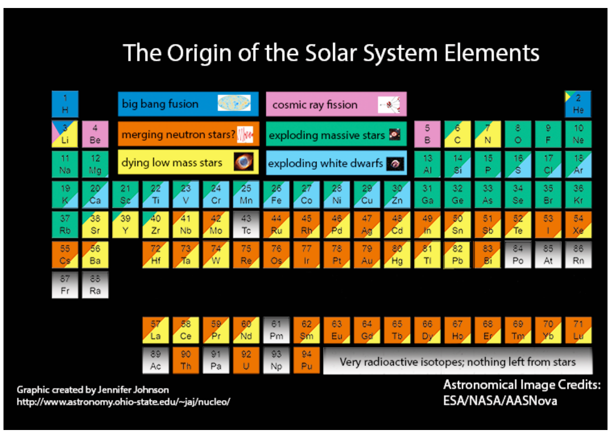
THE VORTEX

The American Chemical Society
California Section Newsletter

March 2022, Issue 3, Volume 84

WHAT'S INSIDE



ICH Q3D(R2) draft Guideline

Cover photo credits:

Bugs: Alex Madonik - ACS

Periodic Chart: Science magazine (v. 363, issue 6426, pp. 474-478).

ICH Logo: Modified from ICH website, https://www.ich.org

Newsletter Editor Donald MacLean

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Alex Bruefach Named 2022 Outreach Volunteer of the Year

Alex Bruefach has been named a recipient of the 2022 Outreach Volunteers of the Year award for the California Local Section. An announcement with all of the awardees' names will be made around beginning of March, 2022 in *Chemical & Engineering News,* awardees photos and volunteer accomplishments will be published on ACS website at www.acs.org/voty, and profiles will be posted weekly on ACS social media accounts. From the pool of awardees, the ACS Committee on Community Activities will select one global winner who will be featured via the same article, website, and social media campaign.

Tri-Valley Science Fair at Alameda Fair Grounds – March 19th

By Alex Madonik | February 19, 2022

When: March 19, 2022 @ 10:00 am – 5:00 pm Pacific Time
Where: Alameda County Fair Grounds
2100 Valley Ave, Pleasanton, CA 94566
Cost: Free
Contact: Alex Madonik 510-527-6458
Email: alexmadonik@sonic.net

The Tri-Valley Innovation Fair goal is to connects everyone to the excitement of science, engineering, and technology. Over 50 exhibitors will showcase the region's rich and diverse accomplishments, and learning opportunities. You will meet the people who make innovation happen in local companies, schools, and community organizations. Interactive and hands-on activities will be featured indoors and outside. Special performances are also scheduled throughout the day. Activities will span a range of topics, including rockets, robots, agriculture, weather, chemistry, health, biotech, art, astronomy, insects, music, animals, and more! A detailed program and list of exhibitors will be posted on the Calacs.org website.

Cal ACS will be there with a booth featuring hands-on chemistry activities, copies of the Earth Week 2022 edition of Celebrating Chemistry and plenty of fun souvenirs for scientists of all ages. We're looking for VOLUNTEERS to help staff our booth — please contact Alex Madonik for more details.

This event is FREE, but register early for FREE parking.

Chemistry Olympiad Exam

By Eileen Nottoli

This year is a banner year for schools and students who have signed up to participate in the Chemistry Olympiad. Twenty-schools and 294 students plan to participate. The local exam will be administered in March and we will select the top sixteen students (with a limit of two selected from any one high school) to take the local section sponsored National Exam. This year's National Chemistry Olympiad exam will be held on April 30th at Los Positas College in Livermore.

We have expanded our tutoring of high school students with chemistry and chemical engineering undergraduates from the University of California, Berkeley. In addition, Alex Madonik and Peter Olds have been tutoring three students who were among the highest scorers in last year's Olympiad; we also offered one of the three top students a scholarship to a new tutoring program. We began our Cal student tutoring last year as a way of encouraging more schools to participate in the Olympiad, especially those outside the Bay Area. We plan to continue the tutoring program as long as our Cal tutors are willing. To say thanks we hosted a pizza party for our Cal tutors and will present them with a tee-shirt of their choice from the ACS store and their favorite element pin.

