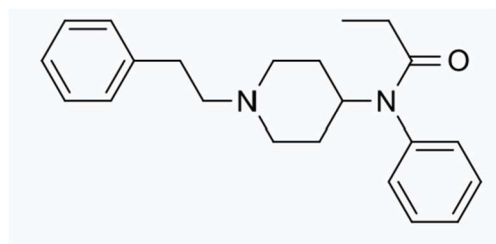


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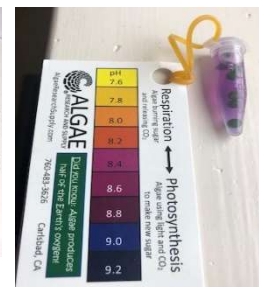
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MAGAZINE OF THE CALIFORNIA SECTION, AMERICAN CHEMICAL SOCIETY

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Top Left: Chemical Structure of Fentanyl - <https://en.wikipedia.org/wiki/Fentanyl>

Middle: Apothecary Globe – Donald MacLean

Bottom Right: As carbon dioxide is consumed to make sugar, the pH shift upward – Alex Madonik

If you have material you think is worthy, submit it to Donald.maclean.acs@gmail.com



The next issue of *The Vortex* is the September issue.

Chair Message - Atefeh Taheri



Greetings and warm wishes to all of you in the month of June! As we embrace this vibrant season, it is my pleasure to share with you some important updates and upcoming events that exemplify our commitment to advancing chemistry and fostering inclusivity within our community.

June holds significant cultural and historical milestones that resonate deeply with Cal ACS's core values. First and foremost, we commemorate Juneteenth, a celebration of emancipation and the end of slavery in the United States. This day reminds us of the importance of equality, justice, and the ongoing journey towards a more inclusive society.

In conjunction with Juneteenth, June is also recognized as PRIDE Month, a time to honor and support the LGBTQ+ community, celebrate their achievements, and advocate for equality and acceptance. At Cal ACS, we stand firmly alongside our LGBTQ+ members and embrace the principles of diversity and inclusivity that enrich our scientific community.

Furthermore, let us remember Father's Day, a special occasion to express our gratitude and & Juneteenth Celebration Picnic on June 17th.

affection for the fathers, father figures, and mentors who have guided and inspired us throughout our lives.

I am thrilled to announce that Cal ACS will host a Pride & Juneteenth Celebration Picnic on June 17th. This event will allow us to come together as a community, enjoy the festivities, and deepen our connections. We invite each and every one of you to join us for this momentous occasion, where we can embrace the spirit of unity, celebrate diversity, and strengthen our bonds.

As we embrace PRIDE Month, I am excited to share that I will attend the SF PRIDE Parade on Sunday, June 25th, 2023. I hope to see many of you there to support the LGBTQ+ community. Let us unite as allies, celebrating diversity and advocating for equal rights.

Our mission at Cal ACS is rooted in the pursuit of advancing the chemical sciences and improving the lives of those within our reach. We strive to promote scientific literacy, champion diversity and inclusion, and inspire the next generation of chemists through our various initiatives, outreach programs, and advocacy efforts. As we embark on this exciting month filled with meaningful observances, let us renew our commitment to Cal ACS's mission. Together, we can create a positive impact within our scientific community and beyond, fostering a society where knowledge is shared, discoveries are made, and everyone feels valued and included.

Wishing you all a joyful and fulfilling June filled with pride, reflection, and appreciation. I look forward to seeing you at our Pride & Juneteenth Celebration Picnic on June 17th.

Upcoming Events

By Donald MacLean

1. Cal ACS Picnic, Castle Rock Regional Recreation Area, Walnut Creek, Sat June 17.
2. Hands-on science at four Contra Costa County Library events:

	Date	Time	Location
Brentwood Library	Weds., June 14	11:00-1:00	104 Oak Street, Brentwood CA
Bay Point Library	Thurs., June 15	2:30-4:30	205 Pacifica Avenue, Bay Point CA
Pinole Library	Thurs., June 29	11:00-1:00	2935 Pinole Valley Road, Pinole CA
Danville Library	Tues., July 11	1:00-3:00	400 Front Street, Danville CA

3. CalACS Day at the Oakland Coliseum A's vs Giants, Sat., August 5th, 2023 @ 4:00 pm – Fanny Frausto and Vanessa Marx are the leads. We have 80 spots.
4. Kids Zone Event at Children's Creative Museum at Yerba Buena Gardens (San Francisco), August 12th. – Atefeh Taheri is the lead
5. ACS Fall National Meeting, San Francisco and hybrid, August 13-17. Note the section is a sponsor of the fentanyl symposium.
6. Solano Stroll - Albany / Berkeley, Sun. Sept. 10th.
7. Awards Luncheon, Skates (Berkeley) - date to be determined.



