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MAGAZINE OF THE CALIFORNIA SECTION, AMERICAN CHEMICAL SOCIETY

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Middle: Sunflowers and Corn at Twilight – Donald MacLean

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



ACS Younger Chemist Committee Leadership Institute Travel Award

The ACS Younger Chemist Committee invites all eligible younger chemists to apply for the Leadership Institute travel award. This award grants the opportunity to attend the ACS Leadership Institute, all expenses paid in January 2024. Applications open August 15th and close October 15th. Learn more & apply at: <https://bit.ly/YCCLDI>



ACS
Chemistry for Life®



American Chemical Society
Younger Chemists Committee
✉ info@acsycc.org

[About](#) [Diversity & Inclusion](#) [Awards](#) [Events](#) [Local Sections](#) [International](#) [Career Resources](#) [Blog](#) [Q](#)

Section Elections

By Michael Cheng

Look out for local section election email notice from the Cal ACS Section Office.

1. **Chair-elect (1 position)** - The Chair-Elect shall be Chair of the Program Committee and shall assist the Chair with the direction and management of the Section.
2. **Treasurer (1 position)** - The Treasurer shall have charge of the funds of the Section, including receiving all monies coming to the Section.
3. **Councilors (3 positions)** - Representing CalACS members in the meeting of the Councils during ACS National meetings.
4. **Director At Large (1 position)** - It is a member of the Board of Directors, and has full power to conduct, manage, and direct the business affairs of the Section.
5. **Members At Large (3 positions)** - Assist the officers; bringing before the Executive Committee items of concern from members of the Section.

Ballots will be sent out near 10/31/2023, and voting will close near 11/20/2023. Elections will be held using Survey Monkey. Mail in ballots also done, but must be requested from the local section office at office@calacs.org

Upcoming Events

By Donald MacLean

1. Awards Luncheon, @ Lara's Fine Dining, Richmond, Sat. October 7, 2023: starting at 11:30. Contact [Julie Mason](mailto:Julie.Mason@calacs.org) at office@calacs.org for arrangements. See Flyer.
2. "Exploring Health and Environment: Navigating Chemicals in Our Everyday Lives", @ 4D Molecular Therapeutics, Emeryville, Wed. October 11, 2023: 17:00 – 19:30. See Flyer.
3. BACS 2023, UCSF Mission Bay - @ Robertson Auditorium, November 3, 2023. See flyer.
4. "Shining Light on Solar Cells and Their Material Impacts", Rachel Woods-Robinson, PhD, @ Zoom, Saturday, November 4th, 2023, starting at 10:30 am (PST). See flyer.
5. Outreach:
 1. Bay Area Maker Faire- Oct. 13-15 and 20-22 at Mare Island in Vallejo. – This is for information only as the section is not attending.
 2. Fairmont Elementary School Festival Thurs. Nov. 16th El Cerrito, 9am -12 pm.
 3. Richmond Elementary, Nov. 17th STEAM (Science, Technology, Engineering, Art, Math). Contact Alex Madonik for more information.
6. National Chemistry Week, October 15-21.

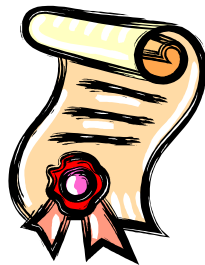
Please contact NCW Coordinator [Alex Madonik](mailto:Alex.Madonik@calacs.org) if you would like copies of Celebrating Chemistry or other materials for use in outreach at your school or event.



THE HEALING POWER OF CHEMISTRY

October 15-21 | 2023 | #NationalChemistryWeek





Congratulations
**California Section American
Chemical Society**

Annual Awards Luncheon & Presentation

*Honoring 50-, 60- and 70-Year Members of the American Chemical Society,
Recognize our 5, and 10-year members
Walter B. Petersen Award Presentation*

Date: Saturday, October 7, 2023

Time: 11:30 -12:30, no-host social; 12:30 – 1:45 pm, lunch; 1:45 pm, award presentations

Place: Lara's Fine Dining, 1900 Esplanade Drive, Richmond CA

Lunch: Cost \$60 per person, (\$30 for 5- and 10-year members, students and postdocs); Includes entrée, dessert and coffee or tea Lunch will include entree, soup (clam chowder) or salad, dessert (tiramisu or cheesecake) and soda, coffee, or tea

Your choice of entrées is Grilled Chicken, Grilled Salmon, Homemade Fettuccine Pasta, or Rigatoni Short Tube Pasta. Please select one: soup or salad, entrée, and one dessert.

Reservations are required: RSVP as soon as possible and no later than Wednesday **September 27, 2023** to the California Section office by e-mail to office@calacs.org. When making reservations, please indicate your choice of entrée.

To pre-pay: Please mail checks made out to "California Section ACS" to the California Section office, 2950 Merced St. #225, San Leandro CA 94577, or you may pay by PayPal by going to <http://www.paypal.com> > Send Money > Send Money Online > To: office@calacs.org and follow the instructions.

Abstract (for awards):

The American Chemical Society honors those members who attain 50, 60 and 70 years of membership. The list of those in the California Section who have attained these honors this year includes:

50 Years	60 Years	70 + Years
Kent D. Campbell Benito O. Delumen Kathryn M. Graham Alvin J. Greenberg John M. Hughes Anand Kumar Donald R. Kelsey Koon Wah Leong Karim Nafisi Movaghar Ronald J. Rusay Robert D. Sanner Elizabeth C. Theil Paul Sutor Ray R. Victor	Robert G. Bergman Mary Morrison Exner George L. Kenyon Jack F. Kirsch John T. Leffingwell Chieng Chang Lin Elek Linder John J. Natt John F. Sebastian Howard A. Storms	Stanely Shigeru Furuta Jackson E. Harrar Stanley Kushinsky Claire Nobles Lieske Carl Snyder

The Walter B. Petersen Award is made annually to a California Section member for outstanding service for an extended period to the Section. This year's recipient is Toni Miao.