Charlie Gluchowski has made arrangements to have the local section participation for National Chemistry Olympiad at Las Positas College. We will partner again with the Silicon Valley Section. The national exam consists of three parts: a multiple choice exam, a word problem exam, and a lab practical.

Prepared by Alex Madonik and Sushila Kanodia

This April 17–23 chemists across the globe will join together to celebrate #ChemistsCelebrateEarthWeek. Participate by planning your own #CCEW event – or finding a scheduled event near you. Visit www.acs.org/ccew to learn more. #insectchemistry

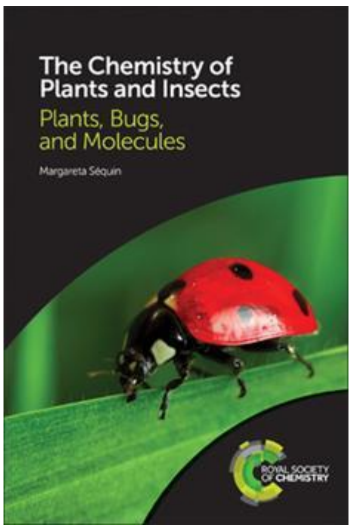
Chemists practice chemistry every day, but the celebration of Earth Day during month of April provides an occasion to focus on our role and our connection to the planet Earth and its resources. This year's ACS Earth Week theme is "The Buzz about Bugs: Insect Chemistry". In the California Section, we celebrate the 20^{th} anniversary ACS Earth Week with a virtual event on April 23^{rd} from 2 to 5 PM. This event will feature live demonstrations and interactive, hands-on chemistry, followed by virtual visit with ACS President Dr. Angela Wilson. Sign up online by March 31^{st}, and we will send you a FREE kit with instructions for three exciting, family-safe, hands-on chemistry activities. If you need additional resources, including extra copies of Celebrating Chemistry, you can contact us at CalACSEarthWeek@gmail.com

Visit the Cal ACS web site and sign up at https://calacs.org/outreach/earth-week/

Attention K-12 students: you can enter the Earth Week Illustrated Poem contest – visit our website at the link shown above for details and the entry form. Submit your entry electronically by Sunday, April 24th, 2022 for a chance to win prizes in one of four grade categories. Local winners will advance to the national ACS contest.

Another opportunity to show your imagination and creativity this year is the build-a-bug contest, using virtual parts of different insects to create something entirely new, and then naming your creation. Share a print of your bug electronically to enter the contest at **https://calacs.org/outreach/earth-week/**

Our website offers a variety of resources for Earth Week and do-it-yourself science. You'll find links there to other Bay Area resources, including the **Essig Museum of Entomology**.



If you want to dig further into this topic, former Cal ACS Chair Margareta Séquin has written an engaging book that is the perfect starting point: **The Chemistry of Plants and Insects: Plants, Bugs, and Molecules**. This book explains the natural chemical compounds that determine the fascinating interactions between plants and insects, providing a gentle and absorbing introduction to organic chemistry that is highly relevant to everyday life and to the natural world and much more. A fascinating read!

Again this year the in-person event at John Muir National Historical Site has been cancelled due to COVID health concerns.

The Irony of Iron

Part 3

by Bill Motzer

In Part 2 of this series (February 2020 Vortex), I discussed some iron element fundamentals, abundances, and concentrations in the Universe, Sun, meteorites, Earth's crust, mantle and core, the ocean, freshwater, and the human body. How such iron concentrations got there is rather intriguing, but we need to start at a beginning.