Cal ACS Picnic

Saturday, June 17, 11 am - 2 pm PT

Castle Rock Regional Recreation Area, [Stagecoach picnic spot](#)
1700 Castle Rock Road, Walnut Creek, CA 94598

Activities and Highlights:

- Trivia about Cal ACS, Juneteenth, and PRIDE
- Exciting prizes for trivia winners
- Some other fun games
- Delicious food and refreshments
- Networking opportunities with fellow participants
- Scenic location surrounded by nature

This is a free event, but registration is required for all participants.

RSVP Here!

Feel free to dress in PRIDE theme attire:

Feel free to express yourself and show your support for PRIDE! Dress in attire that represents PRIDE to you.

More information at: calacs.org or email taheri@ucdavis.edu

SYMPOSIUM ON FENTANYL AND ITS DEVASTATING
EFFECTS ON STUDENTS AND YOUNG ADULTS:
DANGERS, STATISTICS AND CURRENT STATUS



Dr. Donna Nelson,
University of Oklahoma, ACS President, 2016
invites you to learn about this problem in the United States.

Cosponsors: CALSEC, CARB, CATL, CCS, CELL, COMSCI, ENVR, MEDI, PROF, SCC, TOXI,
WCC, YCC, Families Against Fentanyl

Financial cosponsors: CATL, COMSCI, Families Against Fentanyl, SCC, WCC

Television, Congress, and Science: Communities unite against illicit fentanyl (Aug. 15 A.M.)

8:00 Introductory remarks: Donna Nelson

- 8:05 Breaking Badder: The man behind fentanyl.
John Madinger, University of Hawaii at Manoa, Honolulu, HI
- 8:35 Sizzle reel: Its purpose, characteristics, and appearance.
Donna Nelson, University of Oklahoma
- 9:05 SHIFT: A UT Austin initiative to shift the conversation about substance misuse on
campus in the fentanyl era.
Brent Iverson, UT-Austin, TX

9:35 Intermission

- 9:45 Fentanyl hysteria: be a voice of reason.
Alli Timmons, Oklahoma State Bureau of Investigation
Forensic Science Services, OK
- 10:15 Using definitive drug testing data to track fentanyl and other drug use trends.
Steven Passik, Millennium Health, San Diego, California
- 10:45 Comments on Illicit Fentanyl from Congressman Neal Dunn of Florida.
Neal Dunn, U.S. Congress, DC
- 11:05 Panel Discussion

Engineering, Science, Medicine, and Society: The challenge spans all disciplines (Aug. 15 PM)

- 2:00 Introductory remarks: Jim Rauh
- 2:05 Fentanyl: A perfect storm in science

- Donna Nelson, University of Oklahoma
- 2:35 Case for classifying illicit fentanyl as a weapon of mass destruction.
Jim Rauh, Families Against Fentanyl, OH
- 3:05 Intermission; ready remote presentations**
- 3:15 Development and validation of a novel point-of-care technology for rapid non-targeted identification of emerging threats in North American drug markets.
Drew Hall, UC San Diego, CA
- 3:45 Case for declaring fentanyl as a weapon of mass destruction.
David Digregorio, MA Department of Fire Services, Hopkinton, MA
- 4:15 Fentanyl: The state of San Diego, CA.
Robert Harkins, Homeland Security, San Diego State University, CA
- 4:45 Panel Discussion
- 4:55 Concluding Remarks

Controlling fentanyl with science: Vaccines, CBD, and advanced detection techniques (Aug. 16 AM)

- 8:00 Introductory remarks: Donna Nelson
- 8:05 Novel fentanyl vaccine design and an unexpected protective role of IgA.
Elizabeth Norton, Tulane University, LA
- 8:35 Development of vaccines and monoclonal antibodies to counteract overdose from fentanyl and its analog.
Marco Pravetoni, University of Washington, WA
- 9:05 Structure-activity relationship study of cannabidiol-based analogs as negative allosteric modulators of the μ -opioid receptor.
Jessica A. Gudorf, Eli Lilly and Company, IN
- 9:35 Intermission**
- 9:45 ZIP: (ZIF-8) based impedometric platform for ultrasensitive detection of fentanyl.
Anirban Paul, UT-Dallas, TX
- 10:15 Development of a solid phase extraction method for fentanyl analogs in biological matrices for analysis by LC/MS-MS.
Alli Timmons, OSBI, OK
- 10:45 Panel Discussion.
- 11:15 Concluding Remarks

Posters (Aug.14. PM) – Note this precedes the lectures.

1. Weaponizing fentanyl as a WMD.
Jim Rauh, Families Against Fentanyl, OH
2. Recent news about the illicit fentanyl epidemic.
Donna Nelson, University of Oklahoma
3. How illicit fentanyl became a prime social danger in the U.S.
Olivia Townsend, Gage McNett, and Donna Nelson, University of Oklahoma

How Sweet It Is!

Part 4

by
Bill Motzer



In Part 3 of this series (Motzer, 2023), I discussed the milk sugar lactose, one of the main constituents of human and most mammal (largely bovine) milk. It's a slightly sweet,

reducing disaccharide unique to milk composed of glucose and galactose. By itself lactose cannot be digested and requires the digestive enzyme lactase to break the bond between glucose and galactose (**Figure 1**).