Exploring Health and Environment: Navigating Chemicals in Our Everyday Lives

A joint event between California section of American Chemical Society
& Association of Women in Science, East Bay Chapter

OCTOBER 11, 2023 / 5:00 – 7:30 PM

5959 Horton St, #200 conference room, Emeryville, CA 94608

ABOUT THE EVENT:

Schedule:

- 5:00 - 5:30 PM: Sign-up and Networking
- 5:30 - 6:30 PM: Talk and Q&A
- 6:30 - 7:30 PM: Networking w/ Light Bites

Abstract:

The presentation delves into the prevalent challenges of human infertility and congenital defects exacerbated by environmental toxins. Chemicals like bisphenol A (BPA) and phthalates, present in plastics, cosmetics, and personal care items, disrupt hormones and pathways as endocrine-disrupting compounds (EDCs). Despite efforts to replace BPA with alternatives labeled "BPA-Free," these substitutes carry similar risks. These findings emphasize the potential health risks, urging consumer awareness, policy reform, and sustainable alternatives.

For Registration:



<https://exploringhealthandenvironment.eventbrite.com>

Questions?



taheri@ucdavis.edu

OUR SPEAKER: Prof. Sonya M. Schuh



Dr. Sonya Schuh, originally from Southern California, developed a passion for nature and water activities. Her curiosity and upbringing by educator parents led her to a science career. She earned a B.S. in Marine Biology and Zoology from Humboldt State University and conducted marine research. Later, she completed her Ph.D. in Physiology and Biophysics at the University of Washington, focusing on chemical effects on sperm. At Stanford's Stem Cell Biology Institute, she delved into genes and environmental factors affecting human reproduction. Joining Saint Mary's College of California, she initiated a research program on endocrine disruptors' impact on stem cells and embryos. Dedicated to teaching and diverse collaborations, her most cherished accomplishment is her three children, inspiring her ongoing commitment to shaping a better future.

BACS



BAY AREA CHEMISTRY SYMPOSIUM
connecting industry + academia

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sponsored
event



Please join us for

The 4th annual **Bay Area Chemistry Symposium**, an ACS sponsored symposium for Synthesis and Design in Medicinal & Process Chemistry



WHEN

Friday, November 3rd, 2023

WHERE

Robertson Auditorium, UCSF

SUBMIT

Abstracts for talks & posters today!

This symposium, unique in the Bay, will provide an ideal forum for students, postdocs, and industrial chemists to meet and exchange ideas covering themes in chemical biology, synthesis, and computational chemistry. The 2023 symposium will feature keynote seminars from leading local academics & industrial chemists, as well as short talks from students, post-docs, and industry researchers. A lively poster session promises a much-anticipated return to networking with local chemists through this opportunity to learn about cutting-edge chemistry across the Bay Area's outstanding institutions. Visit our website for more details!

OUR 2023 KEYNOTE ACADEMIC SPEAKERS



Prof. Kevan Shokat
UC San Francisco



Prof. Carrie Partch
UC Santa Cruz



Prof. John Hartwig
UC Berkeley

Last year's BACS was
generously supported by our

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For more information on sponsorship & registration, visit: bayareachemistrysymposium.com

California Section American Chemical Society **About the Speaker**



Rachel Woods-Robinson, PhD

Rachel Woods-Robinson (she/her) received a B.S. in Physics from UCLA, and a Ph.D. at U.C. Berkeley and Berkeley Lab designing new crystals for solar energy by combining computational chemistry, thin film growth, and device fabrication. Rachel recently started as a Postdoctoral Fellow at University of Washington's Clean

Energy Institute to study environmental and human impacts of such new solar materials. In addition to research goals to curtail climate change, Rachel aims to support scientists in sharing our work accessibly and engaging collaboratively with our communities, and loves outdoor adventuring. She co-founded "Cycle for Science," in which scientists go on bicycle tours and visit K-12 classes to teach hands-on lessons about sustainability, and she instructs "Cycle the Rockies" (Wild Rockies Field Institute), an immersive month-long course in which undergrads ride bicycles across Montana to learn about local energy and climate impacts.

All are welcome
Saturday, November 4, 2023

Title

Shining light on solar cells and their material impacts

Time

10:30 – 11:00 am Chatting

11:00 am Talk and Discussion

Reservation

Please visit the CalACS website www.calacs.org to register for this meeting or use Brown Paper Tickets.

RSVP here!

Please register before Thursday, November 2, 2023, 12 noon. Your email address is needed to send the ZOOM link, which will be shared with attendees on or before the day of the event via Brown Paper Tickets.

Cost

Free!

Abstract

Addressing climate change requires transitioning to renewables such as photovoltaic solar panels, but one key barrier to this transition is that we need better materials. In this talk, we'll start at the sun and then zoom into a solar panel all the way down to the nanoscale, highlighting materials challenges that scientists face at each length scale to make solar more efficient, reliable, and sustainable. We'll meet the different material components, such as absorbers and transparent conductors (TCs), and I'll share some of my research into designing new TCs for solar. Next, we'll zoom back out to discuss challenges we face beyond the lab in bringing solar to society, including critical raw materials, environmental impacts, and "green sacrifice zones." Lastly, I'll share some insights from my outreach project Cycle for Science and college course Cycle the Rockies.

Questions?

Please contact Elaine Yamaguchi at eyamaguchi08@gmail.com

How Sweet It Is!