Iron is created within stars as a result of stellar nucleosynthesis. Iron's formation and distribution throughout the Universe occurs in either super massive exploding stars or white dwarf exploding stars (Figure 1). Several astrophysical processes are theorized for nucleosynthesis to occur within stars, with the chain of nuclear fusion processes commonly called hydrogen "burning" (i.e., by deuterium fusion, the proton–proton chain reaction, and the carbon-nitrogen-oxygen or CNO cycle), and subsequent helium (He)-, carbon (C)-, neon (Ne)-, oxygen (O)- and silicon (Si)-burning (Table 1). These processes create elements up to and including iron (Fe) and nickel (Ni). However, in super massive stars, such as red giants, once Si-burning is completed and Fe and Ni forms in its core, stellar nucleosynthesis ceases. Subsequent gravitational collapse then occurs with the star's upper layers descending inward toward the core with associated heating before exploding as a Type II supernova (Figure 2). This collapse almost immediately results in an explosion with a compressional shock wave rebounding outward. The shock front briefly increases temperatures by approximately 50 percent. This causes furious burning (fusion) for about one second thereby finally resulting in explosive nucleosynthesis or supernova nucleosynthesis by the r-process (rapid-neutron capture process), the final end-stage of stellar nucleosynthesis.

Such super massive stars are least eight times and not more than 40 to 50 times, the Sun's mass of approximately 2×1030 kg, typically averaging about 25 solar masses (Table 1). They are rather short-lived stars with ages of approximately 107 years and are also believed to have been some of the first stars formed after the Big Bang.

Type II supernova generally are differentiated from other supernova types and their remnants (aka a supernova remnant or SNR) by occurrence of hydrogen in their spectra. They are usually observed in galactic spiral arms and in H-II regions, (i.e., regions of interstellar partially ionized atomic hydrogen, typically occurring as gaseous molecular clouds where star formation has recently occurred. Sizes range from one to hundreds of light years in diameter with densities ranging from a few to about a million particles per cm3). One such SNR is the Orion Nebula, now known to be an H-II region. Other SNR with iron in their spectra includes Cassiopeia A (Figure 3). It's these SNR that have scattered iron and other elements across the Universe, accumulating in galaxies, stars, and ultimately in our solar system.

