

# Nitrogen and Phosphorus Effects on Algal Growth in Various Locations

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BIO 1106, Spring 2011, Baylor University, Waco, TX 76798

## Abstract

The purpose of this experiment is to see the effects of nitrogen and phosphorus on the growth of green algae of various locations in the Waco Wetlands. The experiment was conducted by isolating and placing the green algae, *Spirogyra sp.*, in three artificial, controlled environments each filled with water from different locations in the wetlands. Specifically, this experiment tested the initial levels of Phosphorous and Nitrogen found within locations one, two, and four, and the nutrients' effects on the growth of *Spirogyra sp.* over a two week period. Each week, measurements of the nitrogen and phosphorus were taken and the mass of the algae was measured. Phosphorous and nitrogen are limiting nutrients essential for greater algal growth and consequentially, greater depletion of environmental phosphorous and nitrogen in location one. Although the hypothesis was proved wrong, data was collected that proved the critical importance of nitrogen and phosphorous to algal growth.

## Introduction

The Lake Waco Wetlands acts as a habitat for native species inhabiting the area and water quality protection for the waters of Waco. The wetlands filter pollution from the surface and ground water through plant uptake, sediment absorption, detritus decomposition, and chemical precipitation (Mainstone 2002). Waters from the North Bosque River travel through the wetlands and removes pollution, which is defined as high concentrations of nitrogen and phosphorus. This pollution produces an increase in aquatic plant and algae growth. Excessive vegetation, such as large algal blooms, depletes the dissolved oxygen levels and causes eutrophication of water (Carpenter 1998). Although excess nitrogen and phosphorus can negatively impact the environment, these elements are limiting factors to biological activity and are important to the growth of marine ecosystems (Smith 1984). This study measured the uptake of nitrogen and phosphorus by *Spirogyra sp.* from water samples at various locations in the wetlands (Figure 1). The hypothesis is there will be greater algal growth in higher concentrations of nitrogen and phosphorus.