Part 6

by

Bill Motzer



Introduction: In Part 5 (September 2023 Vortex), I summarized stevia's discovery and characteristics as a sugar substitute with essentially zero calories. This is because when steviol glycosides are ingested, they cannot be further digested in the stomach and intestines and they're transferred virtually unchanged into the bloodstream and then metabolized by the liver to steviol glucuronide, with subsequent urine excretion. Therefore, there's no increase in blood sucrose levels. Two 2010 review studies by The World Health Organization (WHO) determined no health concerns with stevia or its sweetening extracts. Based on long-term studies, WHO's Joint

Experts Committee on Food Additives approved an acceptable daily intake of steviol glycoside of up to 4.0 mg/kg/day of body weight for steviol glycosides, that was also endorsed by the European Food Safety Authority. A 2011 review study concluded that stevia sweeteners, as a sugar replacement, could benefit diabetics, children, and those on calorie restricted diets. However, newer investigations have prompted some concerns with stevia consumption and a few of these are noted below.

Toxicity studies involving human consumption of stevia are not in abundance because they tend to be observational studies rather than experimental investigations that generates empirical data. But even empirical studies have had problems; for example, one early study indicated that in laboratory test-tube tests, steviol and rebaudioside-A were potentially mutagenic. However, these effects were not demonstrated for the doses and routes of human exposure. Another study by the Memorial Sloan Kettering Cancer Center suggested that: "steviol at high dosages may have weak mutagenic activity." A Center for Science in the Public Interest review study noted no published carcinogenicity results for rebaudioside-A (or stevioside).

A bioassay investigation (Shannon, et al., 2016) noted that steviol glycosides have a steroidal structure; therefore, they may potentially act as a human endocrine disruptor. Using reporter gene assays (RGAs), a H295R steroidogenesis assay, and Ca^{2+} fluorimetry-based assays on human sperm cells, the researchers assessed the endocrine disrupting potential of stevioside and rebaudioside-A, and their metabolite steviol. With increasing steviol concentrations (500 to 25,000 ng/mL) in the presence of 157 ng/mL progesterone. These steviol glycoside metabolites, can antagonize progesterone's nuclear receptor transcriptional activity thereby increasing progesterone's production. Additionally, steviol induces an agonistic response on progesterone's sperm receptors of (aka *Catsper*). Thus steviol has the ability to affect progesterone signaling by lowering progesterone transcriptional activity and by increasing the production of progesterone.

A 2020 animal (mouse) study concluded that the non-caloric sweeteners such as artificial sucralose or natural stevia may have several consumer risks. The authors (Farid, et al., 2020) indicated that these substances are responsible for: (1) increasing glycemia in spite of their lack of calories, (2) increasing liver enzymes by changing intestinal flora, (3) causing elevated urea and creatinine levels, and (4) reducing anti-inflammatory cytokines and promoting or elevating pro-inflammatory cytokines secretion. Therefore, they recommend not using sucralose or stevia and instead decreasing the daily dose of sucrose.

Allergic and Reaction Studies: found that a small percentage of the population may have allergic reactions to steviol glycosides, particularly if they have sensitivities to plants in the *Asteraceae* or chrysanthemum- sunflower family that includes ragweed and daisies. Upon ingestion, side effects include possible mild nausea, bloating, dizziness, numbness, stomach upset, diarrhea, headaches, and muscle pain. Additionally, some people have experienced more serious symptoms such as fast, uneven or pounding heart beats, chest flutter, shortness of breath, excessive perspiration (sweating), tremors, and high fever. Serious eye symptoms and conditions may also occur, including blurred vision, tunnel vision, eye pain or swelling, or seeing halos around lights. If any of these occur, it's recommended that one immediately contact their health provider (Khan, 2023).

Drug Interactions: Stevia, may also mildly interact with certain drugs. Khan (2023) lists 18 drugs that could be affected by stevia consumption. Again, it's recommended that you inform your health provider of all medications that you are currently taking. Pharmacists can also advise you on any possible drug interactions. Never begin taking, suddenly discontinue, or change the dosage of any medication without a doctor's recommendation.

Extraction Methods: The steviol glycosides occurring in *Stevia rebaudiana bertonii* leaves, for example, require enhanced extraction techniques. This is because stevia plant cell walls are "tough," generally resisting conventional boiling and/or centrifuging methods. Thus, to extract the active sweet compound stevioside and concentrate it up to 300 times its normal leaf concentration, stevia manufacturers resort to other methods, many of which are patented and accordingly may be proprietary. Nevertheless, sufficient information is available indicating that food grade alcohols (generally ethanol) are used as extraction solvents. But some manufactures are reported using methanol, which is difficult to remove with trace amounts possibly remaining in the extract. Other extraction techniques include stevia hydrated in a water-alcohol mixture, with addition of calcium, iron, or aluminum. These are subsequently removed, by passing the solution through an exchange resin using other solvents such as acetone or n-butanol. The major drawbacks here are when water is removed trace amounts of these solvents may remain.

Additives and fillers may include titanium dioxide, preservatives, chemical stabilizers, and emulsifiers. Other additives and/or fillers include rice or corn maltodextrin, sugar alcohols such as erythritol, and vegetable glycerin.

Conclusions: What can consumers do? One can read the package label and then research the ingredients on-line; however, manufacturers are not required to fully disclose all ingredients, particularly if the serving size is one gram or less. Generally, any ingredient under 0.5 g per

serving doesn't require full ingredient disclosure. Consequently, some web sites recommend growing your own stevia, as a potted plant or purchasing (generally from a health food store) raw stevia where the pure dried stevia leaf has been ground to a fine powder. In this form, it is about 30 to 40 times sweeter than table sugar but still retains a peculiar somewhat bitter aftertaste. Yet, stevia is likely safe for most adults taken as a sweetener or in recommended doses and avoiding excessive quantities. Because stevia is marketed as a dietary supplement it's not approved for safety and effectiveness by The Food and Drug Administration (FDA); it's the dietary supplement company's responsibility to ensure that their products are safe and accurately labeled (FDA, 2023). Still, the FDA has approved only the purified form of stevia as generally recognized as safe (GRAS) or safe to use. Therefore, the FDA does not recommend use of stevia leaves or crude extracts, because there is insufficient information about their safety. As with many manufactured/processed products the term *caveat emptor* should really be *caveat informatus*.

