Rochester Academy of Science

BULLETIN

"An organization of people in the Natural Sciences"

February 2022; Vol. 76, #2

President's Message

Best Wishes for the New Year!

As the calendar turned to another year, I send you my best wishes for clear skies, lots of birds, hikes in the woods, pleasurable time in the field, fascinating talks and interesting new knowledge, neat additions to your collections, good times with shared-interest friends, appreciation for our natural world, and all that makes life worth the while. I look forward to another interesting and busy year for all Academy members.

* * *

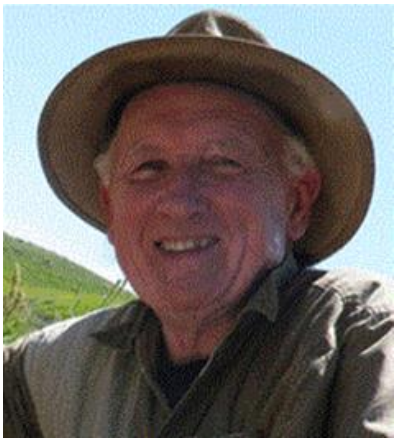
Our Undergraduate Student Research Grant Review Committee recently selected five students to receive research grants from the Rochester Academy of Science based on the quality of research and presentation. This important RAS program encourages the scientists of the future currently in school, especially after all they have been through this year.

Committee members reviewed and graded these, consulted with each other, and presented a consensus on the awards. Thank you to chairman William Hallahan and members Helen Haller, Tim Tatakis, and Michael Richmond for their diligence in completing this.

Each September, Dr. Hallahan sends our Request for Proposals to the sciences faculty at the colleges and universities throughout Upstate NY. The money awarded principally comes from three endowments: the Katherine H. Jensen Memorial Research Grant Fund, the Thomas F. & Annie A. and Grace Murray Memorial Research Grant Funds, and the Student Grants Endowment Fund. I am thrilled to report that thanks to the generosity of a few members, we were able to not only make a deserved fifth award to a student but were also able to increase the size of the awards.

Best wishes for an active and happy 2022!

Michael Grenier, RAS President



Announcement of the 2020-2021 Undergraduate Student Research Grant Awards

This year, we had five proposals, requesting a total of $2477. Our mission was to award only significant grants rather than small, partial awards. The maximum amount of the grant is $500. The RAS Grants Committee awarded a total of $2390 for five research projects.

First place: full funding plus $50 to the student.

Ryan Preble, Cornell University. *Genetics of Anti-cancer Neurotoxic Compounds in the Common Pawpaw (Asimina triloba)*. Award: $500. Sponsor: Susan Strickler, Ph.D.

Austin Glazier, Keuka College. *Presence and identification of* Wolbachia *spp. in freshwater crayfish from the Keuka Lake watershed*. Award: (full funding) $500. Sponsor: Luciana Cursino Parent, Ph.D.

Brock Johnston, SUNY Brockport. *Co-Culturing of 3T3-L1 adipocytes and J774A.1 macrophages*. Award: (full funding) $500. Sponsor: Laurie B. Cook, Ph.D.

Raunak Al-Rubayie, St. John Fisher College. *Remote Sensing Freshwater Bacteria in Great Lakes*. Award: $400. Sponsor: Fernando Ontiveros, Ph.D.

Campbell Vogt, SUNY Buffalo. *Establishing the evolution of Sir3 silencing function in duplicated yeast through ancestral gene reconstruction*. Award: $440.00. Sponsor: Laura Rusche, Ph.D.

All of the money for the grants this year was from gifts to the Undergraduate Student Research Grants Fund.

Events for February 2022

For updates to events, check the Academy website http://www.rasny.org and section websites.

1 Tue: Fossil Section Meeting
7:30 p.m. Meeting will be held remotely via ZOOM and is open to all RAS Members and guests. Forests first appear in the fossil record during the Devonian period and two of the earliest are in New York State. Our distinguished guest is Dr. Christopher Berry of Cardiff University in Wales, speaking on *The Devonian Fossil Forests of Gilboa and Cairo in New York and Others*. For meeting details and login info Contact Michael Grenier at paleo@frontier.com.

