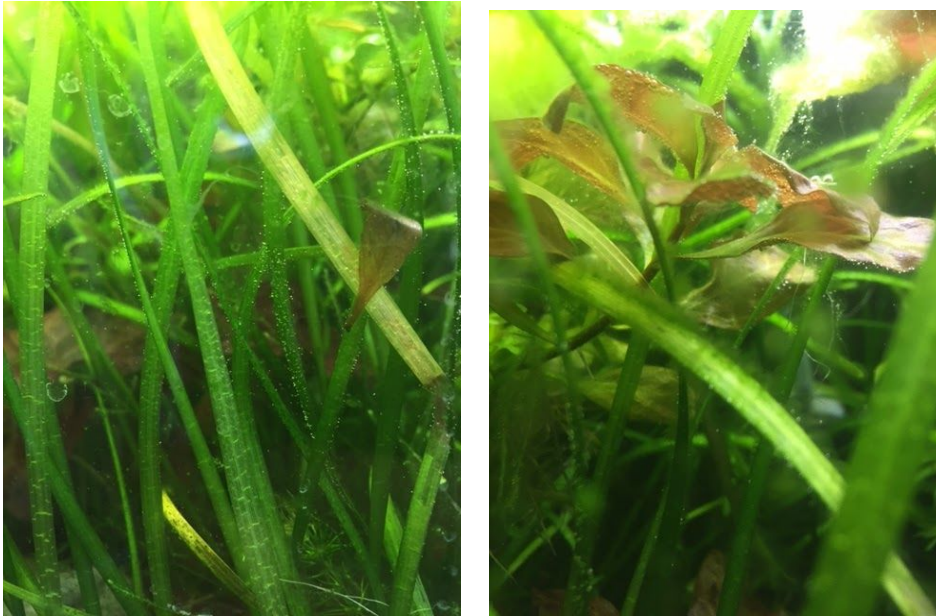
Testing the Parameters

Before the experiment could be conducted all the parameters of the aquarium were tested and observed in order to compare them to addition of CO₂.

The carbon dioxide reactor was set to dose small amounts (1 bubble every 2 seconds) into the aquarium. We decided to look at the short term and long term effects of the carbon dioxide.

The Learnings

After an hour we observed how the carbon dioxide was affecting the aquarium. It was noticed that initially the pH dropped slightly and many of the plants started to have shiny bubbles on their leaves.



Plants with Bubbles on Leaves

After two days the pH had returned to normal neutral and the plants growth had accelerated like crazy. One plant in particular was growing almost an a centimeter a day!

Over the long term our sparsely planted aquarium became a lush forest of green. Plant growth was accelerated and all of the plants looked very healthy.

The Follow Up

Students were then asked to explain the phenomenon of the experiment, the addition of carbon dioxide to the aquarium environment. Students were given access to preselected websites in order to explain their results. Each student was asked to write a narrative that explained the experiment, described the results, and explained the outcome.

What was Learned

- CO₂ when mixed with the aquarium water created carbonic acid which lowered the pH.
- The bubbles on the plants were oxygen bubbles created through photosynthesis
- The rapid plant growth was caused by the acceleration of photosynthesis which allowed the plants to grow fast.
- Plants are necessary to balance increased levels of CO₂