References:

1. Farid, A, et al., *The Hidden Hazardous Effects of Stevia and Sucralose Consumption in Male and Female Albino Mice in Comparison to Sucrose* (2020): Saudi Pharmaceutical Journal, v. 28, n.10, pp. 1290-1300, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7584803/>
2. [FDA \(Food and Drug Administration\), *Facts about Dietary Supplements \(2023\)*](https://www.fda.gov/news-events/rumor-control/facts-about-dietary-supplements) <https://www.fda.gov/news-events/rumor-control/facts-about-dietary-supplements>
3. Khan, S., *Stevia*: (2023): <https://www.medicinenet.com/stevia/article.htm>
4. Shannon, M., et al. *In Vitro Bioassay Investigations of the Endocrine Disrupting Potential of Steviol Glycosides and Their Metabolite Steviol, Components of the Natural Sweetener Stevia* (2016): Molecular and Cellular Endocrinology
5. v. 427, pp. 65-72, <https://www.sciencedirect.com/science/article/abs/pii/S0303720716300533>

Periodic Graphics – Side Effects – Colored Urine

By Donald MacLean

Sometimes drug side effects lead to a blockbuster product, such as Viagra. Viagra (nonproprietary name Sildenafil) was being tested as a treatment for angina chest pain, but during clinical trials a side effect, facilitating erectile arousal, was noted. The blue pill as it is known as has been a blockbuster drug. In the July 3, 2023 issue of C&EN, Periodic Graphics topic is “Six Surprising Side Effects of Medicine”. The following are listed: compulsive behaviors, light sensitivity, sleep disorders, stool or urine discoloration, tooth staining, and vanishing fingerprints. There are a host of other side effects out there that can be both bad and good, depending upon your sense of humor. I particularly like the vanishing fingerprints side effect, but these days other forensic evidence and surveillance cameras cancel this criminal activity advantage. I will concentrate on the urine color changes as that can be quite shocking and humorous.

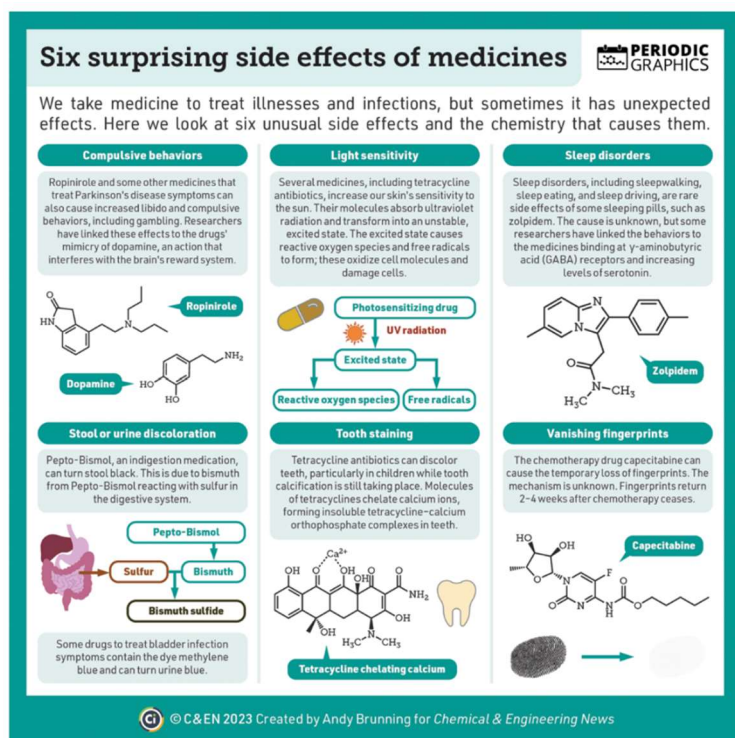


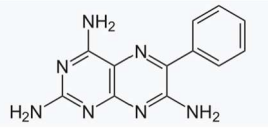
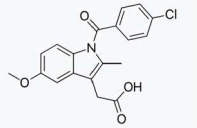
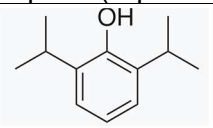
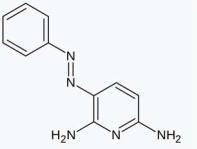
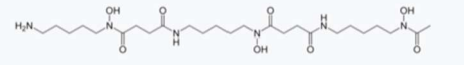
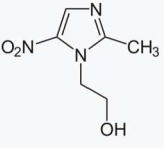
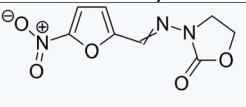
Figure 1. Periodic Graphics. ¹

saved the day for the 4077 MASH. Pretty hilarious.

The normal color of urine ranges from light yellow to dark amber, depending on the concentration of solutes in the urine. There are a few color inducing medications out there. They are shown in Table 1. Some of these medications are no longer available or have been reformulated even though the Brand name is still the same. Several foods can induce color changing urine such as beets (red or pink : betacyanin), carrots (orange : Vitamin A and B12) and asparagus (green / blue : carotene pigments and chlorophyll).