2 Wed: Astronomy Board Meeting
7:00 p.m. UR Bausch & Lomb Hall, room 480. ASRAS members welcome. Contact: Mark Minarich at mminaric@rochester.rr.com.

4 Fri: Astronomy Members Meeting
7:30 p.m. – 10:00 p.m. RIT Carlson Center for Imaging Science, CAR- 1125. Parking Lot F. Meeting will be held in person at RIT as well as virtually via Zoom. Speaker: Miki Nakajima, Ph.D., Planetary Scientist and Assistant Professor of the department of Earth and Environmental Sciences, and also the department of Physics and Astronomy at the University of Rochester. Topic: the formation and evolution of terrestrial planets. Contact: Mark Minarich at mminaric@rochester.rr.com.

5 Sat: Astronomy Member Observing
Member Observing: Starting from dusk till last person leaves. Farash Center for Observational Astronomy, 8355 County Road 14 Ionia, NY 14475. For weather related cancellations or changes contact Mark Minarich at mminaric@rochester.rr.com.

6 Sun: Astronomy Open House
Open House: 12:00 p.m. - 3:00 p.m. Observatory tours and work parties. Sledding if snow. Farash Center for Observational Astronomy, 8355 County Road. For cancellations contact Roger McDonough, site manager, at rdmcdogz@aol.com.

9 Wed: Life Science - Herbarium Workshop
1 p.m. – 4 p.m. The Life Sciences section will hold a workshop at the RAS Herbarium, located in the basement of the Rochester Museum and Science Center (RMSC). At RMSC go to the front desk to meet other participants. You must be fully vaccinated, and masks are required for all visitors at RMSC. If you plan to attend, please send RSVP or any inquiries to Elizabeth Pixley, herbarium curator, at eypixley@gmail.com, or call (585) 334-0977.

16 Wed: RAS Board Meeting
7:00 p.m. Virtual meeting using Zoom. For details, contact Michael Grenier at mgrenier@frontiernet.net.

18 Fri: Astronomy Section Winter Lecture
Dan Watson, Ph.D., University of Rochester professor of physics and astronomy, on converting the Mees Telescope to remote operation. For Zoom link contact Mark Minarich at mminaric@rochester.rr.com.

19 Sat: Anthropology
1 p.m. RMSC Cumming Nature center, 6472 Gulick Road, Naples. Alex Smith, Ph.D., will speak on his archeological research project investigating South Bristol's "ghost town" of Frost Town**,** that was one of the region's earliest industrial logging communities. Dr. Smith will give a public update on what researchers have found so far and what plans they have for 2022. Free and open to the public.
Contact: alsmith@brockport.edu.

22 Tue: Mineral Virtual Meeting
7:00 p.m. Zoom meeting. Meetings this academic year are held on the 4th Tuesday of the month. At this meeting we will learn about pseudomorphs, i.e., minerals that have the external crystal shape of another mineral. Have you ever wondered how this happens? Howard Heitner will enlighten us with his presentation, "Pseudomorphs, Trickster Mineral Specimens." A link for the meeting will be emailed to members. Guests welcome. Contact: J. Dudley at juttasd@aol.com. □

Venus Conjunction. Jan 8 at noon. Venus was 5 degrees above the Sun. Sun was hidden behind roof, and sky was very clear blue. Venus was about 1.2 minutes across, larger than any other planet gets, even Jupiter. (Credit: Douglas Kostyk)

M17 (aka the Swan Nebula, aka the Omega Nebula). This image is another in the multi-year data project. Data for this image was collected over 4 nights in 2020 and 4 nights in 2021 and consists of over 600 sub-exposures with a total exposure time of 31 hours. (Credit: Eric Day)

⇦

Featured Article

Judy Massare, Ph.D., RAS Fossil Section member and Professor Emerita, SUNY Brockport.

Excavating the Rutland Ichthyosaur.

Hundreds if not thousands of ichthyosaurs, extinct marine reptiles that superficially resembled dolphins, have been collected in Britain since the early 1800s. However, a recently excavated specimen is noteworthy not only for it size, the largest ichthyosaur ever discovered in Britain, at more than 30 ft (10 m), but also for its completeness. The specimen is about 180 million years old (Lower Jurassic), from the Whitby Mudstone, a fossiliferous unit that is best exposed along the Yorkshire (northeastern) coast.