Lactase, also known as lactase-phlorizin hydrolase, is an

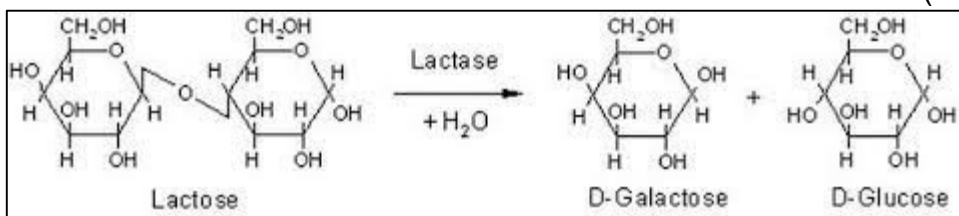


Figure 1: Structural diagram showing lactase enzyme action on lactose, producing free galactose and glucose.

enzyme secreted in Mammalia small intestines that catalyzes lactose resulting in the breakdown or conversion to glucose and galactose. Lactase in humans is most abundant during infancy produced by enterocytes cells lining the intestinal walls. These cells form a chemical barrier (aka *brush border membrane*) through which food must pass to be absorbed. Mutations in the encoding lactase gene may result in an inherited lactase deficiency, a condition

commonly known as lactose intolerance: an inability to properly digest lactose. Lactose not absorbed in the upper gastrointestinal tract undergoes bacterial fermentation in the colon producing intestinal distress such as gas, bloating, cramping and diarrhea.

Lactose intolerance can occur at different ages. In general, infants are not usually affected, but lactose intolerance can occur in children as young as two years of age. However, as one ages, lactose intolerance tends to increase because less lactase is secreted; therefore, it's quite common in older adults. It's also common in some ethnic populations. However, treatment is available and may include:

- (1) Milk product avoidance: however, this may cause a decrease and/or lack of important nutrients and vitamins such as calcium, vitamin D, riboflavin, and protein. Many people with low lactase enzyme levels can tolerate small amounts of milk products consumed at one time (~57 to 113 g or 2 to 4 ounces)

and will get digestive problems only with larger servings (170 g or 6 ounces or more). Some people may be able to consume dairy products with naturally lower levels of lactose, such as aged hard cheeses and yogurt.

- (2) Lactose-free and lactose-reduced milk and milk products can be found at many food stores. They are the same as regular milk and milk products, but they

have either removed lactose or the added lactase enzyme.

- (3) Use of lactose-free milk products or milk substitutes, including soy, rice, almond, and oat milk.
- (4) Taking an over the counter or physician prescribed lactase enzyme with ingested milk products as directed can aid in preventing digestive upset.

However, the FDA has not reviewed some of these products for safety or effectiveness. Allergic reactions can occur in some people; therefore, one should consult your doctor or pharmacist for more details (Encyclopedia Britannica, 2020; John Hopkins Medicine, 2023; WebMD, 2023).

Summary of Lactase Protein General Chemical Properties in Humans (*Homo sapiens*)

Lactase forms a rather large, somewhat unstable protein molecule. Therefore, it's continuously secreted upon ingestion of lactose-containing foods. Some properties are summarized below:

- **CAS No.:** 9033-10-7 or 9031-11-2
- **Number of amino acids:** 1,927
- **Molecular mass:** 218,572.6
- **Atomic composition:** Carbon (C): 9,907; Hydrogen (H): 14,857; Nitrogen (N): 2,651 Oxygen (O): 2,877; Sulfur (S): 45
- **Formula:** C₉₉₀₇H₁₄₈₅₇N₂₆₅₁O₂₈₇₇S₄₅
- **Total number of atoms:** 30,337
- **Estimated half-life (t_{1/2}):** 30 hours (mammalian reticulocytes, in vitro). Less than 20 hours (yeast, in vivo) and greater than 10 hours (*Escherichia coli*, in vivo).
- **Instability index:** The instability index (II) is computed to be 41.09. This classifies the protein as unstable.
- **Aliphatic index:** 76.25
- **Grand average of hydropathicity (GRAVY):** -0.362

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Macromolecule Insights, *The Lactase Protein* (2005), <http://macromoleculeinsights.com/lactase.php>.

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May Pharmacopeia Trip Experience

Methemoglobin: Fighting Blue Skin with Methylene Blue

By Donald MacLean



On my flight to attend my Dosage Form and Pharmaceutical Technical Procedures Expert Committee meeting in Strasbourg, France, a lady from Portland and I had a chemistry connection. Katherine had a molecular biology background. When I mentioned Kentucky, the topic of the blue skin people came up, which is this diversion topic for this month since my pharmacopeia meeting topics are confidential. No, this is not another Hatfield and McCoy story.

