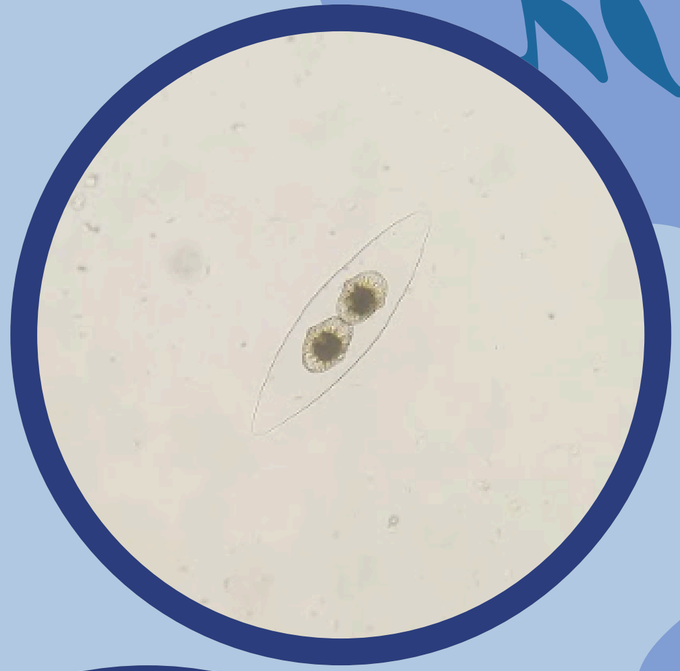
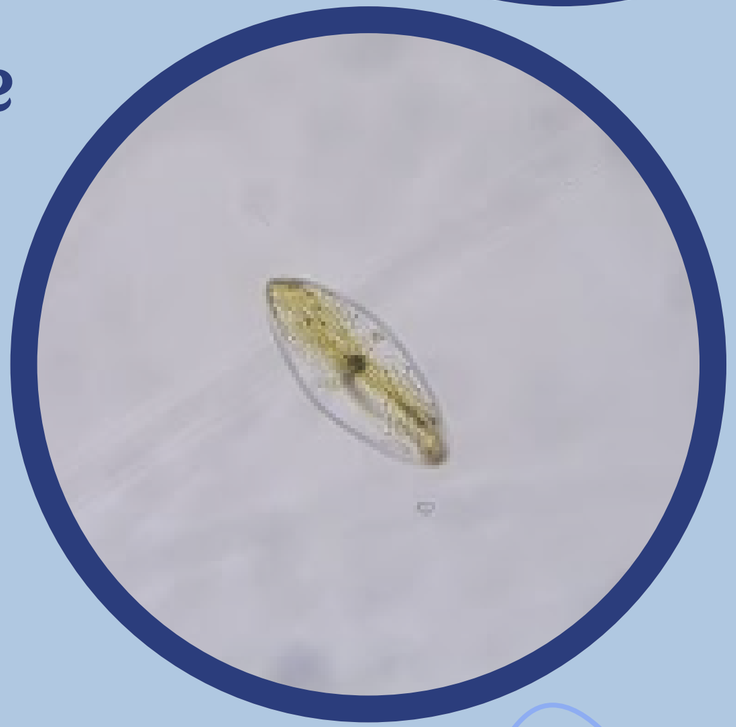
Does Altering the Amount of Dissolved Oxygen Affect the Light Output of Bioluminescent Algae Pyrocystis Fusiformis?

Thiffany Justine Dasig, Makeda Go, Luke Nohea Gee

Introduction

- Bioluminescence: A reaction between chemicals that produces light.
- Purpose: Sustainable Light Source
- Future Applications In Industry





Prior Research

OCEAN EXPLORATION

Bioluminescence

Bioluminescence is light produced by a living organism and is one of nature's most amazing phenomena. It can seem more like science fiction than science!

"Bio-" refers to life or living, "lum" or "lumin" comes from the Latin lumen or lux, for light.

Bioluminescence is a form of chemiluminescence, which is the production of visible light by a chemical reaction. Scientists call the process "**bio**luminescence" when the reaction occurs in living organisms. Bioluminescence is usually blue or blue-green. But it can be nearly violet (bright purple), green-yellow, and less often, red.

How Common is Bioluminescence?

While rare in ecosystems on land, bioluminescence is common in the marine environment. Many types of marine life, from bacteria, to squid, to fish, include some bioluminescent species. Scientists have found bioluminescent creatures from the ocean surface to the deep-sea floor.

How is Light Created?

Like with fire, a chemical reaction using oxygen also causes bioluminescence. However, the reaction occurs *without giving off much heat*. Instead, almost all of the energy is released as visible light.

Bioluminescence is an enzymatic reaction. An enzyme speeds up the chemical reaction by helping a substrate react. The enzyme is reused in the reaction instead of being transformed into another molecule.

Counter-illumi
Abralia veranyi
the Deep Seafl

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ARTICLE

Bioluminescence

Bioluminescence is light emitted by living things through chemical reactions in their bodies.

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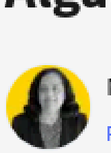
What to Know About Bioluminescent Algae



Medically Reviewed by Nayana Ambardekar, MD on June 06, 2024 | Written by Roma Kunde

HOTOGRAPH

Milky Sea

Milky seas" offer another view of microscopic, bioluminescent organisms. Milky seas, like this ppearance off the Horn of Africa, are caused by e presence of millions of bioluminescent

Prior Research

page | discussion | view source | view history

Bioluminescence in Pyrocystis fusiformis

This is a curated page. Report co

Contents [hide]

Introduction

Pyrocystis fusiformis is a marine dinoflagellate. Dinoflagellates are marine unicellular planktonic organisms. A few species are found in freshwater environments, however 90% of dinoflagellate species are marine. These organisms are found throughout the world's oceans, concentrating at the top euphotic zone of the ocean's water column

Growing dinoflagellates at home

Main Page
Research Forum
Dinos in Lab
Organisms
Photos
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Dinoflagellates are relatively easy to maintain at home, requiring as little care as a houseplant, except that these "plants" produce bright blue light when shaken at night.

For more technical culturing information, we have another page about Growing Dinos in the Lab

Also see our page documenting a red tide of dinoflagellates.

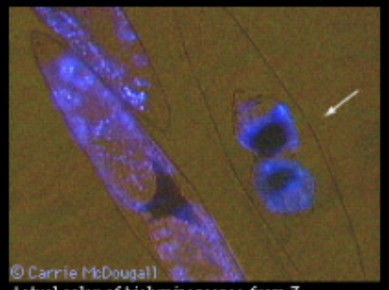
Where to get bioluminescent dinoflagellates

[Disclaimer: we have no ties to these companies and list them here as a service, not an endorsement.]

A very bright and very tolerant species is available via mail through this source: (Note: this species is non-toxic).

- Sunnyside SeaFarms sells *Pyrocystis fusiformis*

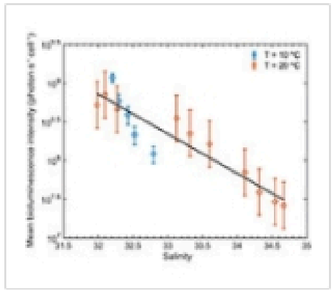
  You can order from their web site. They mail the dinos in clear plastic baggies that contain 50 ml of dinos and seawater for $20 per bag. They also sell 3-ml vials which are suitable for classroom use, so that each student can take a vial home with them.



Actual color of bioluminescence from 3 *Pyrocystis fusiformis* cells. One (arrow) has just reproduced and both new "baby" cells still occupy

Another company is selling a variety of bioluminescent dinoflagellates.

Prior Research



Effects of typical marine environmental factors on the bioluminescence intensity of individual *Noctiluca scintillans*

Shuguo Chen, Siming Gan, Lianbo Hu, Rong Bi, and Yue Gao

Author Information ▾ Find other works by these authors ▾

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Figures (11)
Data Availability
Tables (3)
Equations (3)
References (35)
Cited By (3)
Metrics
Back to Top

Abstract

Red *Noctiluca scintillans* (RNS) is one of the major red tide species and dominant bioluminescent plankton in the global offshore. Bioluminescence offers a number of applications for ocean environment assessments such as interval waves study, fish stocks evaluation and underwater target detection making it of significant interest in forecasting bioluminescence occurrence and intensity. RNS is susceptible to changes in marine environmental factors. However, the effects of marine environmental factors on the bioluminescent intensity (BLI, photon s^{-1}) of individual RNS cells (IRNSC) is poorly known. In this study, the effects of temperature, salinity and nutrients on the BLI were studied by field and laboratory culture experiments. In the field experiments, bulk BLI was measured by an underwater bioluminescence assessment tool at various temperature, salinity and nutrient concentrations. To exclude the contribution by other bioluminescent planktons, an identification method of IRNSC was first developed using the features of the bioluminescence flash kinetics (BFK) curve of RNS to identify and extract BLI emitted by an individual RNS cell. To decouple the effects of each environmental factor, laboratory culture experiments were conducted to examine the effects of a single factor on the BLI of IRNSC. The field experiments showed that BLI of IRNSC negatively correlated with temperature (3–27°C) and salinity (30–35‰). The logarithmic BLI

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Hypothesis

We hypothesize that altering the levels of dissolved oxygen in an environment where bio-luminescent algae are present, will cause a change in the amount of light outputted by species Pyrocystis Fusiformis.