Figure 1: A typical Jurassic ichthyosaur.

It is unusual that the new specimen is not from the coast, but from the Rutland Water Nature Reserve (about halfway between Leicester and Peterborough) in Rutland County (eastern Midlands). The water level in the lagoon had been lowered for maintenance, when conservationist Joe Davis (Leicestershire and Rutland Wildlife Trust) noticed a few bones sticking out of the mud. Dr. Dean Lomax, Nigel Larkin, and Dr. Mark Evans were contacted to investigate the site. In the cold of mid-February, they partially exposed a complete vertebral column and found evidence of the skull as well. The water levels were scheduled to rise, so they reburied the specimen and planned to return in the summer. Meanwhile, they had to arrange the logistics for the massive excavation and acquire the funds for equipment and supplies.

Figure 2: The specimen as it was found in February 2021. ©Dean Lomax.

Figure 3: To protect the fossil from the rising water of the lagoon, it was reburied to wait until summer. ©Dean Lomax.

Led by Dean and Nigel, the team returned during an unusually cold August, with additional help from Dr. Emma Nichols (Horniman Museum, London) and a small group of volunteers. The water level was again low, so the excavation could proceed. The team dug down to the tarp that protected the fossil and slowly exposed the skeleton using trowels and brushes. After numerous photographs, measurements, and a 3-D scan, a trench was dug around the specimen to isolate it for removal. As is typical, field jackets of burlap and plaster, similar to the old-style medical casts for broken arms and legs, were made around sections of the skeleton to protect the fragile bones during removal and transport, and to maintain their relative positions. Because the jackets were so large, pieces of wood were incorporated into the jackets to keep them from bending.

When completed, two of the jackets weighed more than a ton each. But fortunately, Joe had access to heavy equipment to lift the jackets onto a trailer to move them offsite for preparation. Dean identified the specimen as *Temnodontosaurus trigonodon*, the first occurrence of the species in Britain. Plans are to return the prepared specimen to Rutland for display and study.

Figure 4: Early stage of exposing the specimen. ©Dean Lomax.

Figure 5: Fully exposed specimen, ready to be jacketed. ©Dean Lomax.

Figure 6: Specimen viewed from a drone, with Dean (6'4''or so) for scale. © Dean Lomax.

(Continued on p.4)

Judy Massare Ph.D.

(Continued from p. 3)

The NY Times article with a video of the specimen in the ground: https://www.nytimes.com/2022/01/10/science/earth/ichthyosaur-sea-dragon

Information on the excavation team: https://www.anglianwater.co.uk/community/rutland-sea-dragon

Figure 7: Making plaster jackets for the specimen. © Dean Lomax.

Figure 8: Making the plaster jacket for the skull. ©Dean Lomax.

Figure 9: Making plaster jackets for the specimen. ©Dean Lomax.

Figure 10: Building a pallet under the large block for lifting it out of the mudstone. ©Nigel Larkin

Figure 11: Removing the largest block ©Emma Nichols.

Read more about the details of the excavation from Nigel Larkin at: https://geocollnews.wordpress.com/2022/01/10/excavating-the-rutland-sea-dragon.

More pictures and videos are on Twitter, accessible from your computer at: https://twitter.com/search?q=%23RutlandSeaDragon&src=hash

In addition to the ichthyosaur, associated invertebrate fossils and samples of the mudstone were collected. The latter will be examined for microfossils to better constrain the geologic age of the specimen. The invertebrates will allow a more complete reconstruction of the environment in which the ichthyosaur lived. The skeleton shows signs of scavenging, which might lead to an interesting taphonomic study. Large carcasses that sink to the ocean floor today often support an entire community of organisms.

This is the fourth species of *Temnodontosaurus* from Britain. The temnodontosaurs were apex predators in the Early Jurassic Ocean, inferred because of their large size and also because of their distinctive teeth: laterally compressed cones with two distinct cutting edges. Like seals and dolphins, ichthyosaurs used their teeth to grasp and immobilize prey and to orient it to be swallowed. The temnodontosaurs could eat any swimming animal that was small enough to swallow, including other ichthyosaurs.