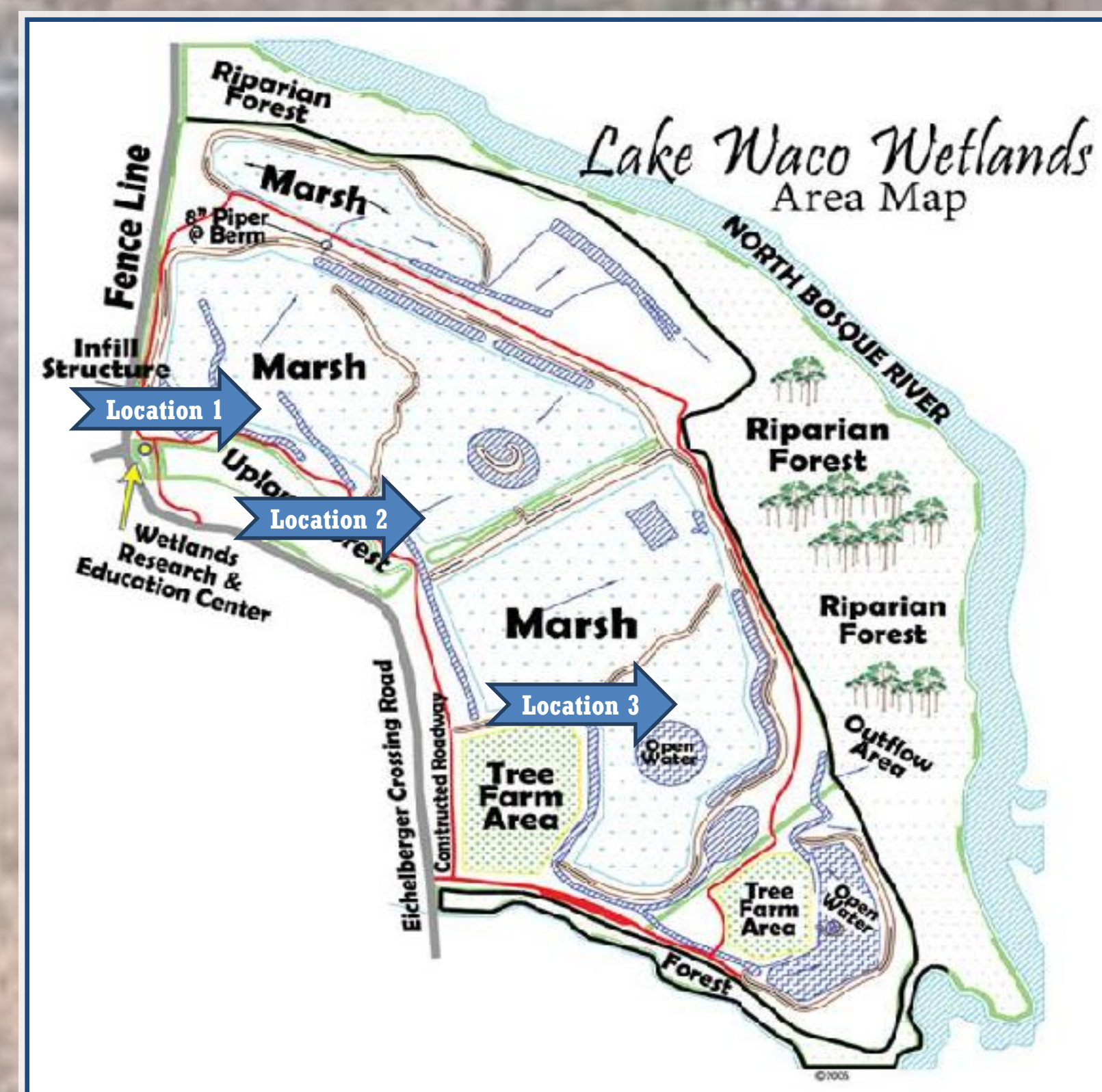


Figure 1. Various locations water from the Wetlands is retrieved

## Materials & Methods

Nine containers (5678mL) filled with 2000mL of wetland water from each location. There are three trials for each location. Four grams of *Spirogyra sp.* were added to each of the 9 containers. Each week alga was weighed and 45mL water samples were collected from each container. Nitrogen and phosphorus levels measured via colorimetric methods on a Flow Injection Autoanalyzer (Lachat 8500 w/series 520 XYZ autosampler). Total phosphorus concentrations (880nm) determined via the molybdate method. Total nitrogen concentrations (520nm) determined using cadmium reduction.

## Results

Figures 2 and 3 show an approximate increase in the concentrations of nitrogen and phosphorus levels over a period of two weeks. With the exception of cell 4, a decrease in phosphorus and nitrogen levels parallel an increase in algal growth in Week 1. For Week 2, the inverse of this is true.