Materials

- Algae Species (Pyrocystis Fusiformis)
- Test Tubes
- Dissolved oxygen meter
- 2.5 Gallon Tank
- Aerator
- Beakers (1000 mL & 150 mL)
- Hot Plate

Research Plan

01. Prepare & Cultivate

02. Separate & Label

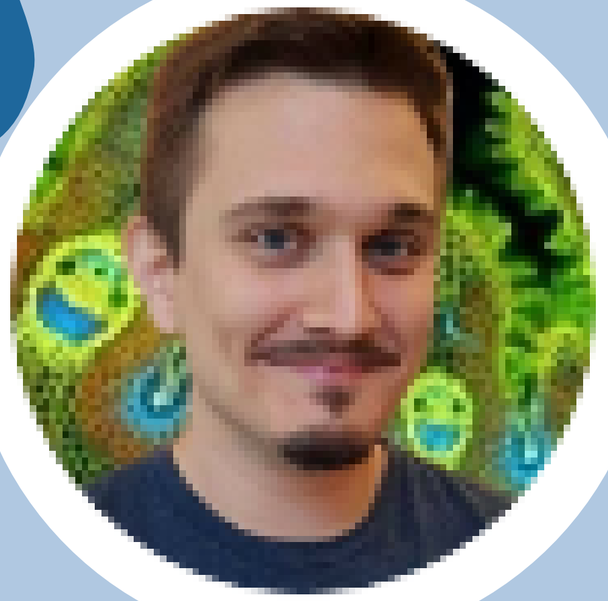
03. Experiment & Testing

04. Repeat & Compare

Mentors

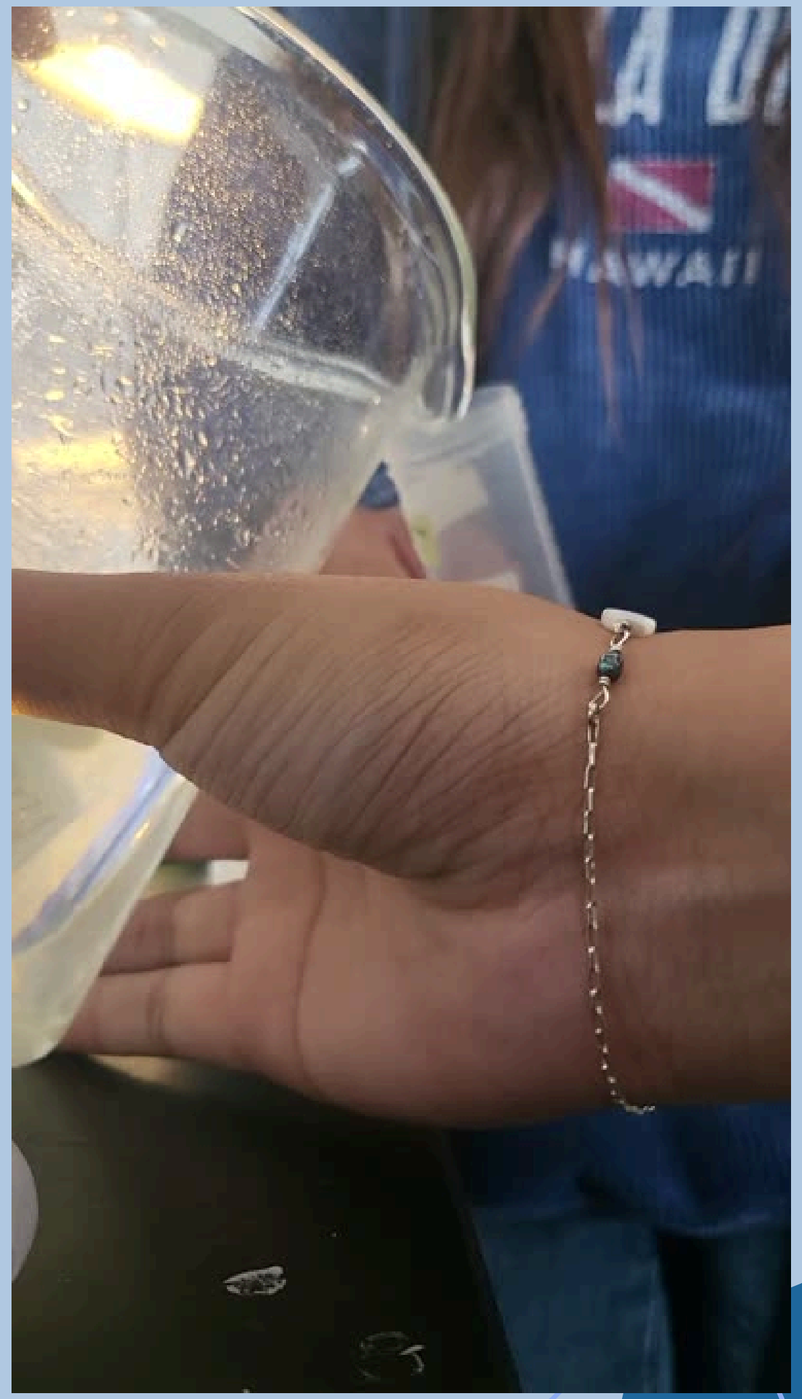
Ms. Bellah
Kealakehe High School
AP Biology Teacher

Sponsors



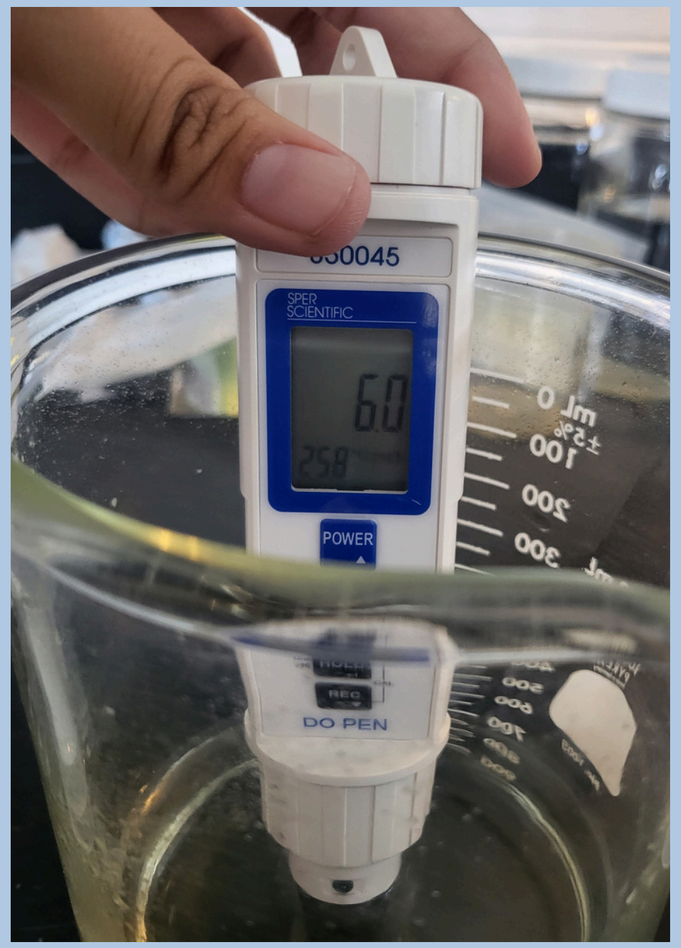
Sebastían C. Cocíoba
Binomica Labs, Deep Sea Ventures
Independent Researcher, Research Contractor

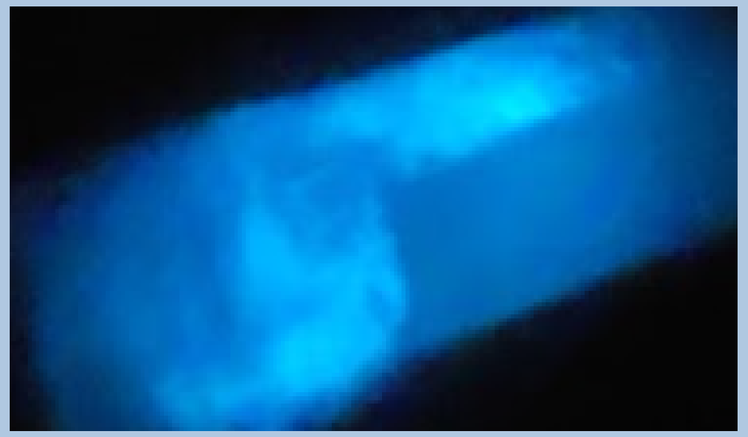
David Lang
Experiment Foundation
Executive Director



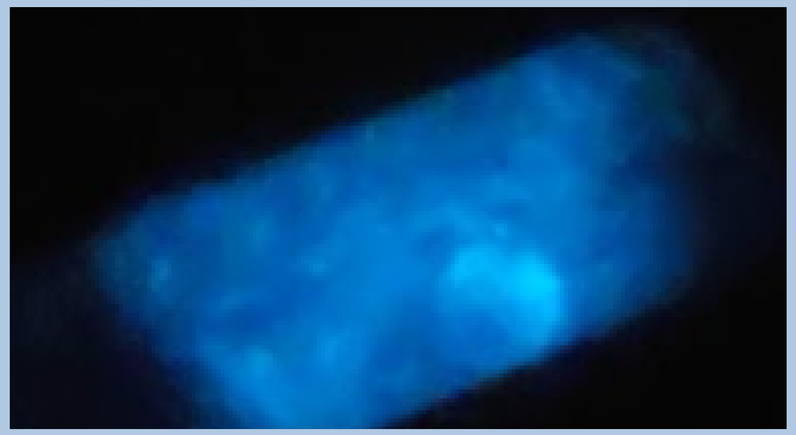
Control Group

- Temperature: 70°F ±°5 (21.1°C ± 15°C)
- Dissolved Oxygen: 6.0 mg/L
- Experiment Volume: 300 mL
- Test Volume: 50 mL



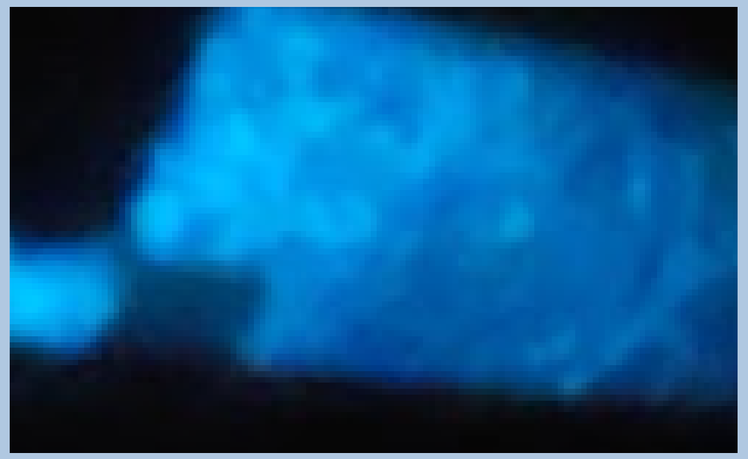


1st Shake – Vial 1
(No oxygen change)

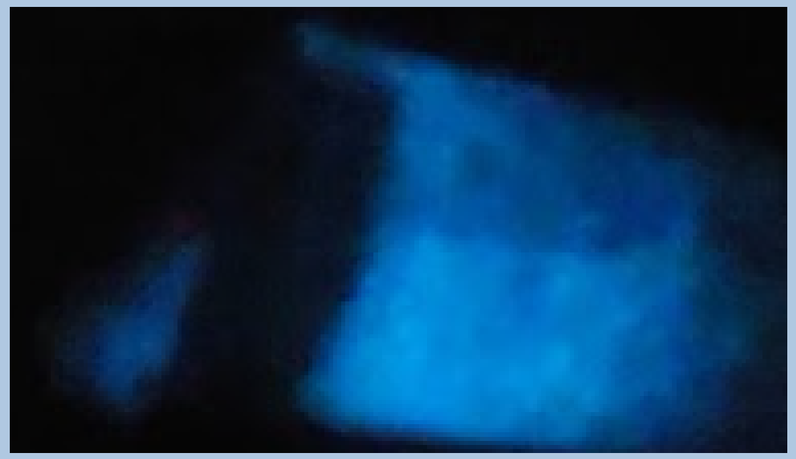


1st Shake – Vial 2
(No oxygen change)

1st Shake – Vial 3
(No oxygen change)