Temnodontosaurus is one of the more primitive Jurassic genera. So, the question arises as to whether these ichthyosaurs had the efficient swimming style typical of other Jurassic ichthyosaurs. Did they oscillate the entire tail or just the tail fin? The way the individual vertebra change shape along the vertebral column reflects column flexibility and thus is key to understanding how the animal swam. The nearly complete vertebral column of this new specimen contains this ecological information.

Funding for the excavation was provided by Anglian Water, The Pilgrim Trust, the Rutland and Leicestershire Wildlife Trust, Rutland County Council, The Geologists Association's Curry Fund and the Palaeontographical Society. □

Figure 11: The jacketed specimen along with a life-size image of the specimen made from the scans. ©Nigel Larkin.

Figure 12: Left to right: Dean Lomax, Mark Evans, Darren Withers, and Nigel Larkin with the barely exposed specimen in the foreground, as they found it in mid-February. ©Dean Lomax.

Featured Article

2021-2022 First Place Undergraduate Student Research Grant Award Winner

Ryan Preble, Cornell University.

***Genetics of Anti-cancer Neurotoxic Compounds in the Common Pawpaw (Asimina triloba)*.**

Sponsor: Dr. Susan Strickler, Boyce Thompson Institute at Cornell University.

Abstract

Asimina triloba, the common pawpaw, produces a class of specialized compounds called the annonaceous acetogenins. These compounds have potential applications in medicine as anti-tumor agents and in agriculture as pesticides. These properties warrant investigation into their production in living systems. The objective of this study is to identify genetic loci associated with acetogenin production. To simplify the collection and analysis of data, acetogenin production will be examined through the specific acetogenin, annonacin, which is predominant in the tissues of the common pawpaw. In the first part of the study, the acetogenin content of the tissues of the pawpaw will be quantified using mass spectrometry. New growth bark, leaf, and fruit tissues will be collected from pawpaw trees growing in the McDaniel's Nut Grove at Cornell University, with fruit tissues being further divided into pericarp, unripe pulp, ripe pulp, and seed tissues. The quantification of annonacin in these tissues will establish the comparability of annonacin concentration between individual plants and a standard protocol for appropriately phenotyping the annonacin production of a pawpaw tree. Running parallel to this metabolomics effort will be an effort to assemble a genome sequence for pawpaw. When this sequence is completed, it will be used as a reference genome for a genome-wide association study (GWAS) on individual plants grown from pawpaw seeds collected from the Cornell Cooperative Extension pawpaw orchard. Using the phenotyping procedure developed in the first part of the study, pawpaw seedlings will have their annonacin production measured and associated to genomic loci in an attempt to isolate sections of the pawpaw genome strongly associated with higher or lower annonacin production. Following the GWAS, any significant loci will be investigated bio-informatically to identify specific genes or gene clusters that may be important in annonacin production.

Background and Rationale

The common pawpaw tree, *Asimina triloba*, is an underutilized fruiting tree crop of the family *Annonaceae*. Members of this family are characterized by their confinement to the tropics (with the exception of genus *Asimina*) and the presence of acetogenins, a class of neuroactive polyketides. *A. triloba* is unique among the Annonaceae as producing the largest tree fruit indigenous to the United States and having remarkable cold tolerance. Most members of the *Annonaceae* are tropical, but the common pawpaw is capable of surviving -33°C temperatures and extends its range to southern Ontario [1]. The common pawpaw also holds strong potential as a commercial crop, though currently it is not used for large scale production [2].

Aside from interest into *A. triloba* for its unique cold tolerance among species in the *Annonaceae*, there is also significant interest into the pawpaw for its acetogenin production. Acetogenins are cytotoxic, and they have seen success and speculation in applications such as lice shampoo, pesticides, anticancer drugs, and anti-parasite drugs [3], [4], [5], [6]. Extract from *Annona crassiflora* has been shown to inhibit proliferation and migration of certain liver cancer cell lines [7], and *A. triloba* extract has been shown to have toxic effects on parasitic trematodes [3]. In addition to endangering around 250 million people per year, trematode infections create up to $3 billion in losses per year in worldwide livestock production [3]. *Because A. triloba* biomass is a significant source of acetogenins, maximizing acetogenin production may present an opportunity to utilize novel drugs against human and animal diseases.