In an episode of MASH (episode Sons and Bowers, 1982), the MASH 4077 heroes are set to compete against the Marines at an improvised constructed bowling game. The gist of the story is Major Margaret Houlihan is not taken seriously by Colonel Potter when she wanted to be part of the bowling team. Then the MASH 4077 finds out that the Marines have a Ringer. Major Houlihan hooks up with the Marine Ringer the night before the actual contest and gains bowling skills from the Ringer in between drinks. The next day wounded soldiers arrived, and the Marines assisted the MASH unit. Afterwards, the doctors claimed to be tired and needed a pep pill. The ringer asked for a pep pill as well. The pep pill was methylene blue. The resulting blue urine panics the Ringer. Needless to say, the ringer bowls poorly and Major Houlihan bowls well which

Table 1. Medicines That Turn Urine a Different Color.

Drug Name (nonproprietary name)	Used for	Urine Result	Caused by
Methylene blue	scans, surgery, and treatment for methemoglobinemia	Blue	Methylene Blue
Urised Combined (Methenamine, Methylene Blue, Phenyl Salicylate, Benzoic Acid)	Reduce irritation caused by bladder infections	Blue	Methylene Blue
Dyrenium (tariamterene) ⁶ 	diuretic	blue fluorescent	Metabolite para-hydroxytariamterene?
Amitriptyline Elavil (amitriptyline)	antidepressant	Blue	artificial colors in these drugs
indomethacin (Indocin) ⁶ 	analgesic, anti-inflammatory, and antipyretic.	Blue	
propofol (Diprivan) ⁶ 	anesthetic	Blue	
Pyridium (Phenazopyridine) ⁶ 	urinary tract infection pain	dark orange to reddish	Azo dye
Desferal (deferoxamine mesylate) ⁶ 	Chelation therapy to rid excess iron	Red	Deferoxamine is a white powder. ?
Flagyl (metronidazole) ⁶ 	antibacterial and antiprotozoal	Black	metabolite
Furoxone and Dependal-M. (furazolidone) ⁶ 	bacterial and protozoal infections ⁷	Yellow to brown	hemolysis?
Ex-Lax , Correctol [banned by FDA in 1999 for OTC] now reformulated	Laxative	Purple	phenolphthalein
Robazin (methocarbamol)	Muscle relaxant	Black, blue or green	

⁶ Chemical Structure figures from Wikipedia under the trade name.

⁷ Nitrofurans are recognized by FDA as mutagens / carcinogens and can no longer be used since 1991. OTC: over the counter.

References:

1. Six Surprising Side Effects of Medicines, Periodic Graphics, Andy Brunning, Chemistry and Engineering News, July 3, 2023.
2. Viagra - <https://en.wikipedia.org/wiki/Sildenafil>
3. 10 of the Most Unusual Medication Side Effects You Should Know About - <https://www.goodrx.com/drugs/side-effects/10-craziest-medication-side-effects>
4. 7 Bizarre Drug Side Effects - <https://www.livescience.com/34438-drug-side-effects.html>
5. Urine color - <https://www.mayoclinic.org/diseases-conditions/urine-color/symptoms-causes/syc-20367333>

USP New General Chapter for Talc Testing for Asbestos, From FTIR or XRD, and Optical Microscopy to XRD and Polarized Light Microscopy, Part 1

By Donald MacLean



Daytime and late-night TV is inundated with cancer causing asbestos legal remediation TV commercials. For a long time, these were directed towards occupational asbestos exposure induced mesothelioma. More recently the commercials have been directed towards consumer baby powder use, which is suspected to cause ovarian and endometrial cancers. Baby powder is based on talc, or corn starch. It was used/is used for preventing diaper rash and for cosmetic purposes. The talc-based baby powder (known as talcum powder) may contain asbestos, even though testing and sourcing should have eliminated asbestos. Asbestos use was widespread in items such as brake pads, heat protective gloves, fireproofing, pipe insulation, etc. pre 1970's. In 2020 Johnson and Johnson stopped selling talc containing baby powder in the USA and Canada and supposedly by 2023 stop selling talc-based baby powder worldwide. A search of the web has found some manufacturers still selling talc-based baby powder.¹

In 1976, the Cosmetic, Toiletry, and Fragrances Association (CTFA), the cosmetic and personal care products industry trade association, issued voluntary guidelines stating that all talc used in cosmetic products in the United States should be free from detectable amounts of asbestos according to their standards. In the USA, the relationship between the FDA (Food and Drug Administration) and USP (United States Pharmacopeia) responsibility is entangled starting from the implementation of the 1906 Pure Food and Drug Act giving USP and the National Formulary (NF) the authority to set testing standards. The 1938 Food, Drug, and Cosmetic Act (FDCA), and other subsequent Acts have further cemented this government – nongovernment partnership, something unique in the world as compendia usually run by governments with regulatory and enforcement status. Therefore, USP is responsible for implementing safety testing standards, not the FDA, but the FDA is the regulatory enforcer and approver, not USP. The FDA and USP have been working on asbestos testing and revising the test for a while.² Public information can be found in various issues of Pharmaceutical Forum going back to 2010. The latest stimuli article describes the thinking that went into the various changes dealing with asbestos in talc.^{3,4} On December 1, 2023 a new USP general chapter <901> Detection of Asbestos in Pharmaceutical Talc will become effective.⁵ The supplementary information chapter is <1901> Theory and Practice of Asbestos Detection in Pharmaceutical Talc.⁶

Talc, or talcum, is a clay mineral, composed of hydrated magnesium silicate with the chemical formula $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$. The current Talc monograph became effective 2022-05-01.⁷ The revised Talc monograph will be official on December 1, 2025 with the changes officially published in USP NF 2023 issue 3. ⁸ The revised Talc monograph references USP <901> for procedure and acceptance criteria. Normally there is a 6-month adoption period for general chapter changes, except for packaging and labels which has a longer adoption period. Here there are 3.5 years before the revised Talc monograph becomes official, its provisions are not enforceable until that date. The reason behind this change is the infrared spectroscopy (IR) and

X-ray diffraction (XRD) methods, as currently written, can lead to false-negative results, which could allow talc samples with asbestos contamination to pass the Absence of Asbestos test in the USP Talc monograph.