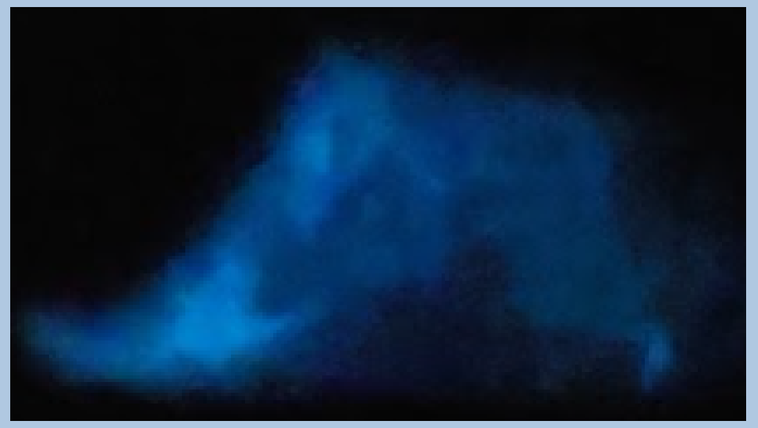
2nd Shake – Vial 1
(No oxygen change)



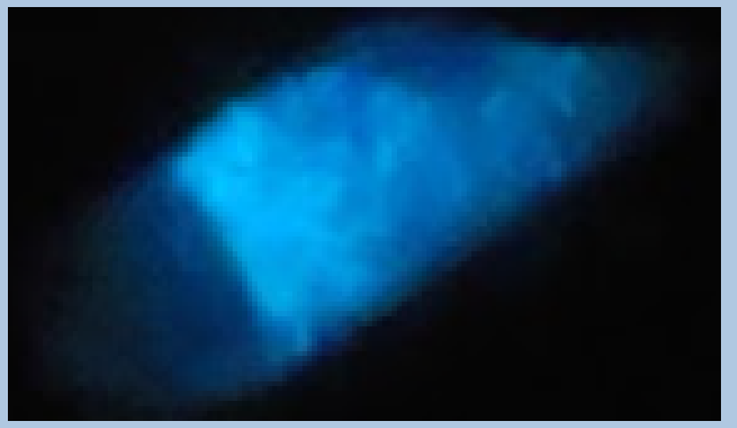
2nd Shake – Vial 2
(No oxygen change)

2nd Shake – Vial 3
(No oxygen change)

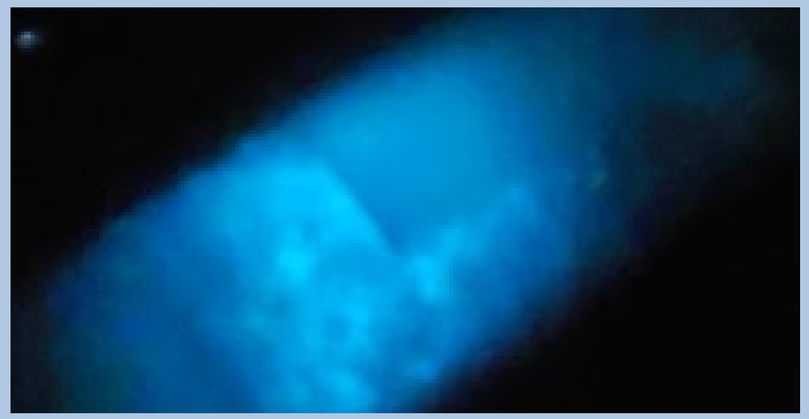
1st Shake – Vial 4
(No oxygen change)



1st Shake – Vial 5
(No oxygen change)

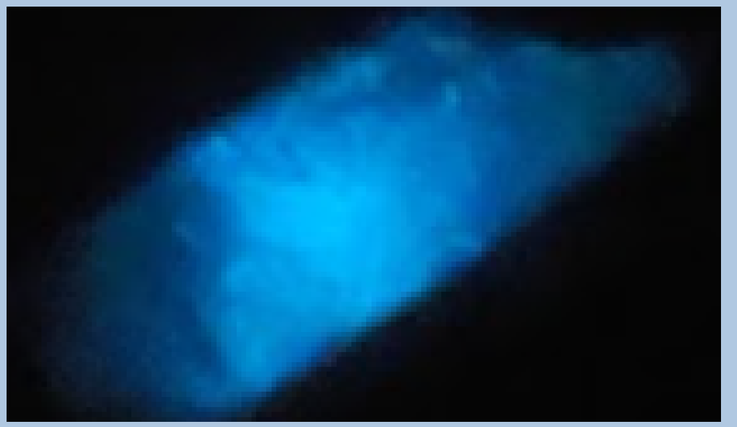


1st Shake – Vial 6
(No oxygen change)



2nd Shake – Vial 4
(No oxygen change)

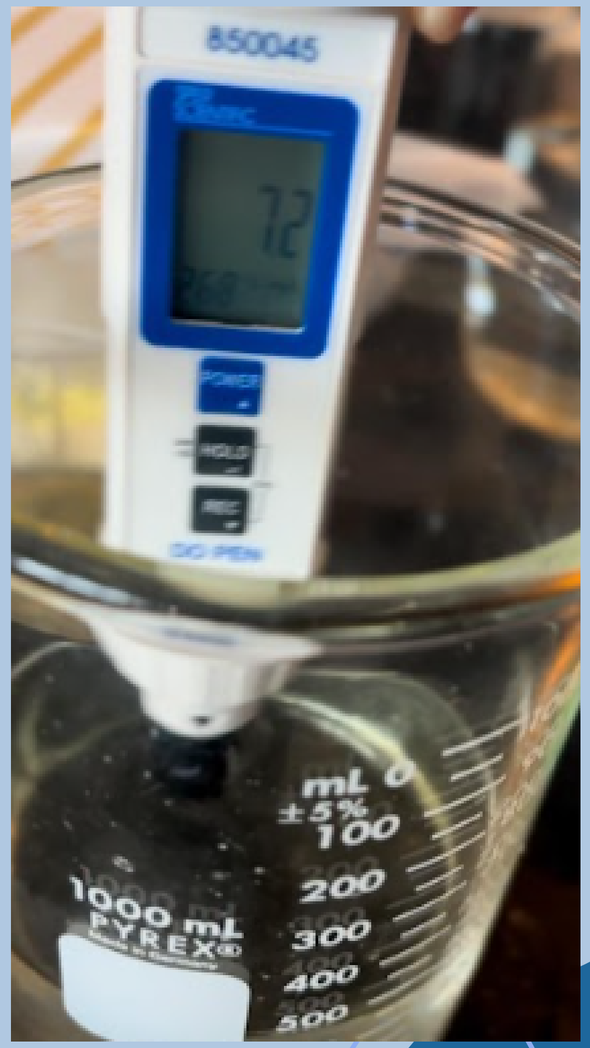
2nd Shake – Vial 5
(No oxygen change)

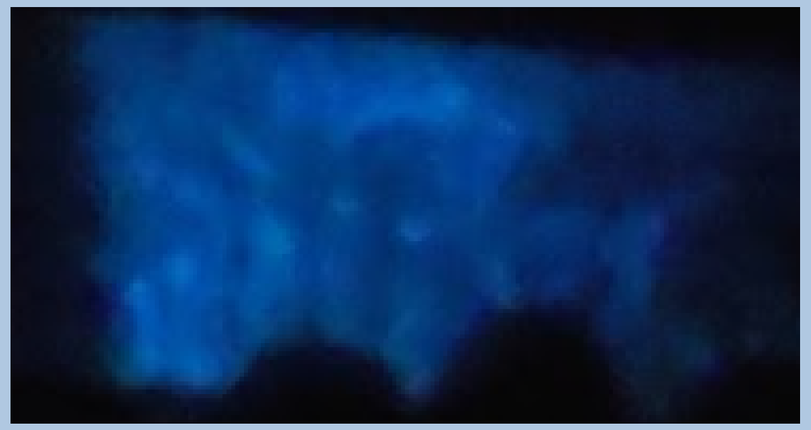


2nd Shake – Vial 6
(No oxygen change)

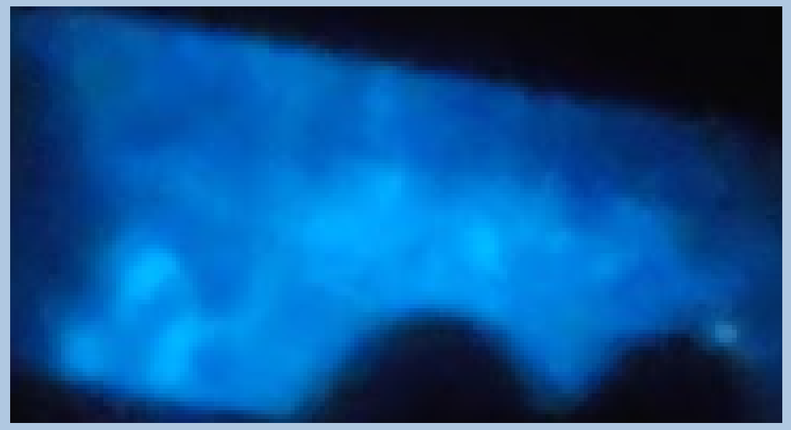
Variable 1

- Temperature: 70°F ±°5 (21.1°C ± 15°C)
- Dissolved Oxygen: 7.0 mg/L
- Experiment Volume: 300 mL
- Test Volume: 50 mL
- Volume: 50 mL

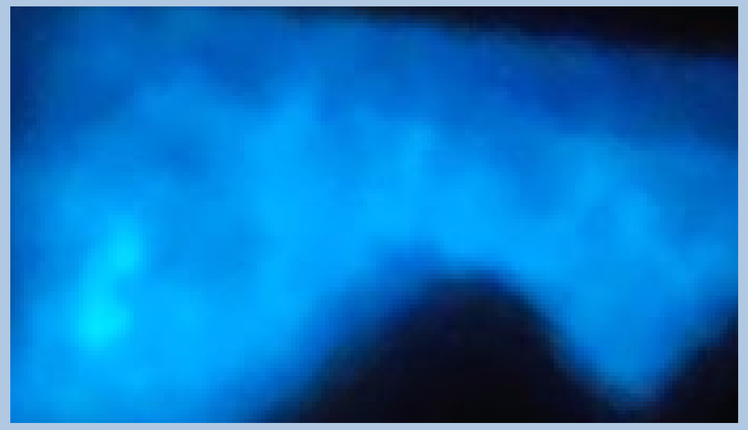




1st Shake – Vial 1
(7.0 mg/mL)



1st Shake – Vial 2
(7.0 mg/mL)