There are several blue skin causes including insufficient oxygen (cardiac and pulmonary [cyanosis]), silver toxicity (Argyria), and dye transfer. When I was taking a toxicology course in Kentucky, I was told about blue people that showed up in the emergency room. In this toxicology class, the lecturer described the situation and we had to figure out the root cause for why the skin was blue. There were 3 causes, a genetic predisposition, silver exposure toxicity, and dye transfer. Up to that time the only person I knew who had permanent blue hue skin was a girl who had a heart transplant. I also know 2 temporary conditions where a person can appear blue, when skin is cold though pale is more appropriate, and when a person lacks oxygen such as a heart attack.

Elemental Exposure:

Silver toxicity is known to turn the skin blue, especially if exposed to sunlight (Argyria). It is not reversible, and the color is systemic. The pharmaceutical compendia have categorized silver as a group 2B impurity (if the element is added on purpose it is not an impurity, such in medicines and dietary supplements). United States Pharmacopeia (USP) general chapter <232> lists several elements to be risk assessed or tested in certain drug products or raw materials. Since 2018 USP and Ph Eur (European Pharmacopoeia) have treated element impurities at the drug product stage based on route of administration and dose on a daily permitted exposure (PDE) regime. You might get argyria if you:

1. take dietary supplements that contain silver;
2. use medication such as eyedrops, nose sprays, antifungal, or wound and burn cream that contain silver;
3. work where silver particles are in the air;
4. wear new clothing coated with silver nanoparticles for odor and microbial control.

Table 1 shows the PDE for class 1, 2A and silver for 3 current administration routes and an upcoming cutaneous route limit.^{1,2} Note the oxidation state and whether the element is in organic or inorganic forms is not considered in the daily limits. Dietary supplements have their own limits and does differentiate between organic and inorganic impurities as shown in USP <2232> Elemental Contaminants in Dietary Supplements (USP: United States Pharmacopeia).³

There are various other elements that can cause blue skin such as from gold jewelry due to copper or zinc present.

Table 1. USP <232> Elemental Impurities – Limits. There are 24 elements that fall in class 1 to 3.						
Current Limits by 3 administration routes					Proposed as of 2024-05-01	
Element	Class	Oral PDE (µg/day)	Parenteral PDE (µg/day)	Inhalation PDE (µg/day)	Cutaneous PDE (µg/day)	CTCL for Sensitizers (µg/day)
Cadmium	1	5	2	3	20	-
Lead	1	5	5	5	50	-
Arsenic	1	15	15	2	30	-
Mercury	1	30	3	1	30	-
Cobalt	2A	50	5	3	50	35
Vanadium	2A	100	10	1	100	-
Nickel	2A	200	20	5	200	35
Silver	2B	150	10*1	7	150	-

*1 Silver Parenteral PDE will be 15 µg/day in 2024.

Dye Transfer:

A patient came in with both legs blue, but the upper body was normal. Blue dye transfer from Jeans was concluded by the fact only the legs were blue. The dye was probably indigo. Indigo structure is shown in Figure 1. Obviously, the dye can be removed so the condition is temporary.

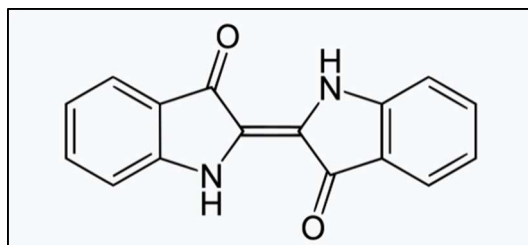


Figure 1. Indigo Structure. From Wikipedia.

Methemoglobin:

When the concentration of methemoglobin in the blood is above 1.5%, the patient develops cyanosis, the main characteristic of this disorder. The color of the arterial blood changes to dark brown with normal PaO₂. The skin turns blue due to lack of oxygen.

Methemoglobin has heme iron as 3+ (ferric) that does not bind oxygen (blue skin). The blood is red-brown, its intensity dependent upon the amount of methemoglobin present.

Hemoglobin has the heme iron as 2+ (ferrous) (rosy skin). The blood is red.

Methemoglobinemia may be acquired via pharmaceuticals such as antibiotics. In this story, methemoglobinemia is genetically inherited. The Fugate family blue skin (cyanosis) was due to a recessive gene for a protein that reduced heme ferric iron to oxygen binding ferrous iron. The first traceable person, Martin Fugate, immigrated from France to the Kentucky-West Virginia area.^{6,7} Both parents were recessive methemoglobinemia (met-H) gene carriers (The gene that encodes this enzyme is located on chromosome arm 22q13-qter. [the q arm is the longer arm separated from the p arm by the centromere]).⁴ The Fugate family faced skullduggery due to fear and being different.