Background asbestos types:

There are 6 asbestos types, which belong to one of two groups, Serpentine or Amphibole. Serpentine is a phyllosilicate with $(\text{Mg}, \text{Fe}^{2+})_3\text{Si}_2\text{O}_5(\text{OH})_4$ (magnesium-iron hydroxyl silicate) with monoclinic and orthorhombic crystal structure. Serpentine minerals have a sheet or layered structure. Chrysotile (white asbestos) is the only member of the Serpentine group. Amphibole is a group of inosilicate minerals, forming prisms or needlelike crystals, composed of double chain SiO_4 tetrahedra, linked at the vertices and generally containing ions of iron and/or magnesium in their structures. Amphiboles crystallize into two crystal systems, monoclinic and orthorhombic. Amsosite (brown asbestos) and crocidolite (blue asbestos) are members of the Amphibole group.

Table 1A and 1B show the different types of asbestos.



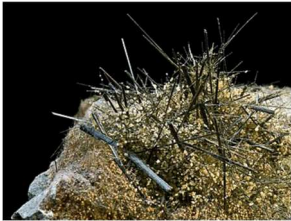



Table 1A. 4 Asbestos Types <u>Listed</u> in USP General Chapters <901> and <1901>. ^{5,6} Elemental information and index of refraction needed for polarized light microscopy is listed.		
	Appearance	Found in Rock type Chemical formula ⁹ Refractive index ¹⁰
Chrysotile 	White Parallel aggregate tough fibers Known as white asbestos.	Serpentine Metamorphic $\text{Mg}_3\text{Si}_2\text{O}_5(\text{OH})_4$ $n = 1.550$
Tremolite 	brown, white, green, gray or transparent.	Amphibole Metamorphic $\text{Ca}_2(\text{Mg}_{5.0-4.5}\text{Fe}^{2+}_{0.0-0.5})\text{Si}_8\text{O}_{22}(\text{OH})_2$ $n = 1.605$ and 1.620
Actinolite 	brown, white, green, gray or transparent.	Amphibole Found in metamorphic rocks, Igneous $\text{Ca}_2(\text{Mg}, \text{Fe})_5\text{Si}_8\text{O}_{22}(\text{OH})_2$ $n = 1.620$
Anthophyllite 	grey, dull green or white color	Amphibole ??? $\text{Mg}_7\text{Si}_8\text{O}_{22}(\text{OH})_2$ $n = 1.605$ and 1.620

Table 1B. 2 Asbestos Types <u>Not Listed</u> in USP General Chapters <901> and <1901>. Elemental information and index of refraction needed for polarized light microscopy is listed.		
	Appearance	Found in Rock type Chemical formula⁹ Refractive index¹⁰
Amosite 	Brown Known as brown asbestos	Amphibole ? $(\text{Fe}^{2+} \text{ Mg})_7\text{Si}_8\text{O}_{22}(\text{OH})_2$ $n = 1.670 \text{ or } 1.680$
Crocidolite 	Blue - fibers are extremely thin (needle-like) Known as blue asbestos	Amphibole ? $\text{Na}_2\text{Fe}^{3+}(\text{Fe}^{2+} \text{ Mg})_3\text{Si}_8\text{O}_{22}(\text{OH})_2$ $n = 1.690$

Background to tests

The current Talc monograph (which became effective as of 2022-05-01) uses the absence of asbestos tests.⁷ It allows suppliers to use Infrared absorption (IR) or X-Ray Diffraction (XRD) for a screen test, then optical microscopy if either the IR or XRD tests positive. See USP.org for the USP 2023 issue 2 for the current Talc monograph testing procedure. Table 2 displays the current and revised Talc Monograph asbestos tests.⁸

Table 2. USP Test for Asbestos, Current and Revised Comparison.		
Current Talc Monograph		Revised Talc Monograph
Procedure 1 Infrared absorption	Perform procedure 1 or 2	Perform <901> <i>Detection of Asbestos in Pharmaceutical Talc</i> , Procedure 1: <i>X-Ray Diffraction</i>
Procedure 2 <941> <i>X-Ray powder Diffraction</i>		
Procedure 3 <776> <i>Optical Microscopy</i>	Perform if procedure 1 or 2 tests positive	Perform <901> <i>Detection of Asbestos in Pharmaceutical Talc</i> , Procedure 2: <i>Polarized Light Microscopy</i>

Current Procedure 1: Infrared Absorption (will be deleted).

In potassium bromide, talc absorption band at $758 \pm 1 \text{ cm}^{-1}$ may indicate the presence of tremolite or chlorite (group of phyllosilicate minerals, serpentine [confusing as tremolite is an Amphibole]). If the absorption band remains after ignition of the substance at 850°C for at least 30 min, it indicates the presence of tremolite. In the range 600 cm^{-1} to 650 cm^{-1} any absorption band or shoulder may indicate the presence of serpentines (only Chrysotile belongs to serpentine group). Figure 2 shows an FTIR testing asbestos flow chart has some of characteristic of USP method, but also shows why the FTIR presence and absence method can be misleading.