Parallel to the potential applications of acetogenins are their dangers. Annonacin, an acetogenin found in several members of the *Annonaceae* including the fruit of *A. triloba*, can induce significant cortical neuron death [8]. Consumption of annonacin has also been linked to atypical parkinsonism in Guadeloupe [9], and the presence of annonacin in the fruit of A. triloba has raised some concerns over the safety of its consumption [8]. As such, pawpaw breeding efforts may wish to reduce acetogenin production in the fruit pulp in order to minimize the risks associated with annonacin and related compounds.

Annonaceous acetogenins may act as both potential sources of novel drugs to fight human and livestock diseases and potential risks to human health. In both cases, proper utilization of acetogenins in

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Ryan Preble,
Student Research Grant Winner
(Continued from p. 5)

A. triloba requires greater knowledge of the mechanisms and gene regulation of acetogenin production. The purpose of this study is to identify key genetic loci associated with high production of the acetogenins annonacin and asimicin, two acetogenins that have been previously identified in the fruit pulp of *A. triloba* [10], [11].

Methods

It remains unclear if acetogenins production differs temporally and across tissues of the same plant. Therefore, we will sample individual pawpaw trees from the MacDaniel's Nut Grove for their leaf, pericarp, fruit pulp, new growth twig, and seed tissues and measure the acetogenin concentrations. Dried and ground tissue samples will be extracted using methanol and analyzed using targeted HPLC-MS to identify the concentration of annonacin in each. From these experiments, it will be determined if relatively high or low acetogenin production in one tissue is predictive of acetogenin production in other tissues of the same plant. Additionally, we will compare the acetogenin content of unripe and ripe fruit of the same individual plant. This will yield insights into the safety of the consumption of ripe pawpaw flesh.

We will collect pawpaw seeds from several cultivars of the Kentucky State University Pawpaw Trial to gain a wide set of genetically diverse germplasm. We will stratify all collected pawpaw seeds simultaneously for 90 days to ensure proper germination. Pawpaw seedlings will be sampled for annonacin concentrations. It is possible that acetogenin production varies depending on the time of year and the developmental stage of the plant. In order to control for this potentially confounding variable, all seedlings will be sampled from the same tissue type at the same stage of development. Collected tissue will be ground, dried, and extracted using methanol. The concentrations of annonacin will be determined by HPLC-MS analysis of the resulting extract. Given sufficient phenotypic variance among the seedlings, the seedlings' genomes will be sequenced and a GWAS will be performed to identify key loci related to annonacin production.

The genome assemblies of pawpaw as well as soursop (*Annona muricata*, another tree species in the *Annonaceae*) will be examined to identify putative gene clusters that encode proteins involved in specialized metabolite production. Comparing the results of the GWAS to any putative gene clusters identified in these two plants will bolster confidence in the identification of genes involved in annonacin production.

Expected Outcomes

Based on the structure of annonacin, its lipophilicity, and existing knowledge on the biosynthesis of other specialized plant metabolites, annonacin is predicted to be synthesized by a type III polyketide synthase or chalcone synthase [12], [13].

Progress to Date

Preliminary analysis of the concentration of annonacin in the tissues of pawpaw collected from the MacDaniel's Nut Grove has shown that the highest concentrations of annonacin can be found in the pericarp of the fruit. Additionally, while more data is needed to confirm the relationship, the preliminary data indicate that annonacin concentrations in the leaves may be predictive of concentrations in the fruit. Examination of the soursop genome assembly has revealed several genes encoding type III polyketide synthases, three of which are organized into a cluster.