The skin maybe blue, but depending upon the amount of methemoglobin present, the blood can appear to be red-brown as shown in Figure 2. Methemoglobin conversion to

hemoglobin is performed by cytochrome b5 reductase (Figure 3). The interesting treatment for methemoglobin is the use of methylene blue dye (Figure 4). With the conversion of ferric iron to ferrous iron, the hemoglobin is better oxygenated, and the skin goes from blue to rosy. The treatment is temporary as the condition returns within 2-3 days.⁸



Figure 2. Methemoglobin Blood. Note the color of blood is not red or blue.⁵

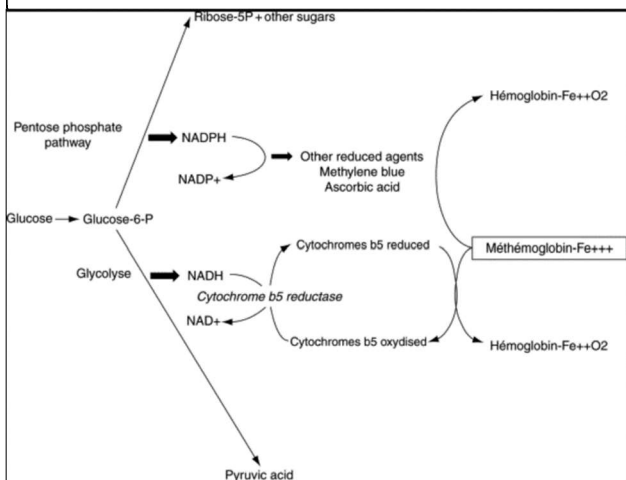


Figure 3. Electron transport for the reduction of ferric iron to ferrous iron by Cyt b5 or by other reducing agents.⁴

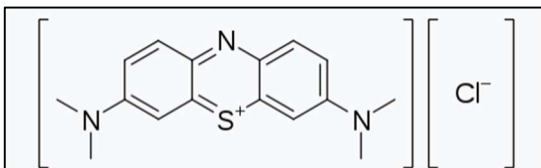


Figure 4. Methylene Blue Structure. From Wikipedia.

Another elevated methemoglobin condition is Hemoglobin M disease. However, its cause is different, therefore methylene blue or ascorbic acid does not work.

For curiosity there is blue blood. An example is from horseshoe crab where the blue color is due to copper, not iron as the oxygen binding center. The horseshoe crab blood is harvested for the endotoxin test and is very expensive. This test is being phased out in favor of chemical tests in Ph Eur (European Pharmacopeia). In the US, the recombinant replacement is controversial.



Figure 5. Horseshoe Crab Blood. The blue color is from copper containing hemocyanin protein.⁹

Topic Book:

In 2019, the fictional novel [The Book Woman of Troublesome Creek](#), by Kim Michele Richardson, described a fictional version of the Fugate family during the Great Depression.

Ph Eur Committee Meeting:

How did my meeting go? Petty good. Ph Eur (EP) had made a big deal about removing animal derived products for testing in a February presentation.^{10, 11} The presentation

focused on the rabbit pyrogen test, and the horseshoe crab endotoxin test alternatives. Currently the endotoxin (general chapter 2.6.14. Bacterial endotoxins) and pyrogen test (general chapter 2.6.8) are still in Ph Eur monographs. The goal is to replace or provide alternatives to animal testing. Previously, the equine Gonadotropin reference standard became unavailable, therefore the monograph was suspended (*number* 0719) as of Supplement 10.8.¹² I asked why the endotoxin test using the horseshoe crab blood has not been replaced. Outcome to be determined later.

Note 1: animal derived testing replacement is controversial for safety concerns. In addition, getting agreement has led to an interesting outcome for the USP (United States Pharmacopeia) EC (Expert Committee) on Microbiology, which has been disbanded over not being able to work together.¹³ This is the first time I have heard of an entire committee being dismissed.

Note 2: methylene blue is used in container closure integrity testing.

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Recommended Location: Aftel Archive of Curious Scents (Berkeley, Alameda County)

By Donald MacLean

The Scent Museum in Berkeley (Alameda County) is this month's science location recommendation. The location is part residential and converted houses are now used as offices and store fronts. The location does not stand out and if not for the two-sided street poster sign put out on Saturdays, it would pass as another granny unit.

The museum is a family run operation, with very enthusiastic dedication to the topic. You will receive a pack containing an aroma comb to put over a bottle to sniff, white gloves for opening old books, a fabric piece to desensitize the previous smell and an introduction to the facility, and 5 dip sticks. On the day that I came, only the white glove was necessary. While indoors, a Covid mask precaution was in effect.

Inside:

The museum interior wall has old postcards showing the growing fields and workers processing the essences in an industrial setting, most notably Europe. The posters are in English and in French showing the location of the source materials 100+ years ago.



Figure 1. Old Sample Collection.

Depending upon how you rotate through, one of the first things that you came to is the old sample collection that reminds me of the stock room (Figure 1).

There are 2 drawer storage cabinets containing bark, wood, resins, leaves, shells, and poop that can be handled with labels indicating their name and their location where they were obtained. I recognize some the items as biblical items (The three wise men brought Myrrh, frankincense, and gold).

One of the wood specimen costs more than gold.