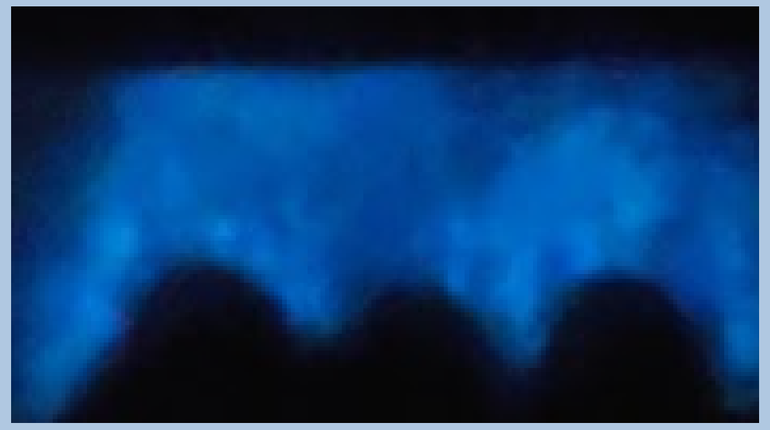


1st Shake – Vial 3
(7.0 mg/mL)

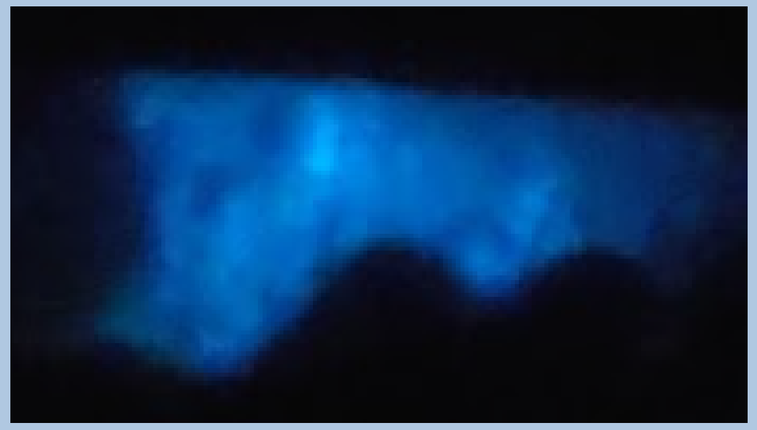
2nd Shake – Vial 1
(7.0 mg/mL)

2nd Shake – Vial 2
(7.0 mg/mL)

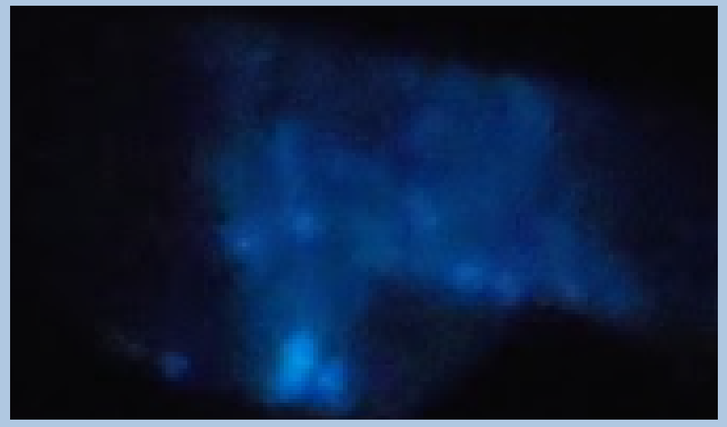
2nd Shake – Vial 3
(7.0 mg/mL)



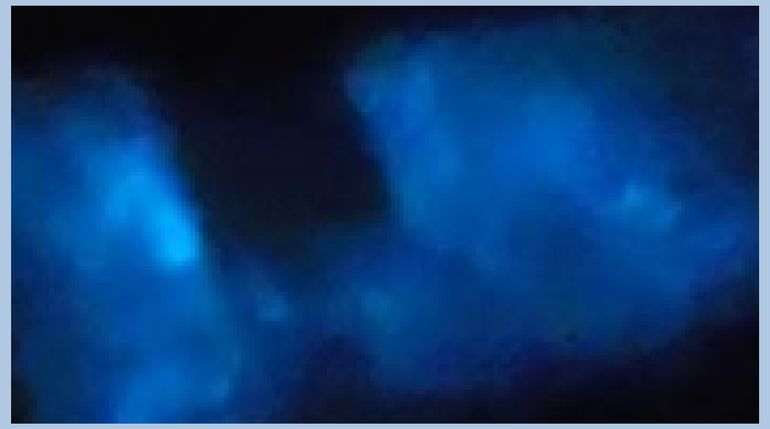
1st Shake – Vial 4
(No oxygen change)



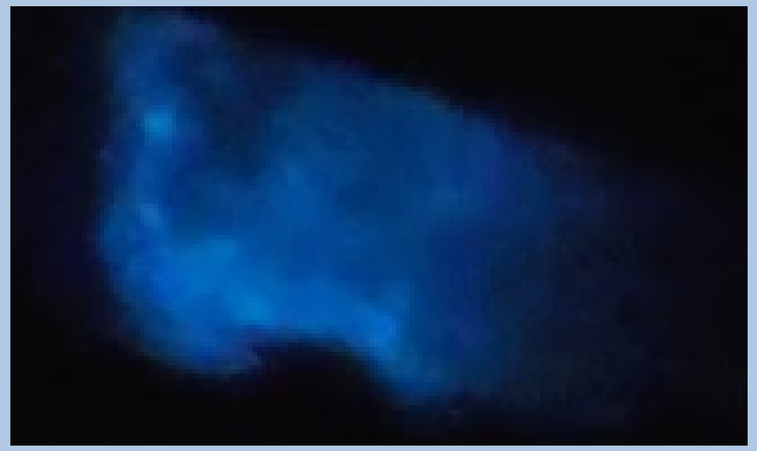
1st Shake – Vial 5
(No oxygen change)



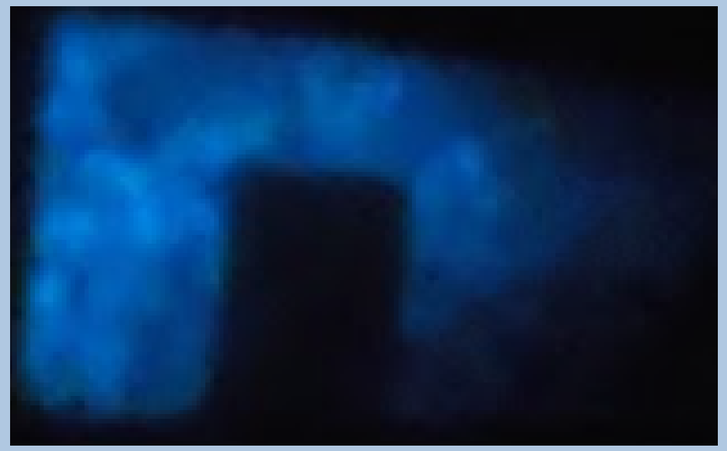
1st Shake – Vial 6
(No oxygen change)



2nd Shake – Vial 4
(No oxygen change)



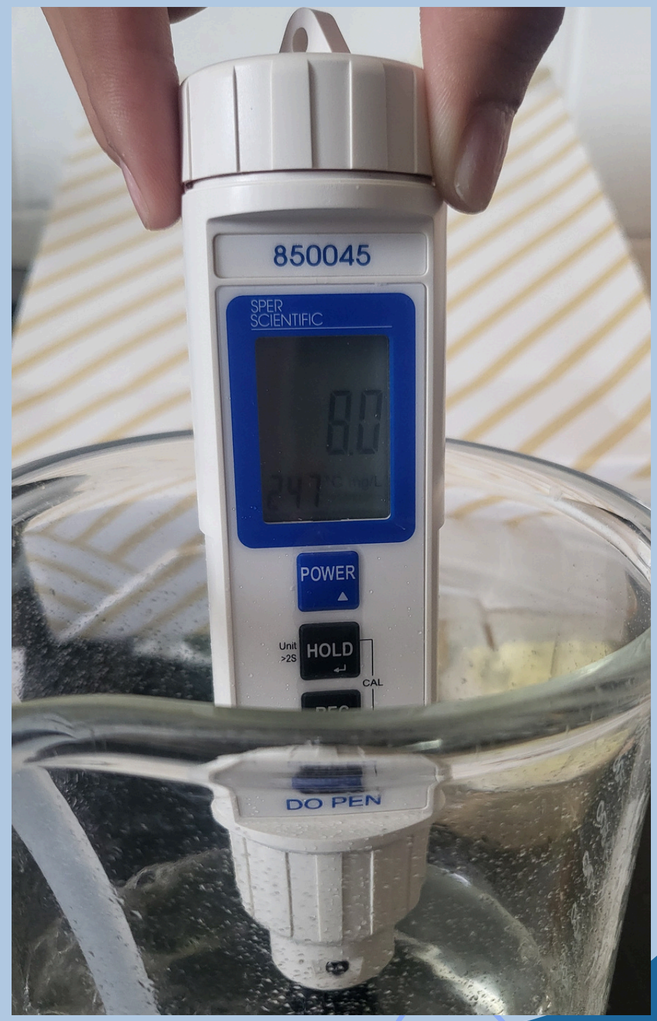
2nd Shake – Vial 5
(No oxygen change)



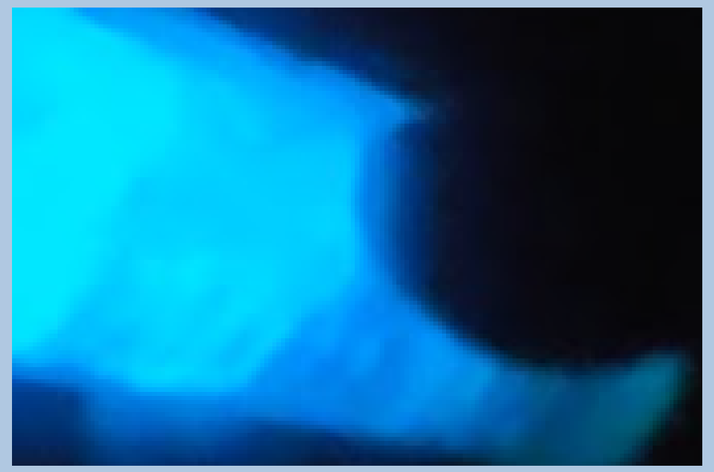
2nd Shake – Vial 6
(No oxygen change)

Variable 2

- Temperature: 70°F ±°5 (21.1°C ± 15°C)
- Dissolved Oxygen: 8.0 mg/L
- Experiment Volume: 300 mL
- Test Volume: 50 mL



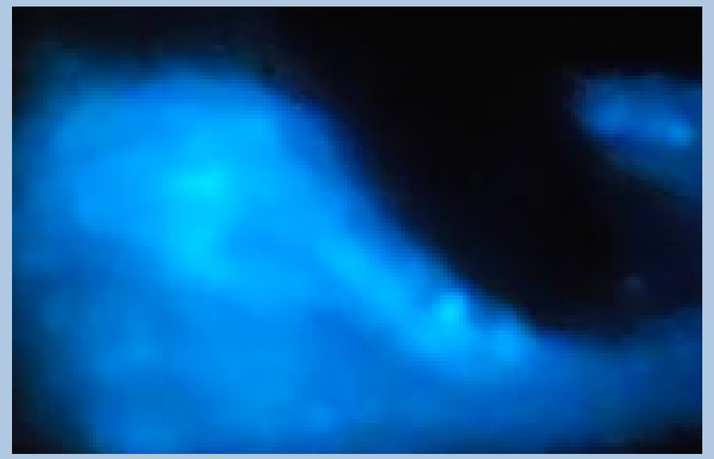
1st Shake – Vial 1
(8.0 mg/mL)