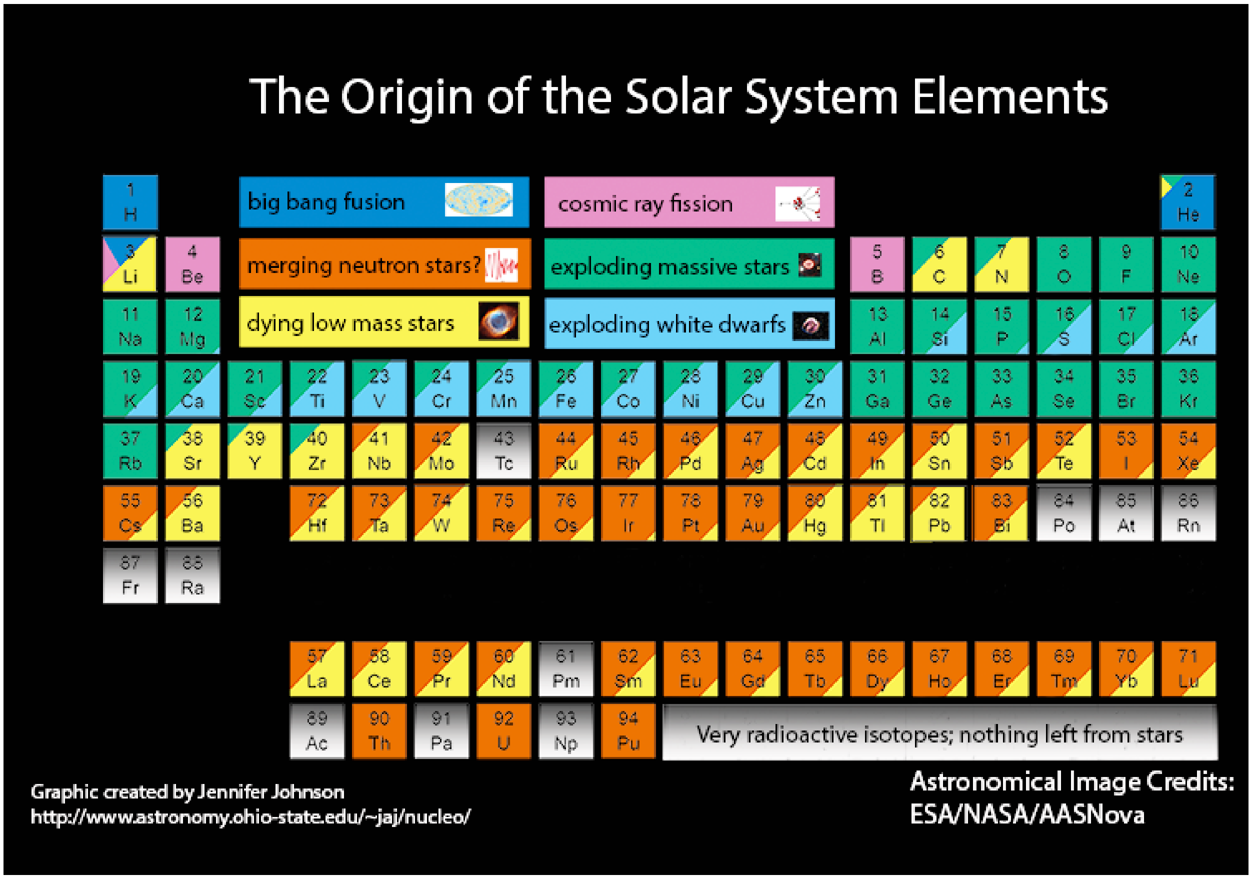


Figure 1: Elemental origins for the solar system in the Periodic Table. Source: NASA and Professor J. Johnson "Populating the Periodic Table: Nucleosynthesis of the Elements" in the February 1, 2019 issue of Science magazine (v. 363, issue 6426, pp. 474-478). You can freely access and download this paper at: https://science.sciencemag.org/content/363/6426/474.