Outside:

The outside exhibits contained several trays with bottle samples. As expected, 100 year and fresh scents have a notable difference. Is the reason oxidation or evaporation? Among the animal essences, my family preferred the poop (Figure 3). I preferred the natural version over synthetic versions (Figure 4).



Figure 2. Narcotic Plants (Champa, Gardenia, Jasmine Sambac, Orange Blossom, Tuberose). Gardenia was our first choice. Smelling it a second time did not give the same impression as the first time.



Figure 3. Animal Essence (Whale, Hyrax, Beaver, Musk, Civet, Onycha). The Whale "poop" was our favorite.



Figure 4. Natural versus Synthetic Versions (Jasmine, Rose, Vanilla). Mixed Opinion.

One tray exhibit contained individual notes and the chord that construct a perfume. Notes are added together to make a chord, and chords are added to make the perfume (Figure 5).



Figure 5. Outside exhibit for the notes and chords that went into a perfume.

Top Chord: The Perfume's first impression.
 Middle Chord: The perfume's heart. Notes were chocolate, pink lotus, and strawberry.
 Base Chord: The perfume's last character.

Sniff each essence note, then smell them together in the chord (base, middle, or top). Smell the blended perfume made from the three chords (Figure 5).

Books

In a corner are 100+ year old books. These books are perusable. The interesting part is the set images, especially the glassware. Obviously some the items shown are not safe to use by today's standards. Books are not only pharmaceuticals, but food and drink, perfumes, etc.

Get your Soveneairs

At the end chose 5 scents to take home (Figure 6). Be careful your kid will take an hour deciding what scents to select.



Figure 6. Scent Library. At the end the staff will dip your five selected scents on a stick and provide them to you in a glassine envelope to take home. Note the wheel has scents divided into classes (floral, spicy, etc) on the inside circle, type (narcotic, sweet, rosy, etc), then on the outside will have source examples.

Parking: Very challenging and if you pay, be wary as the traffic mender is out to ticket you.

Location: 1518 – ½ Walnut St., Berkeley, CA

Hours: Saturday 10-6 pm (masks indoors required)

Price: \$25 adults, \$15 children

Web site: www.aftelier.com or www.aftelarchive.com

Northern California ACS Undergraduate Research Symposium - May 6

By Steve Bachofer

The complete e-program books is available at the website:

<https://sites.google.com/stmarysca.edu/2023-norcal-research-symposium/home>

Saint Mary's College of California



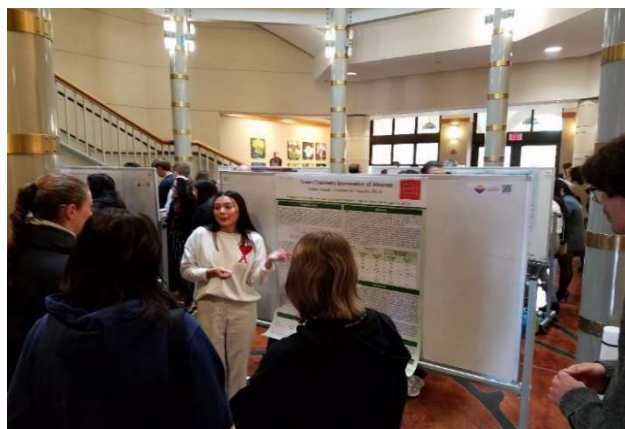
(Moraga, California) hosted this symposium after a three-year hiatus due to COVID. It was delightful to see the undergraduates sharing their discoveries. Students from seven institutions participated (CSU-Chico, CSU-East Bay, CSU-Sacramento, Saint Mary's College of California, San Jose State University, Santa Clara University, University of San Francisco). The symposium had nine oral presentations and 35 posters which were all high quality.

The size of this symposium was a bit smaller than before COVID however it showed plenty of signs of coming back strong. This re-start of an annual event allowed all to be excited for the future!
Images

Student poster sessions were busy and full of great dialogue. Students shared their project results and faculty gained insights on the research.

Students were active and seemed to enjoy the faculty and student interest in their research.

This symposium has been jointly hosted by colleges and universities since 1989. It is a venue where undergraduates can refine their presentation skills in a friendly environment. In many cases, this is the first professional poster or presentation that they have given to a chemistry knowledgeable audience.



Earth Day Celebration at The John Muir Historical Site In Martinez

By Romit Chakraborty, Shelia Kanodia, and Alex Madonik

The John Muir National Historic Site in Martinez was the place to be on the 22nd of April, as the California Section of the ACS celebrated Earth Day with an array of exciting events. With the sun shining brightly overhead, the atmosphere was electric, as visitors young and old flocked to the various displays and exhibitions.

Margareta Séquin presented her ever-popular plant scents and molecular models, which provided a fascinating insight into the world of chemistry. Visitors were able to get up close and personal with these intricate structures, marveling at the complexity and beauty of the molecules that make up our world.