Figure 2. Average Nitrogen Levels

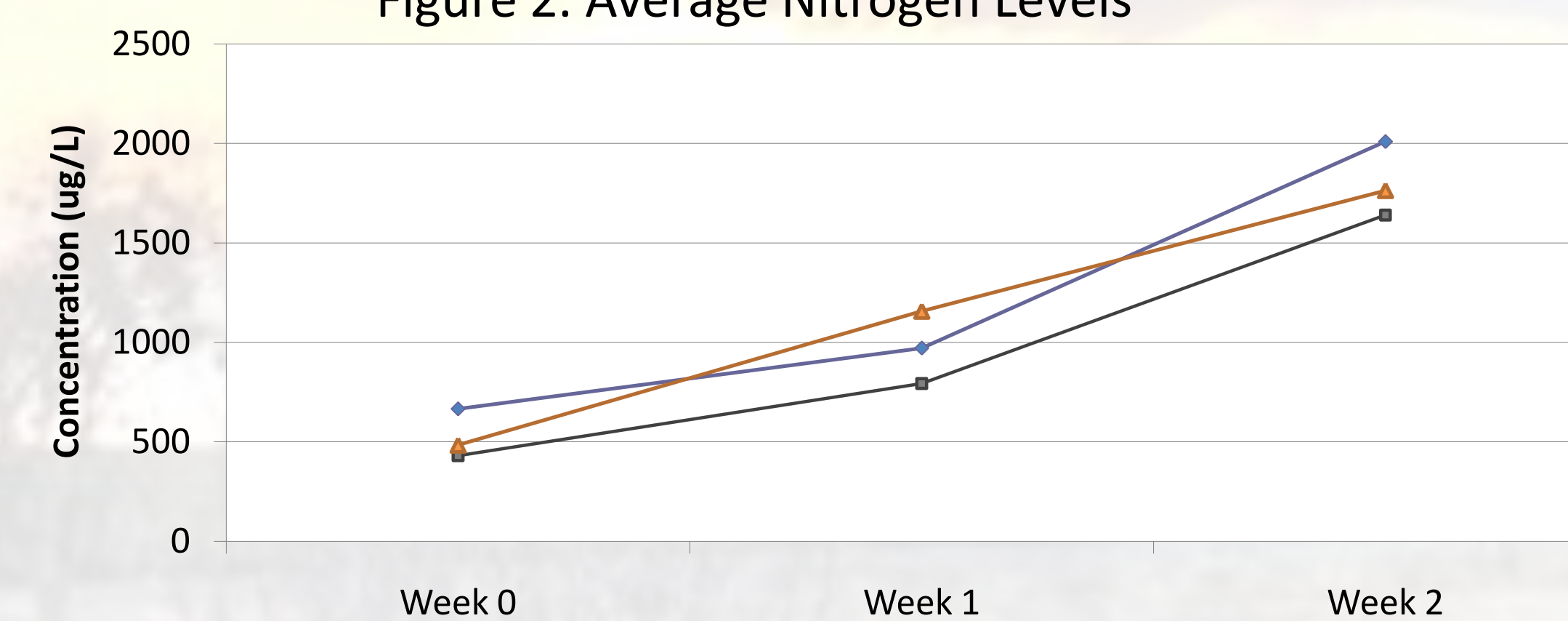


Figure 3. Average