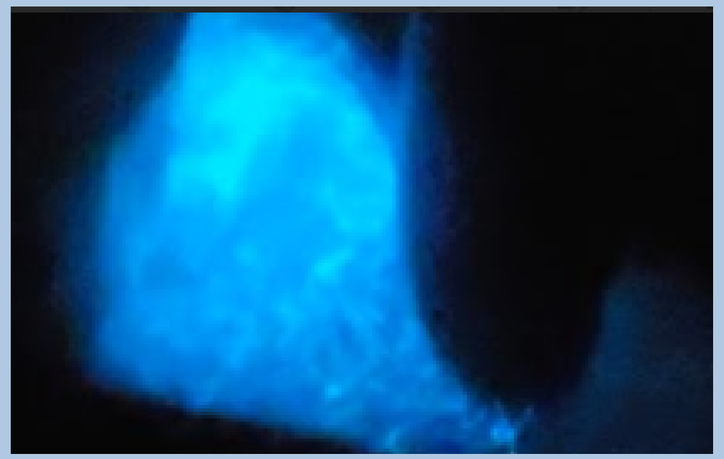
1st Shake – Vial 2
(8.0 mg/mL)

1st Shake – Vial 3
(8.0 mg/mL)

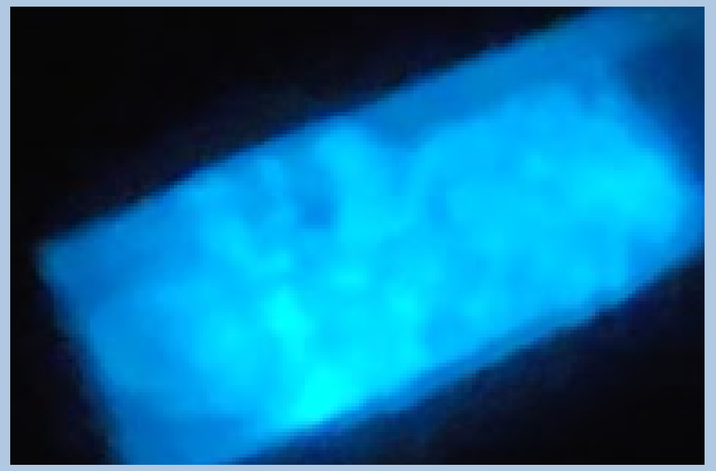
2nd Shake – Vial 1
(8.0 mg/mL)



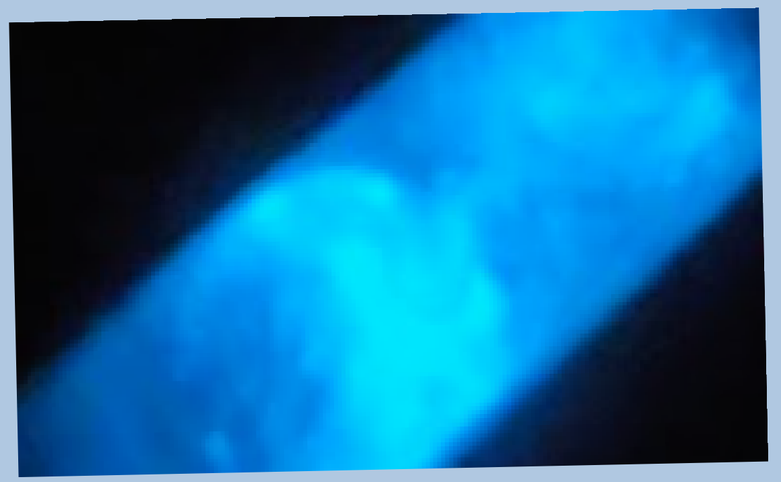
2nd Shake – Vial 2
(8.0 mg/mL)



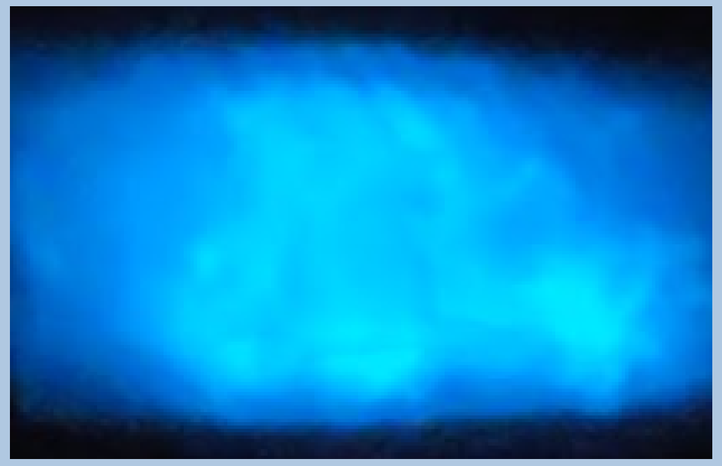
2nd Shake – Vial 3
(8.0 mg/mL)



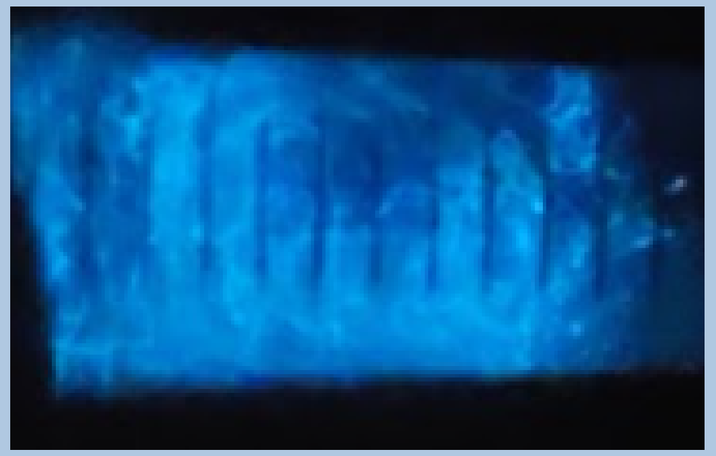
1st Shake – Vial 4
(No oxygen change)



1st Shake – Vial 5
(No oxygen change)

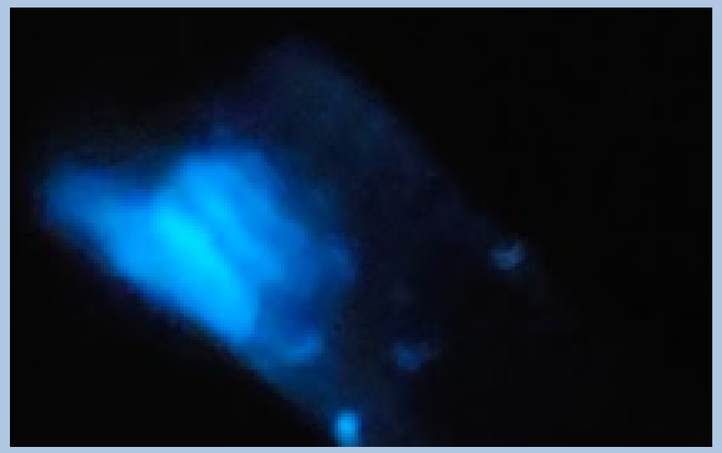


1st Shake – Vial 6
(No oxygen change)



2nd Shake – Vial 4
(No oxygen change)

2nd Shake – Vial 5
(No oxygen change)



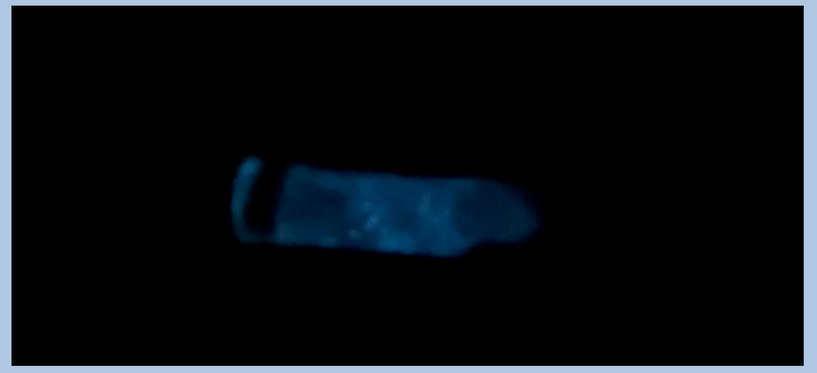
2nd Shake – Vial 6
(No oxygen change)

Variable 3

- Temperature: 33.6°C (92.48°F)
- Dissolved Oxygen: 5.0 mg/L
- Experiment Volume: 300 mL
- Test Volume: 50 mL

1st Shake – Vial 1
(5.0 mg/mL)

1st Shake – Vial 2
(5.0 mg/mL)



1st Shake – Vial 3
(5.0 mg/mL)

2nd Shake – Vial 1
(5.0 mg/mL)

2nd Shake – Vial 2
(5.0 mg/mL)

2nd Shake – Vial 3
(5.0 mg/mL)

1st Shake – Vial 4
(No oxygen change)

1st Shake – Vial 5
(No oxygen change)