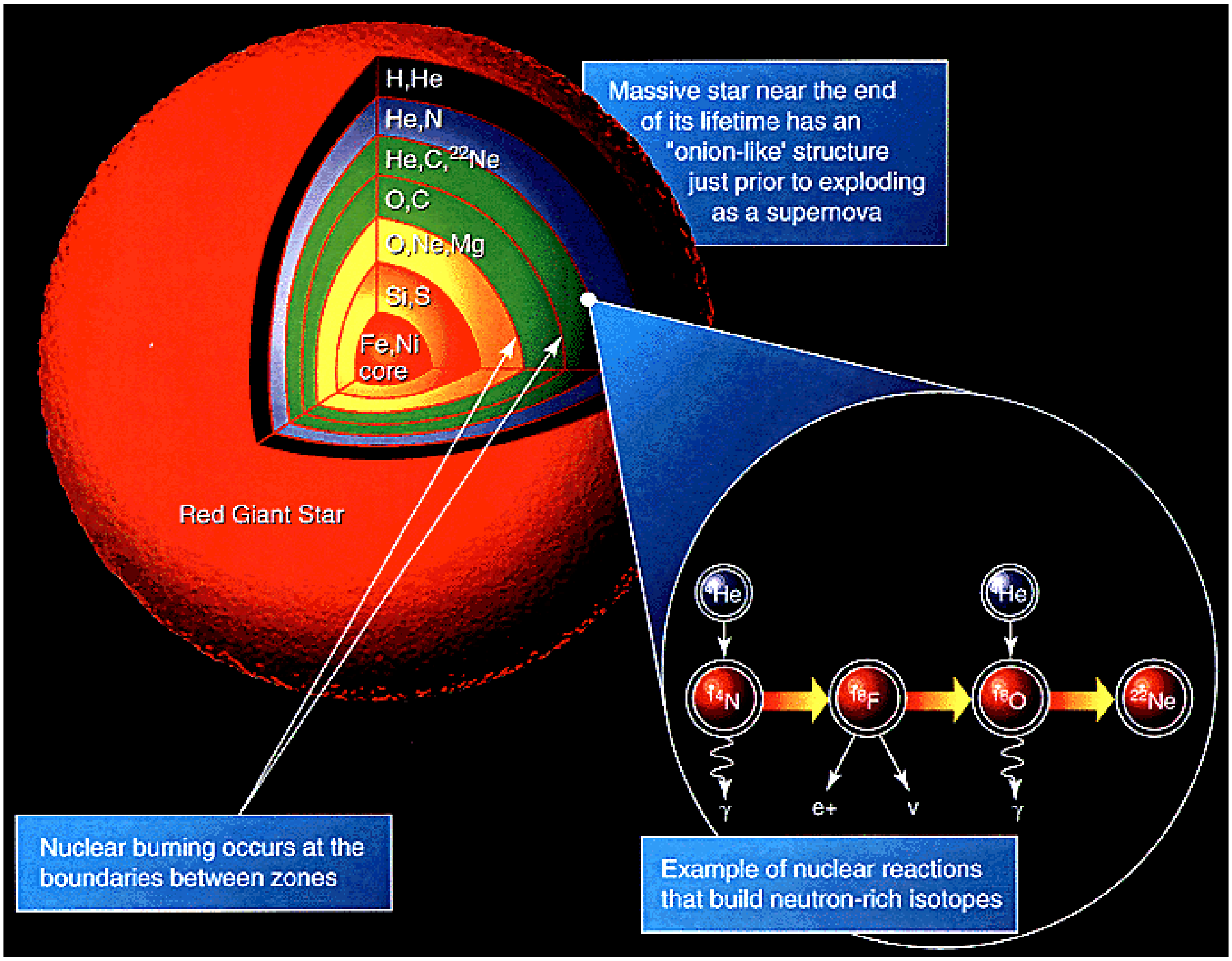


Figure 2: Nuclear synthesis in a supergiant red star just before stellar collapse and subsequent explosion as a supernova. Source: NASA.

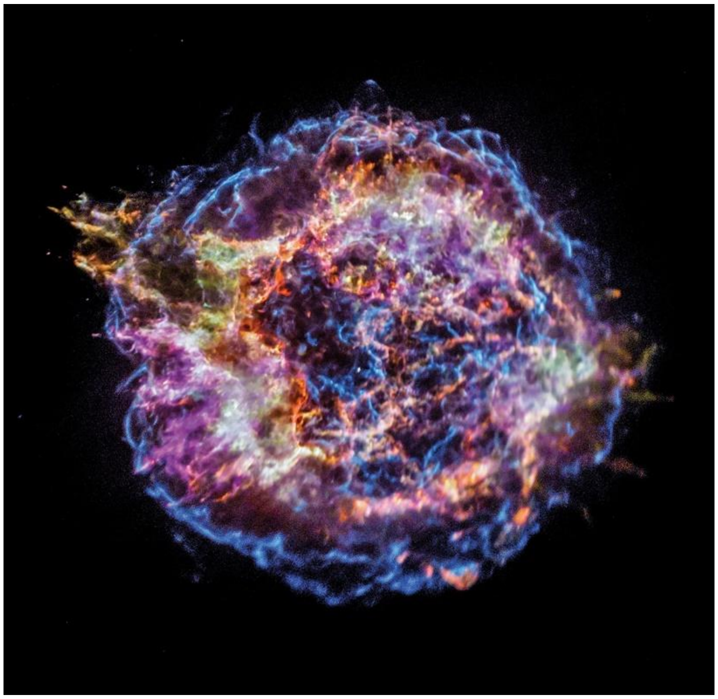


Figure 3: X-ray spectral image transposed to visual light of the Cassiopeia A collapse-core supernova remnant (SNR): silica (Si) shown in red, sulfur (S) in yellow, calcium (Ca) in green, iron (Fe) in purple, and the blast-boundary in blue. From J. Johnson (2019) open access paper. See also *Digital Dentistry Revisited* in the October 2020 Vortex.

Table 1: Super Massive Red Giant Nucleosynthesis Processes and Products

Process	Main Fuel	Main Products	Typical Star: 25 Times Solar Mass		
			Temperature (K)	Density (g/cm^3)	Duration
H-burning	H	He	7×10^7	10	10^7 years
Triple alpha*	He	C, O	2×10^8	2,000	10^6 years
C-burning	C	Ne, Na, Mg, Al	8×10^8	10^6	10^3 years
Ne-burning	Ne	O, Mg	1.6×10^9	10^7	3 years
O-burning	O	Si, S, Ar, Ca	1.8×10^9	10^7	0.3 years
Si-burning	Si	Ni (decays to Fe)**	2.5×10^9	10^8	5 days