But it wasn't just the adults who were drawn to the chemical displays. Kids were equally fascinated by the colorful algae on display, which provided a fun and interactive way for them to learn about the role of these important organisms in the ecosystem. They may not be glamorous, but they are found everywhere and play a key role in marine food chain, while generating more oxygen than all land plants put together.

Of course, no celebration would be complete without some great music, and the Earth Day event at John Muir did not disappoint. The Irish Folk outfit CaliCeltic kept the crowds entertained with their lively tunes, while visitors enjoyed ice cream sandwiches and soaked up the California sun.

As the festivities continued, it was clear that everyone was having a great time. Atefeh Taheri, the ACS California Chair, was on hand to ensure that everything ran smoothly, while Sushila Kanodia kept visitors engaged with her infectious enthusiasm for all things chemistry.

Another highlight was the electrolyzer set up by Alex Madonik, which used the power of the California sun to split water into its component parts. Visitors were able to see first-hand the incredible power of renewable energy, and how it can be harnessed to create clean and sustainable sources of power.

As the day drew to a close, it was clear that the Earth Day celebrations at John Muir had been a huge success. The lively atmosphere, combined with the fascinating displays and engaging activities created a lively event that had something for everyone.

But perhaps most importantly, the event highlighted the importance of conservation and sustainability in today's world. As we face ever-increasing challenges from climate change and other environmental issues, it is essential that we all do our part to protect our planet and ensure that it remains a healthy and vibrant place for generations to come.

In this sense, the Earth Day celebrations at John Muir had served as an important reminder of our responsibility to care for the planet and had inspired visitors young and old to do their part to protect our environment. With events like this, we can all work together to create a better, cleaner, and more sustainable world.



Figure 1. Sheila Kanodia

Sheila Kanodia's report on the algae photosynthesis demo:

April 22nd, 2023 turned out to be a bright sunny day at the John Muir Historic site, a venue for the Earth Day celebration: indeed a perfect day for the in vitro demonstration of photosynthesis to the young and not so young visitors to our CALACS booth. The experiment utilized small algae beads in an aqueous media in plastic microcentrifuge tubes. The media contained two pH indicators which facilitated monitoring of pH change with the progression of photosynthesis. In sunlight with photosynthesis in progress, visitors observed the color change of the media from golden yellow to purple. With the help of a pH scale/color scheme card, visitors noted the pH change from acidic to alkaline with photosynthesis and also the formation of tiny gas bubbles. The reversal of pH change in dark couldn't be observed in real time but was shown by presenting the tube previously kept in the dark. The process of photosynthesis involves the conversion of light energy to chemical energy by algae, plants and other organisms by transforming carbon dioxide plus water into sugars and oxygen. In our demonstration, this reaction was shown to take place by the pH change of media from acidic to

alkaline. Since CO_2 is acidic, with the onset of photosynthesis, the amount of CO_2 in the media decreased thereby causing the pH to shift to alkaline range. The oxygen gas produced is trapped in the algae beads. With the buildup of oxygen gas, the density of the beads decreased, allowing them to float to the surface of the media. Interesting visual observation and a fun experiment indeed for the kids and adults alike!

Visitors also learnt the food value of algae. Many foods in our day-to-day consumption already contain algae extracts. We provided algae snacks for the visitors to taste. Algae is a good source of biopolymers and biofuels in addition. Algae may provide us with our ticket to the planet Mars in future as a major source of oxygen.

Sodium alginate details from Alex Madonik:

One widely-used seaweed product is sodium alginate, a remarkable gelling agent that is found in many food products. We were introduced to sodium alginate by the Earth Week 2020 edition of Celebrating Chemistry, but the pandemic interrupted our outreach plans that year. In fact, I never opened the packages of sodium alginate and calcium lactate that I ordered that spring, and our Earth Week Coordinator (Sushila Kanodia) encouraged me to take another look at them this year. I found a very simple recipe for making gel beads and worms on the Carnegie Mellon University web site. Of course, the key is that calcium ions cross-link sodium alginate by displacing the sodium ions and bridging between two polymer strands. Food coloring adds to the fun, and dispensing the alginate solution from a squirt bottle or syringe into the calcium lactate solution creates outlandish forms instantly.

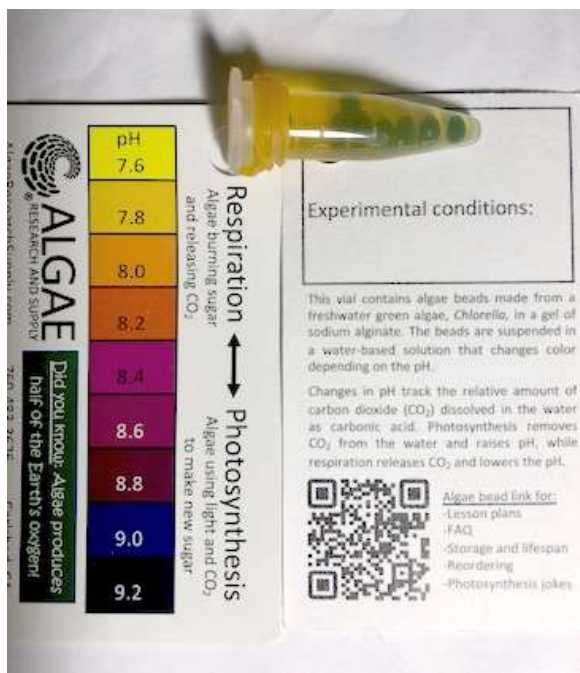


Figure 2. pH and Photosynthesis. As carbon dioxide is consumed to make sugar, the pH shift upward as noted by the pH indicator going from yellow to purple.