References

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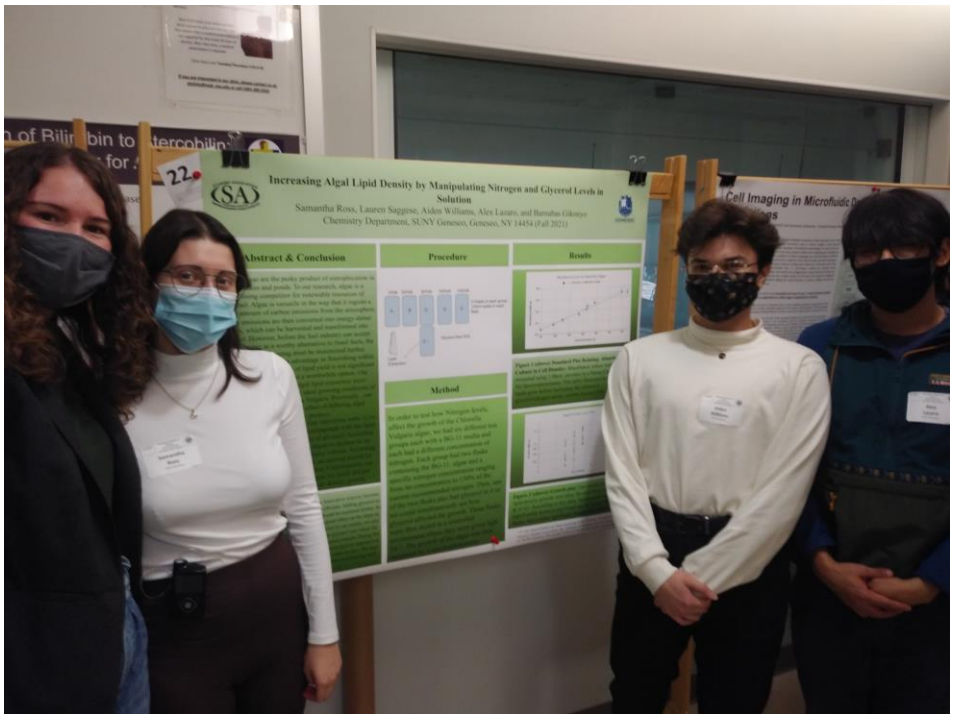
Featured 2021 RAS Paper Session Poster

Samantha Ross, Lauren Saggese, Aiden Williams, Alex Lazaro, and Barnabas Gikonyo, Ph.D., Department of Chemistry, SUNY Geneseo.

Increasing Algal Lipid Density by Manipulating Nitrogen and Glycerol Levels in Solution

(A very special thank you from our group to the Geneseo Foundation, the SUNY Geneseo Student Association, the eGarden of Geneseo, and the Chemistry Department of SUNY Geneseo. Our project would not be possible were it not for them.)



Authors Samantha Ross, Lauren Saggese, Aiden Williams, Alex Lazaro, and Barnabas Gikonyo, Ph.D., in front of their poster at the 47th Annual RAS Fall Paper Session held November 6th at Nazareth College.

Abstract and Conclusion

To many, algae are the pesky product of eutrophication in local lakes and ponds. To our research, algae is a promising competitor for renewable resources of biodiesel. Algae is versatile in the way that it ingests a notable amount of carbon emissions from the atmosphere.

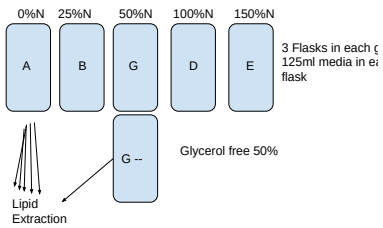
These emissions are then converted into energy-dense lipids, which can be harvested and transformed into biofuel. However, before the fuel industry can accept algae farming as a worthy alternative to fossil fuels, the process of harvesting must be maximized further. Although algae have its advantage in flourishing within small spaces, the amount of lipid yield is not significant enough to be considered a worthwhile option. Our purpose aims to make algal lipid extraction more efficient by determining the ideal growing conditions of the algae species Chlorella Vulgaris. Previously, our plan was to observe the effect of differing algal solutions to produce the amount of yield desired. Our objectives were: a) to test how nitrogen starvation corresponds with the lipid yield, and b) to test the effects of glycerol. According to our data, density growth began to decline as we increased or decreased the solution volume. According to our data, there seems to be an optimal period for growth near the 70-80% bracket. Unfortunately, our data further imply that nitrogen, by itself, did not have a significant role in lipid density growth.

The purpose of our research is to find new, innovative ways to increase algae lipid yield so extraction can be more efficient. Adding glycerol to our solution has proved to be an area that should be explored further. So rather than the nitrogen starvation having a great effect on the algae as we had anticipated, which was discussed earlier in our results, we also gathered that the media we used that held the glycerol was where the impact came from, although it was within a certain margin. During this semester, glycerol will be tested further in a more holistic approach to determine if it is worthwhile to use in various other medias. The next goal is to test if glycerol proves to be consistent in enhancing lipid yield.