Phosphorus Levels

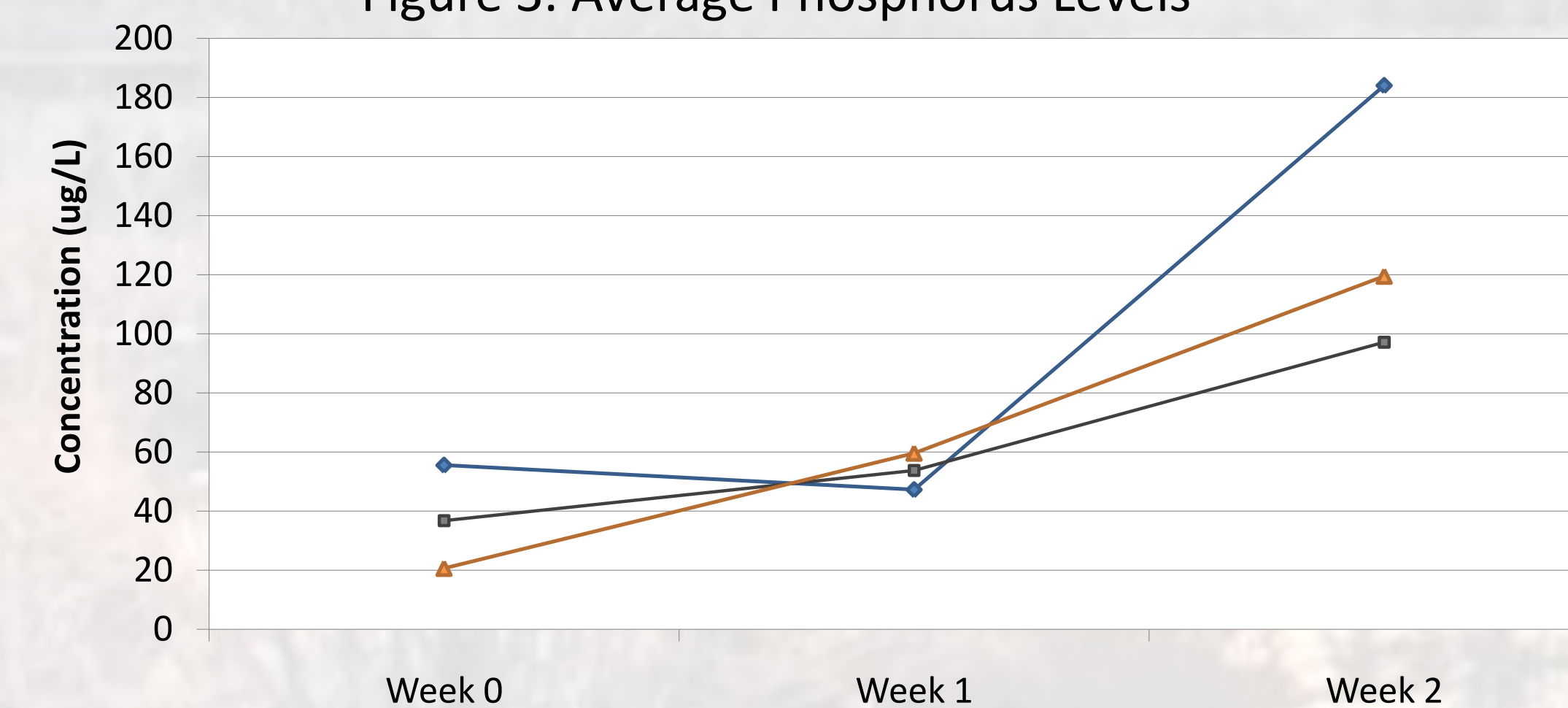
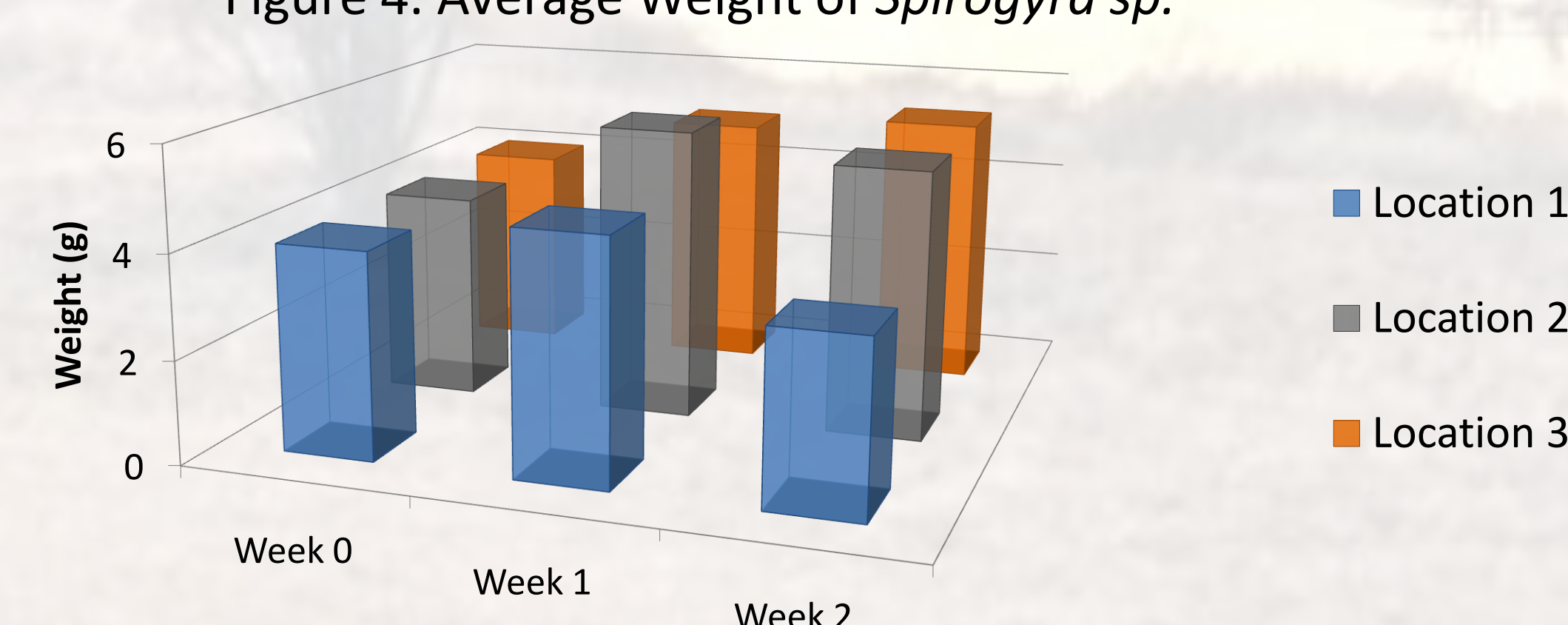