For more photos see <https://calacs.org/outreach/earth-week/earth-day-celebration-at-the-john-muir-historical-site-in-martinez/>

California Section Women Chemists Support Sonoma County's Expanding Your Horizons Conference

June 1, 2023 By: Janet Schunk

After a three-year hiatus due to the pandemic, the Sonoma County chapter for Expanding Your Horizons (EYH) returned to hosting their in-person event at Sonoma State University on Saturday 15-April-2023. The conference is targeted to seventh and eighth grade girls throughout Sonoma, Lake and Mendocino counties, featuring hands-on workshops conducted by women who have careers in STEM fields. The conference's objectives were:

- To foster awareness of the wide range of career options for women in mathematics, science, engineering, and technology based fields.
- To provide opportunities to meet and talk with women who work in these fields.
- To increase young women's awareness of the importance of math and science education, and the need for early career exploration. ^(a)

This year's conference consisted of 10 hands-on workshops, offered over three workshop sessions. The organizers assigned the participants to the workshops based on their interest when they registered. This year, five workshops were presented twice, and the other five workshops were presented only once, due to the low enrollment numbers (45 to 50 attendees, compared to prior years of 100 to 120+ attendees). In prior years, each workshop is typically available for all three sessions.

The ACS California Section Women Chemists team consisted of Anne Taylor and Janet Schunk. We presented one, 50-minute workshop, *Chemists Have Solutions*, where paper chromatography and design of experiments (DOE) were used to explore techniques used by chemists. The session consisted of eight girls, who explored the following questions:

- 1) What color is black? (i.e. dye components)
- 2) Does the amount of marker applied to the stationary phase (paper towel) make a difference in how well the color components separate? (i.e. small dot vs. large dot)
- 3) Does the age of the marker make difference? (i.e. old vs. newer marker)
- 4) Does the direction that we cut the stationary phase (paper towel – horizontal, vertical, diagonal) affect the separation? (i.e. size of weave pattern)

To answer the above four questions, we designed two set of experiments, where our mixture to separate was a black water-based marker; our stationary phase was paper towels; and our mobile phase was water. Our run time was about five minutes.

In the first experiment, the girls were to determine what might be an ideal sample size to tease out the dye components in the black marker. Each girl was assigned to perform either Design 1 or Design 2, working with one brand of paper towel, two paper towel strips cut in the same direction, and either given an old marker (>15 years, Design 1) or a new marker (~5 years, Design 2). They applied a small dot of their assigned marker on paper towel strip 1 and a larger dot of

their assigned marker on paper towel strip 2. Then the strips were placed in a tank with a small amount of water such that the water would wick up from the bottom of the paper towel, through the sample spot and carry the ink dyes, separating “black” into its component colors. Based on the results of experiment 1, the girls then performed a second experiment, where they used paper towel sheets cut in three different directions on the weave (lengthwise, crosswise, and diagonal) to create their strips, and used the sample size result from experiment 1 to apply the same size dot of marker on all three towel strips. The three paper towel strips were placed again in the tank with water to separate the marker into its dye components.

During the run time of the first experiment, Anne shared a bit about her educational and career journeys. This allowed the girls to hear how career and personal life do not always follow a straight path, and that detours and redirection are OK.

During the run time of the second experiment, Janet presented arguments ‘To Ban’ or ‘Not to Ban’ Dihydrogen Monoxide. One of the first questions to be asked is, do we know what Dihydrogen Monoxide is? And if not, is it fair to judge the ban on phrases that could lend to emotional connotations? The whole purpose of this exercise was to emphasize asking questions of data presented before drawing conclusions. A fun example that I hope they will remember in the coming years as they read through social media posts.

In summary, the workshop not only introduced the girls to a technique used by chemists, but it also introduced the girls to being collaborators. One scientist cannot run every possible experiment, but by sharing data with other scientists, they can get to a “solution” faster. And sometimes, having results that say there is no difference in performance is still important information to have for designing future experiments.

The California Section Women Chemists have been supporting Sonoma’s chapter of Expanding Your Horizons conference for over 10+ years. This outreach activity has been part of the Women Chemists Committee contribution to the California Section’s Strategic Plan Goal 3, fostering excellence in chemical education.

Notes:

(a) Sonoma County EYH, <http://eyh-soco.org> . Home tab.