Notes:
* The triple alpha process is a nuclear fusion reaction where three helium nuclei (alpha particles) fuse to form a carbon nucleus, thereby releasing energy. Triple alpha processes typically occur in stars where large amounts of He have accumulated as the product of proton-proton chain and CNO reactions.
** This is known as the iron limit. Iron-56 (^{56}Fe) is abundant in stellar processes with a binding energy of 8.8 MeV per nucleon. Its binding energy is only exceeded by ^{58}Fe and ^{62}Ni, which are the most tightly bound of the nuclides.

Albany Bulb, Albany (Alameda County)
By Donald MacLean

The Albany bulb is the former city dump next to Golden Gate Fields Race Track in Albany. Next to it is the Albany Mudflats State Marine Park. The bulb is a protruding land fill with concrete slabs and iron pipes / reenforcing rods showing the original of the bulb 50 years after the dump closure. If you are old enough, you will remember the mudflat art on the Emeryville side of the Bay Bridge. That art is now gone, but something like that persists at the Bulb. What makes the Bulb interesting is the burrowing owl habitat project. The area is being resculptured for habit while maintaining the small sand beach for dogs. There are lots of birds that use the low tide as a food source at the typical mud flat. The mud flat is not flat, rather has a maze-like water path structure. Along the shore are trees where bird sing to attract mates, and also the smell of horse poop from the track. The unfortunate part is the dumped tires at the shore. Ignoring that it is a good place to see Nature, and in good time the concreate will degrade back into aggregate stone.

Parking: Problematic at times
Cost: Free
Best Time: Warm middays at low tide

Selected Pharmacopeial News

ICH Q3D Proposal for Elemental Impurities On- and Through- the Skin Drug Products.

By Donald MacLean

What is ICH?:

ICH (The International Council for Harmonization) is an initiative that brings together regulatory authorities (i.e. FDA, USP) and pharmaceutical industry to discuss scientific and technical aspects of pharmaceutical product development and registration. ICH topics are divided into four categories that begin with a Guideline code: Q: Quality, S: Safety, E: Efficacy, and M: Multidisciplinary. The number that follows the letter indicates the area within the category. Q3A to Q3F refer to impurities. Q3D refers to elemental impurities. The (R1) refers to version 1, (R2) to revision 2.

ICH has proposed corrections to the Q3D (R1) for Au, Ag, and Ni for the oral, parenteral, and inhalation routes. In addition, it proposed elemental impurity limits for cutaneous and transcutaneous routes for the same 24 elements. This proposal includes a special category-sensitive level for nickel and cobalt. FDA posted its guidance on May 12, 2021 for the ICH Q3D (R2) proposal with 30-day public commentary closed on June 11, 2021 (it has closed).

Their Link is https://www.fda.gov/regulatory-information/search-fda-guidance-documents/q3dr2-guideline-elemental-impurities.

Before proposed Q3D (R2):

Prior to adopting the current ICH Q3D (R1) recommendations, United States Pharmacopeia (USP) and European Pharmacopoeia (EP also known as Ph Eur) selected individual element concentrations were stated in a monograph using a particular method, or if grouped as heavy metal they were stated with comparison to Pb / S species color and / or quantity. EP chapter 2.4.8. “Heavy Metals” and the USP general chapter <230> “Heavy Metals” (not enforceable as of January 1, 2018, but still official) are directed toward heavy metal concentration determination for excipients, and drug products. Currently USP / EP / and JP (Japanese Pharmacopoeia) have specific elemental impurity procedure chapters for selected elemental impurities, but rely on monographs to state the concentration limits if one is different than Q3D (R1). Drug product will have PDE (Permitted Daily Exposure) limits for 24 elements listed in Q3D (R1). Drug substance (API, Active Pharmaceutical Ingredient), excipient, and processing aids may have limits as shown with the chitosan monograph shown below. Drug Product elemental impurity limits may be listed in its monograph if an element has a stricter limit than that listed in USP general chapter <232>, or if the elemental impurity (ies) is (are) not one of the 24 elemental impurities listed USP general chapter <232> Elemental Impurities – Limits, also known as Q3D (R1).