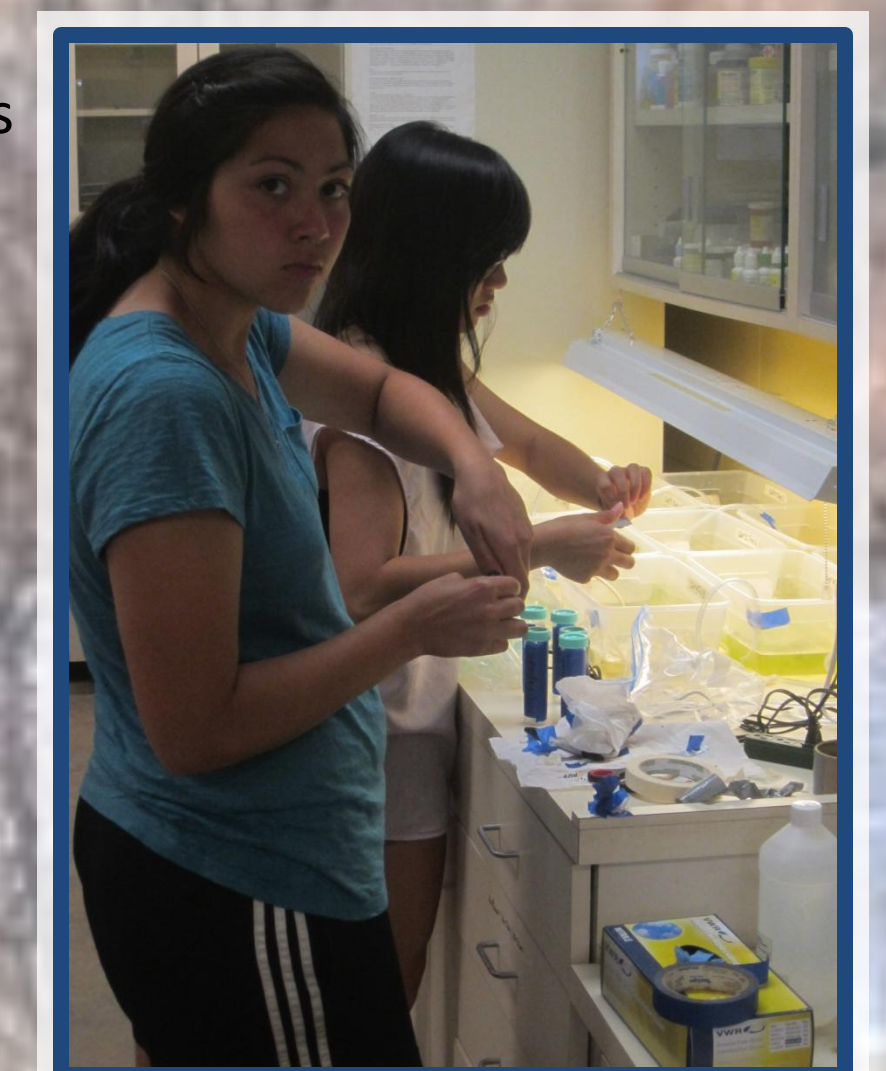
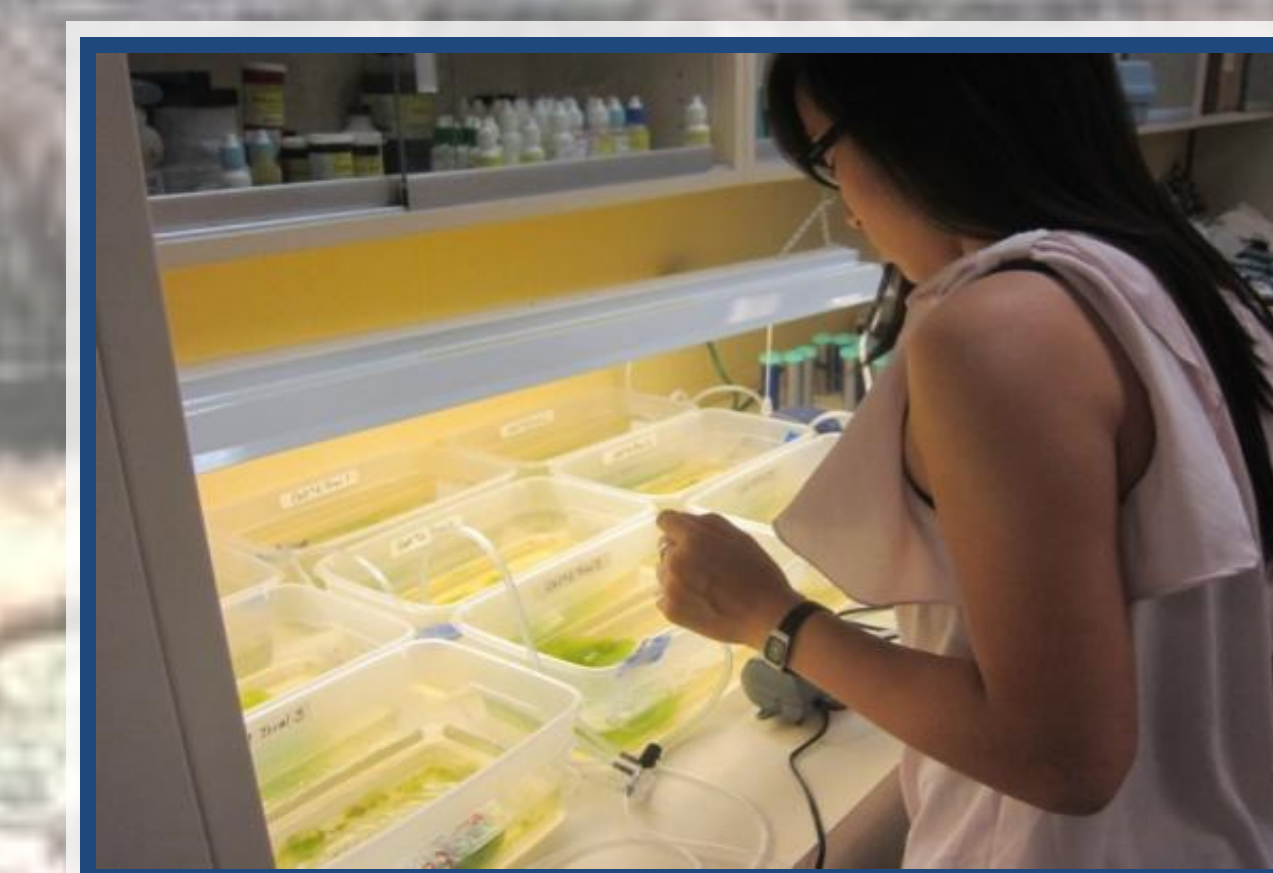
Figure 4. Average Weight of *Spirogyra sp.*