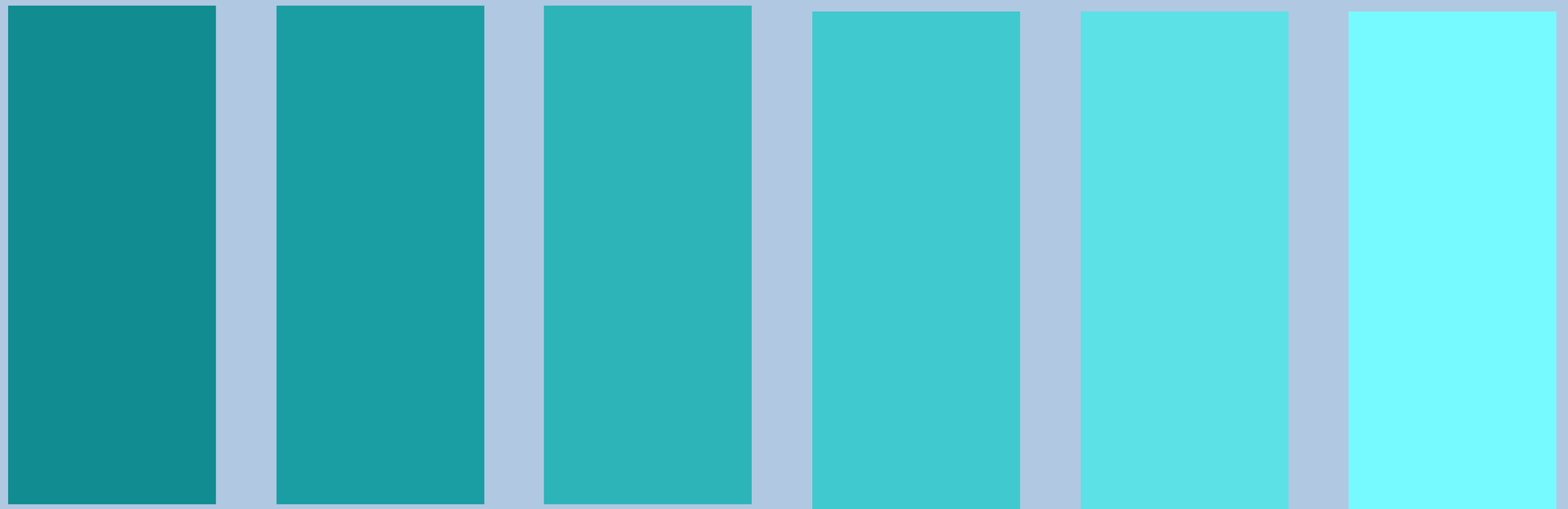
1st Shake – Vial 6
(No oxygen change)

2nd Shake – Vial 4
(No oxygen change)

2nd Shake – Vial 5
(No oxygen change)

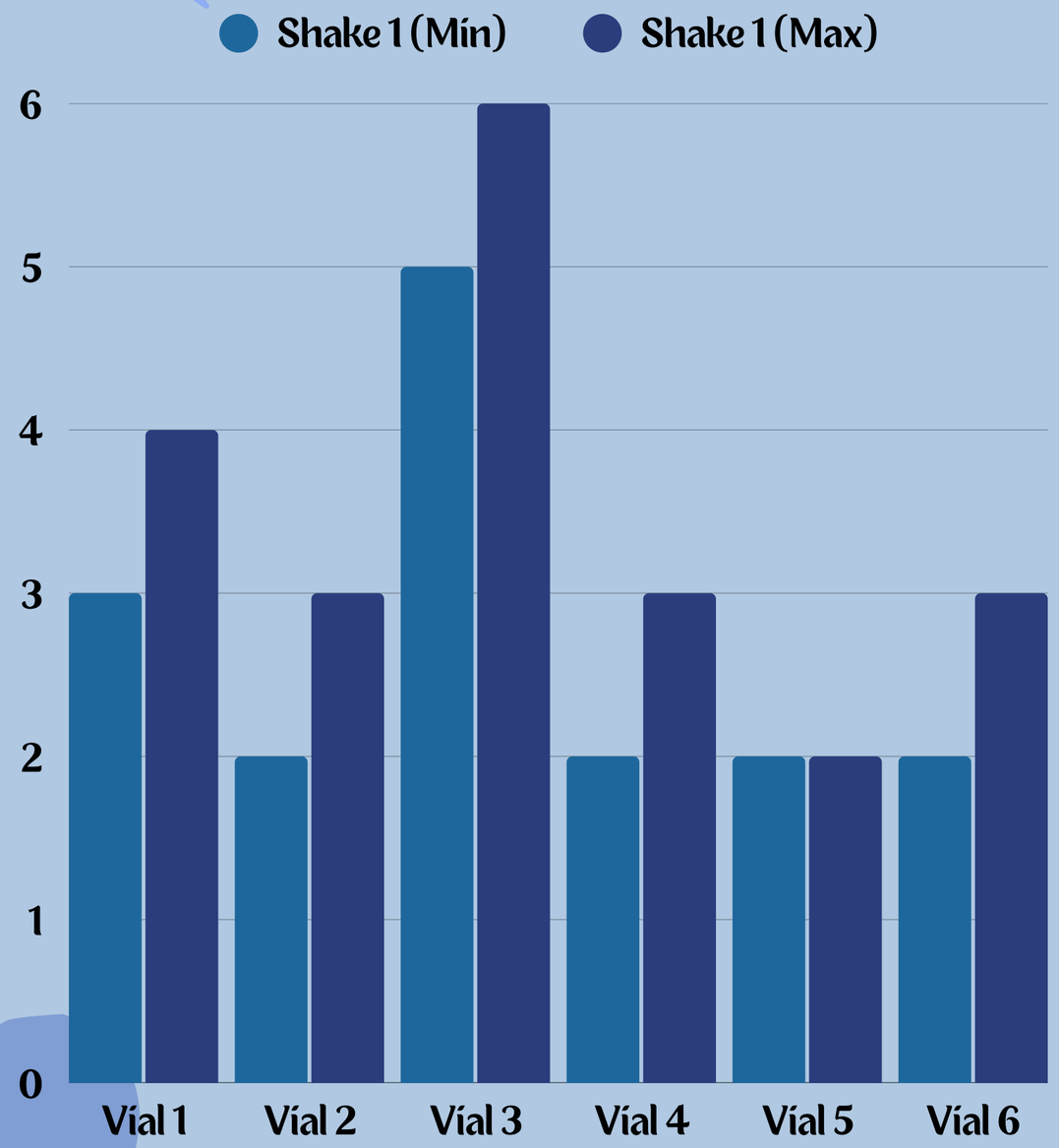
2nd Shake – Vial 6
(No oxygen change)