Table 1. Elemental impurities limits for Chitosan from USP 2022 chitosan monograph. NMT = Not More Than. Note that selected elements are stated as not more than (NMT) ppm, which is not adjusted to the dose, or administration route since this is not a drug product.

Table. From USP 2022 Chitosan Monograph Table 2.	
Element	Acceptance Criteria (ppm)
Lead	NMT 0.5
Mercury	NMT 0.2
Chromium	NMT 1.0
Nickel	NMT 1.0
Cadmium	NMT 0.2
Arsenic	NMT 0.5

In another case where Q3D (R1) is not followed is with dietary supplements chapter <2232> Elemental Contaminants in Dietary Supplements. Here species limits for arsenic and mercury are different than that in USP general chapter <232> Elemental Impurities - Limits. Read the chapter for details.

Table. Limits of Elemental Contaminants from Table 1 USP <2232> Elemental Contaminants in Dietary Supplements and <232> Elemental Impurities - Limits		
Element	**PDE for dietary supplement <2232> (µg/day)** [a]	**PDE for oral route in USP <232> (µg/day)**
Arsenic (inorganic) [b]	15	15 not sourced specific
Cadmium	5	5
Lead	5	5
Mercury (total)	15	30
Methylmercury (as Hg) [c]	2	NA

[a] Permitted Daily Exposure (PDE) is derived from the Provisional Tolerable Weekly Intake (PTWI) that is recommended by the Food and Agriculture Organization of the United Nations and World Health Organization (FAO/WHO) by subtracting the daily exposure (µg/day) to each elemental contaminant from air, food, and drinking water. A body weight of 50 kg and a safety factor are used to calculate the PDE. Other regulations (e.g., Proposition 65 in California) may require different limits; manufacturers are responsible for compliance with applicable local requirements differing from these PDE values.

[b] Arsenic may be measured using a nonspeciation procedure under the assumption that all arsenic contained in the supplement is in the inorganic form. Where the limit is exceeded using a nonspeciation procedure, compliance with the limit for inorganic arsenic shall be demonstrated on the basis of a speciation procedure.

[c] Methylmercury determination is not necessary when the content for total mercury is less than the limit for methylmercury.

With the adaptation of Q3D under USP <232> "Elemental Impurities- Limits", EP 5.20 "Elemental Impurities", and JP17 S2 section G1, 24 elemental impurities are treated using PDE (Permissible Daily Exposure) based on the amount of material being dosed (EP excludes veterinary products, see list in USP <232> for USP exclusions) for 3 administration routes.

Therefore, the allowable concentration for a dose of 1 mg will be different than that of 10 mg. The elemental Impurities PDE limits do not differentiate charge or whether the element is organic or inorganic with an except for herbal medicines (see USP <2232>).

24 elements are listed and categorized into 3 classes based on severity:

Class 1 being the big 4 (Cd, Pb, As, Hg);

Class 2 B (Co, V, Ni), and class 2B (Tl, Au, Pd, Ir, Os, Rh, Ru, Se, Ag, Pt), and;

Class 3 (Li, Sb, Ba, Mo, Cu, Sn, Cr).

Note 1: aluminum is not part of the this but has a special case for nutrition due to kidney toxicity (see USP general chapters <7> Labeling and <1> Injections and Implanted Drug Products (Parenterals) – Product Quality Tests, EP Parenteral Preparations (Text number 0520), or JP section G1- Test for Trace Amounts of Aluminum in Total Parenteral Nutrition (TPN) Solutions).

Note 2: limits do not apply for various applications such as Veterinary. Example: copper is considered toxic to sheep where copper is replaced with selenium.

Currently only oral, parenteral (injections and implanted drug products), and inhalation routes are referenced. Sometimes the parenteral PDE may be higher than the inhalation PDE, and sometimes this may be the other way around. In the proposed ICH Q3D (R2) the cutaneous (applied to the skin) and transcutaneous (transdermal) routes are considered.

Cutaneous Route Description:

Drugs applied to the skin surface which are usually used for their local effects. Disorders treated this way are psoriasis, eczema, skin infection, itching, and dry skin.