## Conclusion & Discussion

As predicted, the initial quantity of phosphorous and nitrogen was higher in the first cell and decreased in each successive location. The hypothesis was proved wrong, however, when algae grew larger in the second location rather than in the first. Also, the gathered data (Figures 2 and 3) shows increasing phosphorous and nitrogen level when the opposite was expected. Although the hypothesis was rejected, the experiment did provide useful insight. The presence of predictable trends with algal growth and death served as evidence for a close relationship between algae and the nutrients, phosphorous and nitrogen. Three major factors affected the concentrations of nitrogen and phosphorous: the growth and death of algae, which inlet the water was drawn from, and how much phosphorous and nitrogen the algae itself brought in. Nutrients brought in by the algae itself had a visible impact on Week 1 (Figure 2 and 3) and offset a large portion of the algae's nitrogen and phosphorous consumption. Algal death, due to either light or nutrient deficiency, led to algal decomposition and, consequentially, large, upward spikes in phosphorous and nitrogen concentrations within the surrounding water. It was also observed that algal growth extracted the limiting nutrients from the surrounding water. Algae is both composed of and requires nitrogen and phosphorous for growth. In terms of the wetlands' effect on phosphorous and nitrogen levels, dropping nutrient levels as the inlets progress, as shown in both Figures 2 and 3, indicate that the wetlands are removing the limiting nutrients from the water, effectively preventing the formation of potentially dangerous algal blooms. This removal of phosphorous and nitrogen from the North Bosque River provides healthier drinking water for the city of Waco.

Figures 5 and 6. Setting up the containers



## Literature Cited

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## Acknowledgments

A special thanks to Dr. Marty Harvill, Nora Schell, Jeff Back, The College of Arts and Sciences, and the Department of Biology.