Method

In order to test how Nitrogen levels, affect the growth of the Chlorella Vulgaris algae, we had six different test groups each with a BG-11 media and each had a different concentration of nitrogen. Each group had two flasks containing the BG-11, algae and a specific nitrogen concentration ranging from no concentration to 150% of the current recommended nitrogen. Then, one of the two flasks also had glycerol in it so we could simultaneously see how glycerol affected the growth. These flasks were then stored in a controlled environment where they were given light 24/7. The growth of the algae was then measured by a spectrophotometer.

Procedure



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Paper Session Poster
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Results

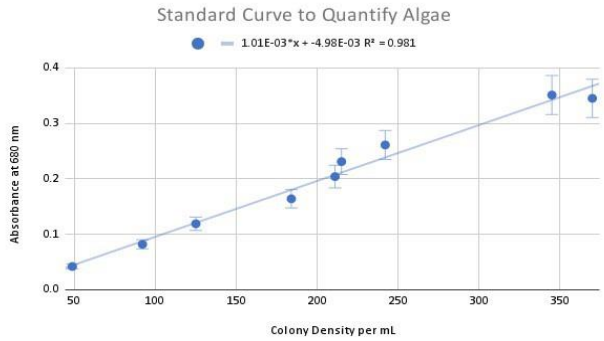

Figure 1 (above) Standard Plot Relating Absorbance of Culture to Cell Density: Absorbance values were measured using 1.00cm cuvettes in a Varian Cary 50 UV-Vis Spectrophotometer. This table illustrates how well our lipids grew before increasing the solution's glycerol/nitrogen media content beyond 80%.

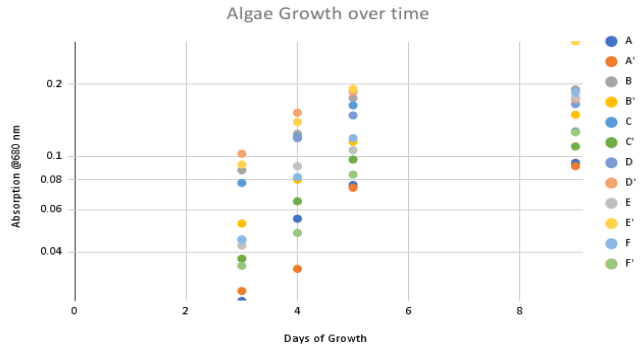

Figure 2 (above) Growth plot: Our second graph plots the lipid density growth over time, for each flask ranging from A-G & A'-G'. According to this data, lipid growth increased significantly between day 4 and day 9. It also illustrates which flasks had a more significant change and which flasks did not. □

ABOUT THE ACADEMY

The Rochester Academy of Science, Inc. is an organization that has been promoting interest in the natural sciences since 1881, with special focus on the western New York state region. Membership is open to anyone with an interest in science. Dues are minimal for the Academy and are listed in the membership application online. Each Section also sets dues to cover Section-related publications and mailings. We are recognized as a 501(c) 3 organization.

For information, contact President Michael Grenier at (585) 671-8738 or by email paleo@frontier.com.
The Academy Internet website is http://www.rasny.org or see us on Facebook at https://www.facebook.com/Rochester-Academy-of-Science-792700687474549.

This "**BULLETIN**" is produced monthly, except July and September, by the Astronomy Section, Rochester Academy of Science. Submissions are due by the 10th of the month and may be emailed to editor@rasny.org.

The Academy postal address is P.O. Box 92642, Rochester NY 14692-0642.

ROCHESTER RESEARCH IN REVIEW

January 19, 2022, Cornell University, Antibodies in blood soon after COVID-19 onset may predict severity, study finds

January 18, 2022, University of Rochester, Weight loss before fertility treatment may not increase births for obese women

January 18, 2022, McMaster University, Changes in sleep and biological rhythms from late pregnancy to postpartum linked to depression and anxiety

January 14, 2022, Cornell University, Nuclei-free cells prove utility in delivering therapeutics to diseased tissues

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