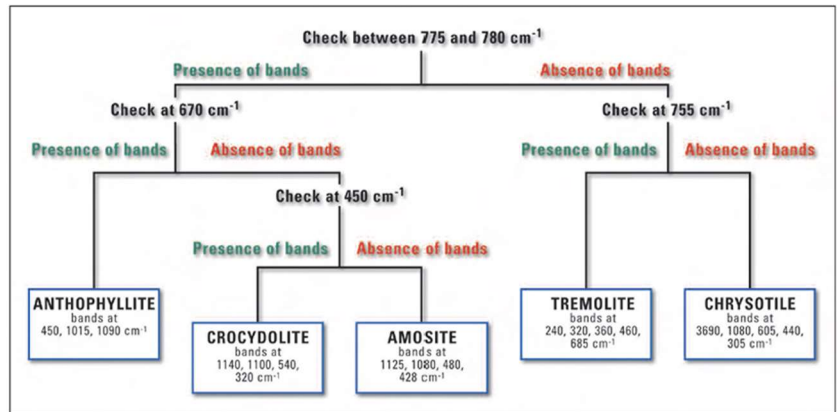


Figure 2. “Solid analysis”, Analysis of mineral fibres (i.e. asbestos) in water, soil and waste material using FTIR spectroscopy. From Shimadzu News 2/2007.¹² This is not the USP description in Procedure 1 but is close.

Current Procedure 2 (current optional Procedure 2 will become Procedure 1)

X-ray Diffraction characterization uses Bragg’s Diffraction. The formula for Bragg’s Diffraction.

$$n\lambda = 2d \sin \Theta$$

where n = integer, λ = wavelength used [Cu $K\alpha$ X-ray is 1.54\AA], d = distance, and Θ = angle

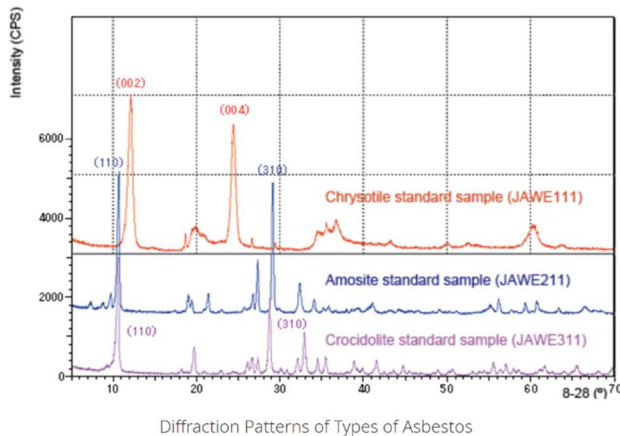


Figure 3. XRD Diffraction Pattern from 3 Asbestos Standards.¹³ Amosite and Crocidolite are not in USP <901>.

A copper X-ray tube provides a $K\alpha$ monochromatic 40 kV radiation tube (The $K\beta$ X-ray that is simultaneously produced is absorbed by a higher atomic number element acting as filter that preferentially absorbs the K beta X-Ray), 24–30 mA; the incident slit is set at 1° ; the detection slit is set at 0.2° ; the goniometer speed is $1/10^\circ 2\Theta/\text{min}$; the scanning range is $10^\circ\text{--}13^\circ 2\Theta$ and $24^\circ\text{--}26^\circ 2\Theta$; the sample is not oriented. Prepare a random sample, and place on the sample holder. Pack and smooth its surface with a polished glass microscope slide. Record the diffractograms: the presence of amphiboles is detected by a diffraction peak at $10.5 \pm 0.1^\circ 2\Theta$, and the presence of serpentines is detected by diffraction peaks at $24.3 \pm 0.1^\circ 2\Theta$ to $12.1 \pm 0.1^\circ 2\Theta$.

Figure 3 shows the overlay XRD profile for 3 types of asbestos. The atom spacing is affected by Miller Indices shown as (XYZ) above the peak. Only the Chrysotile is listed in USP <901>.

XRD should not be used alone for asbestos determination, as XRD cannot distinguish morphology and therefore cannot be used exclusively to determine whether amphibole or serpentine are asbestiform or non asbestiform. However, XRD is critical for the identification of phases present in a mineral mixture and can also determine if foreign materials are present. Table 3 shows the main asbestos diffraction angles.

Scan Type	Target Phase(s)	Target Peak(s)(2-Theta)
Qualitative scan	All (full scan)	All
Quantitative scan	Amphibole (Tremolite, Actinolite, Anthophyllite)	10.5 10.7
	Serpentine Chlorite (Chrysotile)	12.1 12.5
	Serpentine Chlorite (Chrysotile)	24.4 25.1
	Orthorhombic amphibole (optional)	29.3

Current Procedure 3: (optical microscopy confirmation procedure will be replaced by polarization microscopy known as procedure 2)

The presence of asbestos (see [Optical Microscopy \(776\)](#)) is shown if there is a range of length to width ratios of 20:1 to 100:1, or higher for fibers longer than 5 µm; if there is a capability of splitting into very thin fibrils; and if there are two or more of the following four criteria: (1) parallel fibers occurring in bundles, (2) fiber bundles displaying frayed ends, (3) fibers in the form of thin needles, and (4) matted masses of individual fibers and/or fibers showing curvature.

In Part 2, I will discuss the polarized light microscopy, which is the new confirmation method for asbestos in talc.

References Part 1:

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- FAQs: Modernization of the USP Talc Monograph - <https://www.usp.org/frequently-asked-questions/talc-monograph>
- PF 43(4) [Jul.–Aug. 2017] USPC Responses to Comments on Stimuli Article “Modernization of Asbestos Testing in USP Talc”
- Modernization of Asbestos Testing in USP Talc, Pharmacopeial Forum (PF) 40(4) [Jul.–Aug. 2014] available at <https://www.uspnf.com/pharmacopeial-forum>. Public viewing is free, but requires registration.
- USP <901> Detection of Asbestos in Pharmaceutical Talc, USP 2023 Issue 3, official date 01-Dec-2023.
- USP <1901> Theory and Practice of Asbestos Detection in Pharmaceutical Talc, USP 2023 Issue 3, official date 01-Dec-2023.