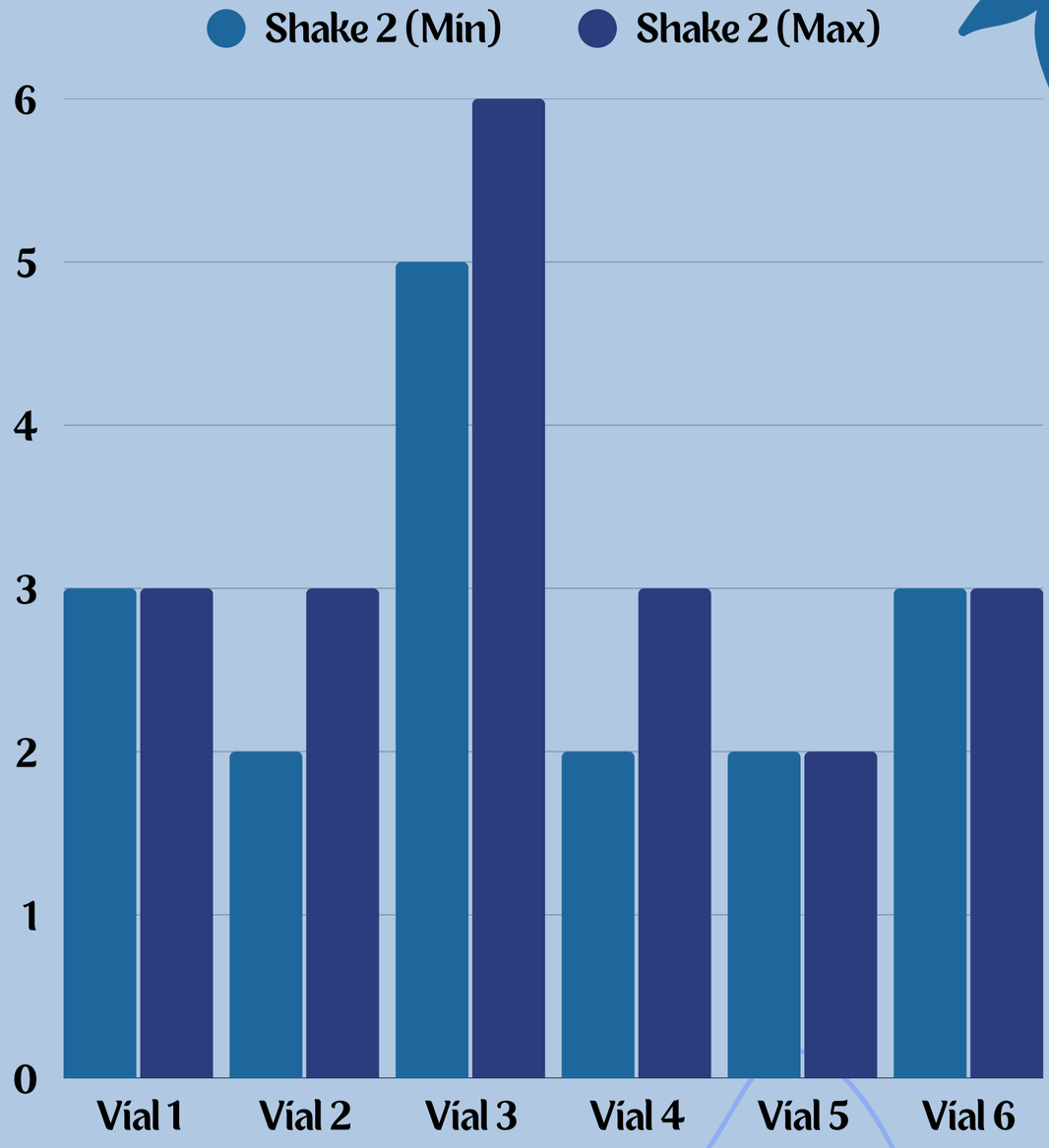
Light Scale



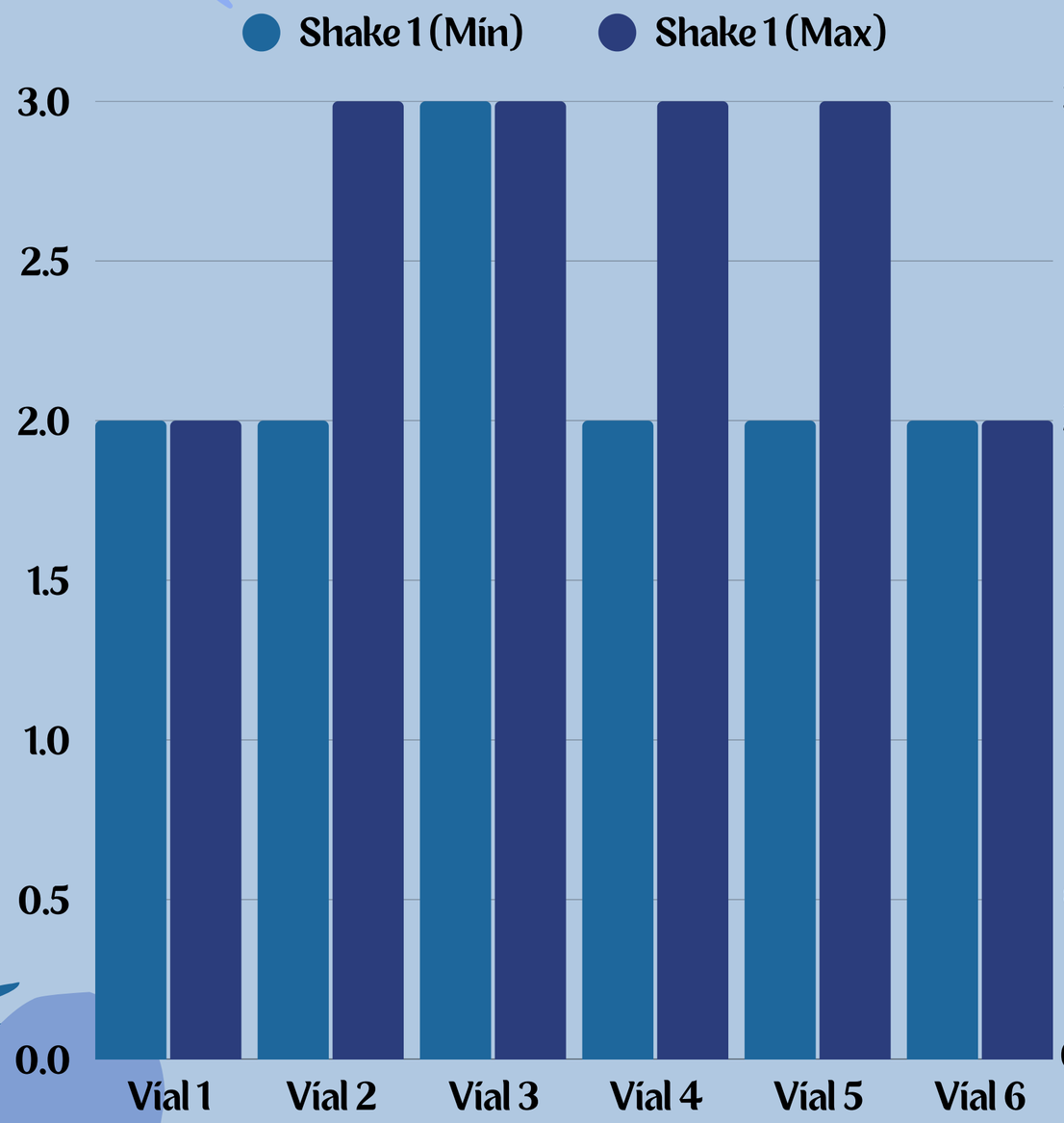
1 2 3 4 5 6

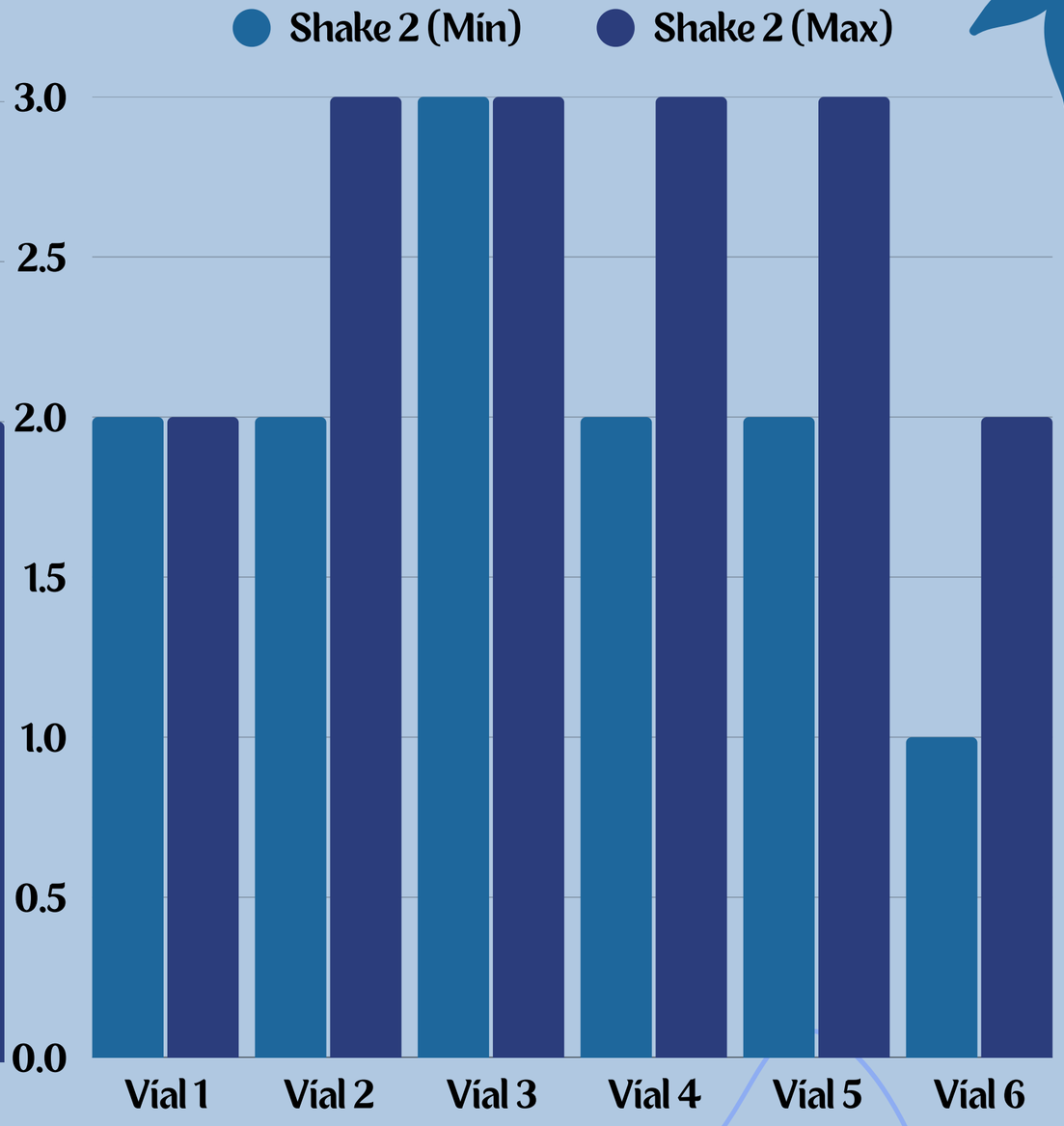
Data Analysis - CG



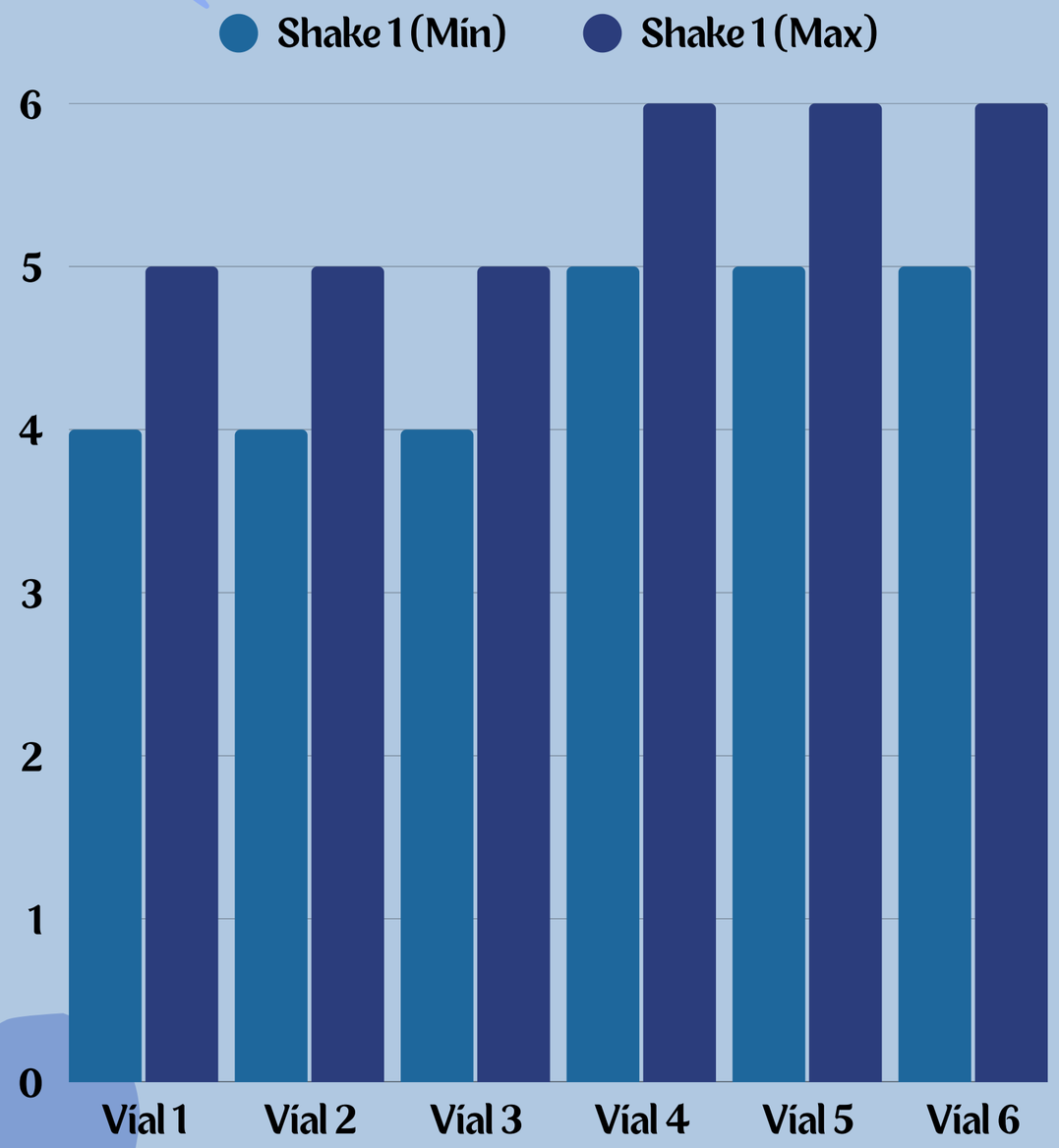


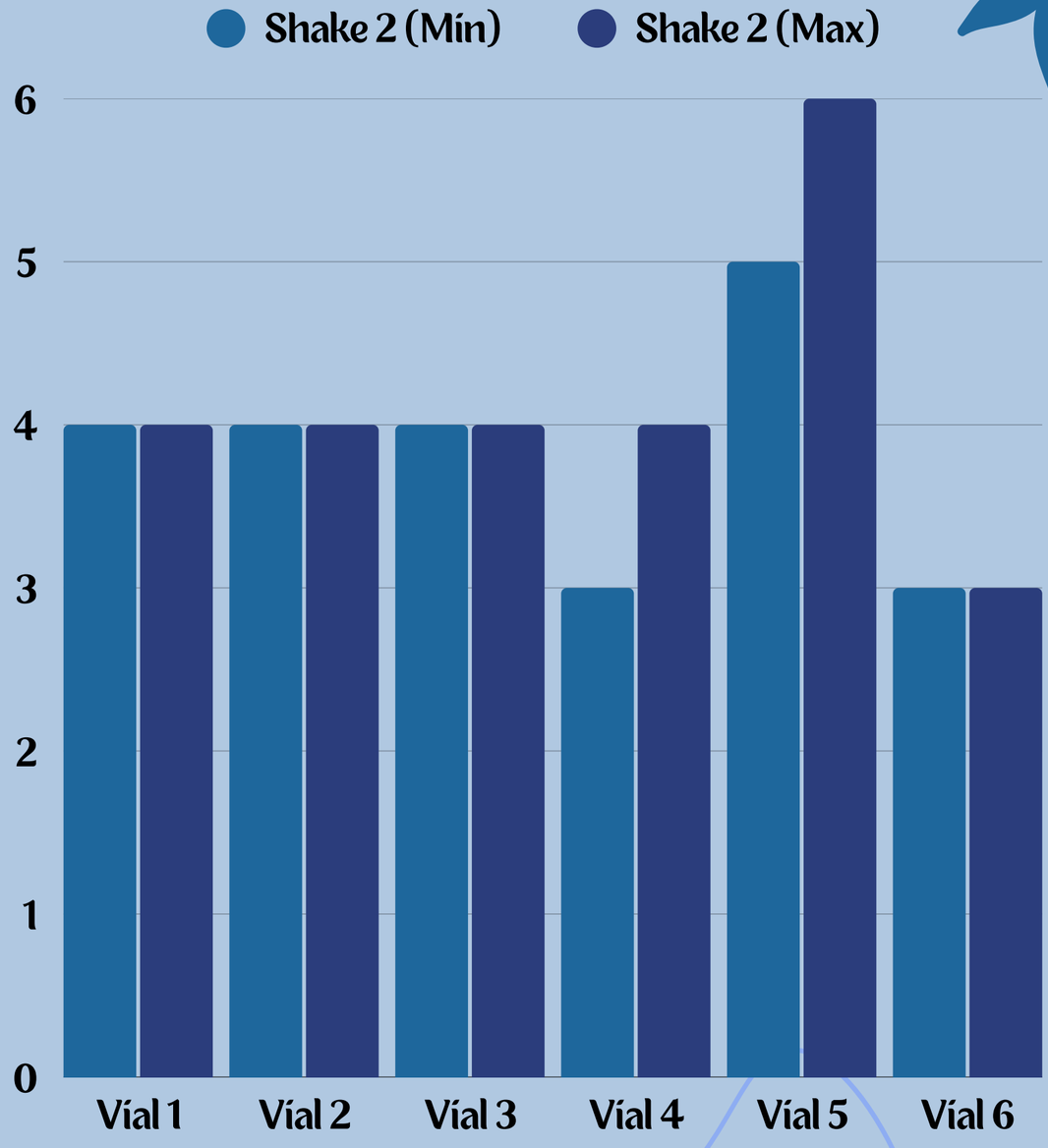
Data Analysis - V1



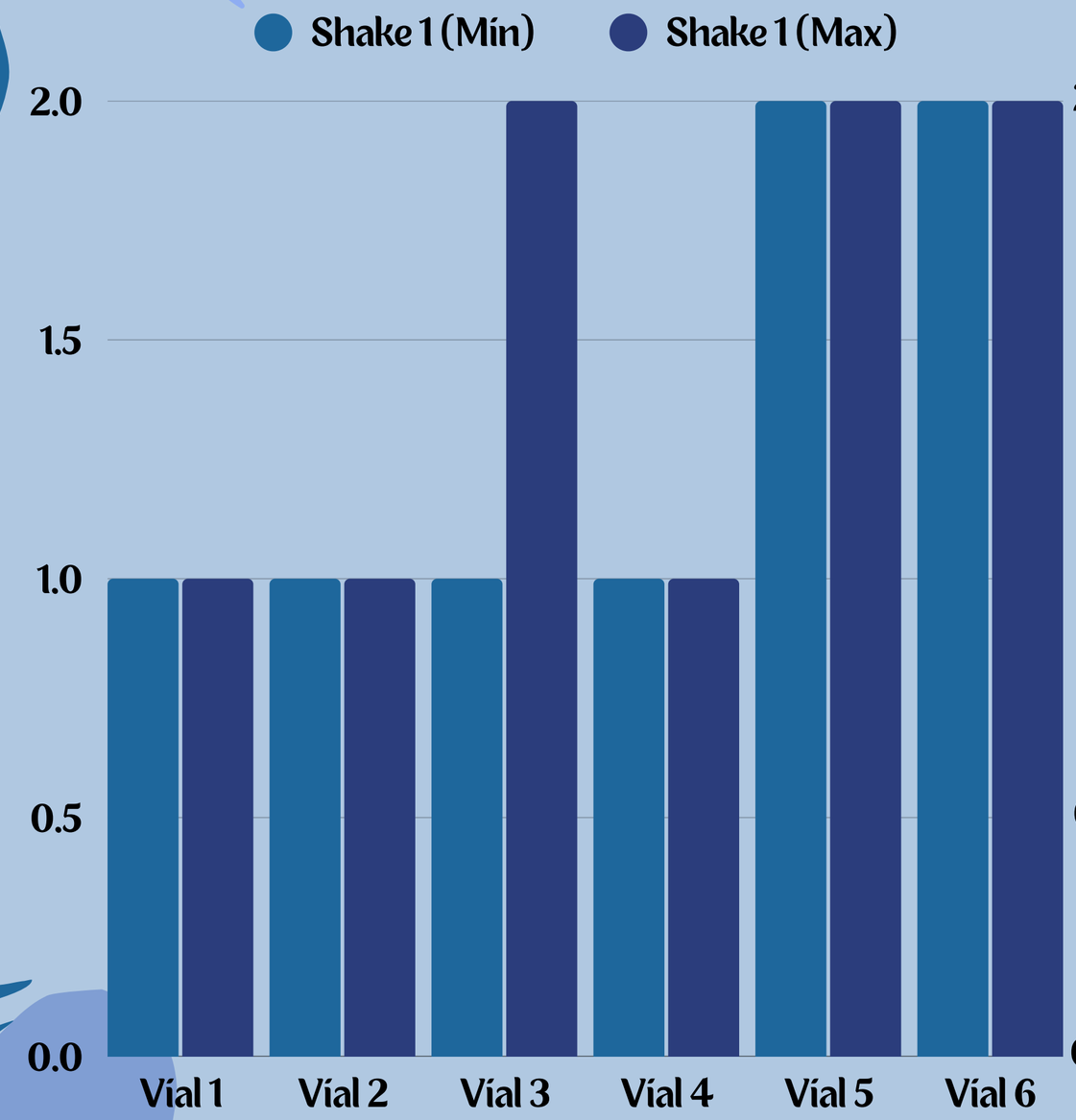


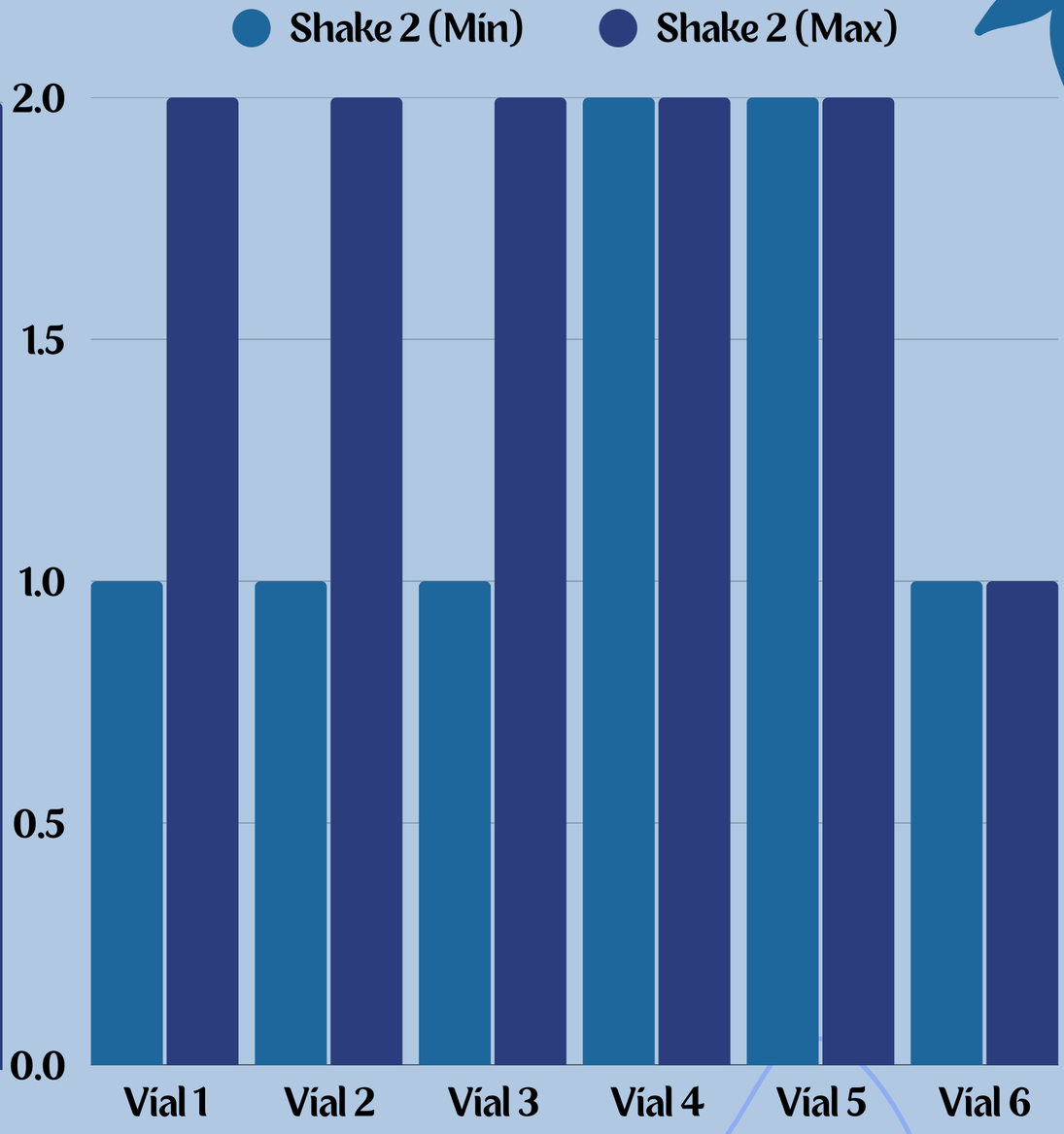
Data Analysis - V2





Data Analysis - V3





Challenges Faced

Cultivation issues

Algae Measurement

Light Measurement

Conclusion

In Conclusion, we found that our original hypothesis was partially correct. While there is no correlation between DO levels and the amount of glow, we did find a correlation between DO levels and the consistency of glow after multiple shakes.

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Thank You!

Any Questions?