7. Talc, USP 2023 Issue 2, official date 01-May-2022
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9. Asbestos Chemical Formula: <https://www.sciencedirect.com/topics/chemistry/amosite-asbestos>
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11. Asbestos pictures from: Types of Asbestos, <https://www.asbestos.com/asbestos/types/> and <https://en.wikipedia.org/wiki/Actinolite>
12. Analysis of mineral fibres (i.e. asbestos) in water, soil and waste material using FTIR spectroscopy, Shimadzu News 2/2007 -
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13. Asbestos X-ray Diffraction Pattern: <https://www.shimadzu.com/an/products/elemental-analysis/x-ray-diffraction/labx-xrd-6100/features.html>

Pumpkins and Corn Mazes

By Donald MacLean

October is associated with fall, and Halloween. This month's travel recommendation is going to a pumpkin patch and corn maze. These are rurally located or at the Metro edge (Brentwood, Contra Costa County). Locally when we say pumpkin festival, Halfmoon Bay (San Mateo County) comes to mind as they have the pumpkin weigh off contest. However, there are lots of pumpkin fields out there including in Marin / Sonoma counties and Brentwood (Contra Costa County).

The best-known local pumpkin festival happens in Halfmoon Bay (San Mateo County) as its town's October weekend festival. On a weekday prior to that infamous weekend, the heaviest pumpkin weigh off occurs. The giant pumpkins are most likely the Atlantic Giant variety with 1000+ pounds of off orange / pink behemoths that barely resemble Jack-O-Lanterns. During the festival Main Street is blocked off and filled with vendors. You can get your picture taken with the winning pumpkin for a fee. Across the street from the winner is the second and lower place heaviest pumpkins (Figure 1) which you can take a picture for free. These celebrated pumpkins have a date with the cannery after the event.



Figure 1. From 2022, the second through fourth place heavy pumpkins at Half Moon Bay Pumpkin festival.

The Autumn Gold, Cinderella's Carriage, Connecticut Field Pumpkin, and Jack-O-lantern Pumpkin are some carving varieties which are the traditionally round and orange that are sold at stores and at patches. If you want more decorative, try the Warty Goblin (Figure 2). However decorative and carving pumpkins do not make good soup. By the time you make it into soup, their flavor is lacking. Comparing Butternut squash against the carving pumpkins, the carving pumpkins are no match for soup quality due to the butternut



Figure 2. Warty Goblin
<https://balconygardenweb.com/different-types-of-pumpkin-varieties/>



Figure 3. Pumpkins for sale at a store.

nuttiness and natural sweetness, though for pumpkin pie they are okay. One pumpkin that is great for cooking and decoration is the Jarrahdale, a moldy color blue-grey dense pumpkin. The nontraditional varieties are sold mixed or sometimes there is a table listing the names with an example (Figure 4).



Figure 4. Left side display of the pumpkin varieties with their price.

Corn mazes and other activities:

A corn or hay bales maze, hay bale stack, and other activities are also located at some localities. Some places have a Friday night maze under the light.

Along with the pumpkin, Indian corn is sold at a premium. Indian corn that is sold has preservation shellac on it. It is not for eating. An interesting fact is shellac is created from the dried secretions of the Lac beetle, this natural product is dried and processed so that it can be transformed into shellac through the use of a solvent which is most often alcohol.

Bring home a pumpkin. Display the nontraditional pumpkins as is. For the orange ones you can carve it and put a candle in the middle or just draw on it. Once a pumpkin is cut up it does not last long.

The orange Jack-O-Lantern types make poor soup and roasting quality, so just use them for pie or cake. The dense squash makes good roasting, something I highly recommend.



Figure 5. Indian Corn.

Experiment – does the whole pumpkin float? Try the dense ones. Cut the pumpkin up and test the seeds, rind, and the flesh.

Did the scary images keep the goblins away? – No, they seem to attract them.

References:

1. The 8 Most Epic Pumpkin Festivals in the US
<https://matadornetwork.com/read/best-pumpkin-festivals-united-states/>
2. 22 types of Pumpkins: <https://www.liveeatlearn.com/types-of-pumpkin/>
3. Master List of Pumpkin Varieties.
<https://www.pumpkinpatchesandmore.org/varieties-of-pumpkins-master-list.php>
4. The Best Farms, Pumpkins Patches, and Fall Festivals in the Bay Area
<https://bucketlisters.com>
5. 16 Amazing Pumpkin Science Experiments: Easy to Set Up and Easy to Perform

Parking in general: varies
Day: weekends late September through October
Traffic: can be bad at the festival and at a nighttime corn maze.

Chemistry In Action:

Bottom Left: Here is a parody emailed to me by Dan Calef. Note the contents are 6 – 2 oz packs. Looks close to 6.022 E 23, Avogadro’s number for mole. Maybe I should have written this in Spanish (Avogadro was Italian) as Trader Joe is now Trader José’s

Bottom Right: From August 5, 2023. Cal ACS attended a San Francisco versus Oakland baseball game at the Oakland Coliseum.



Solano Stroll 2023

Alex Madonik

Cal ACS returned to the Solano Stroll for another full day of chemistry fun in the sun, complete with UV-color-changing beads that became souvenir bracelets for hundreds of young scientists. Michael Cheng took charge this year and was there early to set up our booth, which also included solar-powered electrolysis of water and the pH rainbow demonstration. Visitors found that blowing through a straw into red cabbage pH indicator changes the color from purple to pink, proving that the carbon dioxide in our breath is acidic. Many thanks to Michael and the other volunteers who made it possible: Dan Calef, Charlie Gluchowski, Vanessa Marx, Mariana Alves, and the UC Berkeley team from Alpha Chi Sigma, led by Deverin and Madison.



Vanessa Marx and Mariana Alves explain UV-color-changing beads.

More pictures at <https://calacs.org/solano-stroll-2023/>



Alpha Chi Sigma, led by Deverin and Madison.