Transcutaneous Route Description:

Drugs delivered bodywide through a skin patch. These drugs are sometimes mixed with enhancer chemicals. Example of drugs that are given through the transcutaneous route (transdermal) are nitroglycerin (chest pain), scopolamine (motion sickness), nicotine (smoking cessation), clonidine (high blood pressure), and fentanyl (pain relief).

Proposal for cutaneous and transcutaneous route PDE:

The proposed route uses the existing parenteral PDE (Permitted Daily Exposure) as a base line and adjust upward or downward to obtain cutaneous and transcutaneous values. Part 4 of Q3D (R2) starts out with background, scope, principles of safety assessment for cutaneous products, establishing the cutaneous PDE using the cutaneous modifying factor (CMF), product risk assessment before listing cutaneous PDE values.

Note 1: The condition and location of the skin make a difference to absorption. Just as the elemental impurities PDE limits did not take into account charge and complex, the assumption for cutaneous and transcutaneous has some assumptions such as healthy versus damaged skin, use of enhancers, and allergic potential.

Note 2: The proposal does not apply to drug products intended for mucosal, topical ophthalmic, rectal, of subcutaneous and subdermal routes (the last 2 are parenteral and related to the skin).

Note 3: dermal products differ from oral, parenteral or inhalation products in that they may be removed (i.e. patch), rinsed from the application area (i.e. shampoo), or have constant exposure due the mechanism of application (i.e. transdermal patch).

Special Cutaneous Concentration Limits for Nickel and Cobalt:

A concentration limit in addition to the PDE is warranted for Nickel (Ni) and Cobalt (Co) to reduce the likelihood of eliciting skin reactions in already sensitized individuals. This concentration limit is referred to as the cutaneous and transcutaneous concentration limit (CTCL). [4]

ICH Q3D (R2) proposal:

See snip and clip below from FDA guidance for the addition cutaneous and transcutaneous route PDE proposal. [4]

Table 1: Cutaneous products – PDE, CTCL and elements to be included in risk assessment

Element	Class	From ICH Q3D(R1) for comparison PDE (µg/day)			Cutaneous products		
		Oral	Parenteral	Inhalation	PDE (µg/day)	CTCL (µg/g) for sensitizers	Include in Risk Assessment if not intentionally added[1,2,3]
Cd	1	5	2	3	20	-	yes
Pb	1	5	5	5	50	-	yes
As	1	15	15	2	30	-	yes
Hg	1	30	3	1	30	-	yes
Co	2A	50	5	3	50	35	yes
V	2A	100	10	1	100	-	yes
Ni	2A	200	20	6	200	35	yes
Tl	2B	8	8	8	8	-	no
Au	2B	300	300	3	3000	-	no
Pd[4]	2B	100	10	1	100	-	no
Se	2B	150	80	130	800	-	no
Ag	2B	150	15	7	150	-	no
Pt	2B	100	10	1	100	-	no
Li	3	550	250	25	2500	-	no
Sb	3	1200	90	20	900	-	no
Ba	3	1400	700	300	7000	-	no
Mo	3	3000	1500	10	15000	-	no
Cu	3	3000	300	30	3000	-	no
Sn	3	6000	600	60	6000	-	no
Cr	3	11000	1100	3	11000	-	no

[1] Intentionally added elements should always be included in the Risk Assessment.
[2] Class 2B elements were excluded from the assessment of oral, parenteral and inhalation products due to the low likelihood that they would be present if not intentionally added (see section 4 of ICH Q3D).
[3] Class 3 elements with a cutaneous PDE above 500 µg/day do not have to be included in the risk assessment unless intentionally added (see section 4 of ICH Q3D)
[4] Pd PDE will apply to iridium, osmium, rhodium, and ruthenium.

Figure. Snip and clip for the Cutaneous Product PDE. Note Missing 4 elements in Q3D (R2) but put in footnote.

References:

1. USP 2022, https://online.uspnf.com/uspnf
2. Pharm Eur 10.6, https://pheur.edqm.eu/home
3. Supplement II to the Japanese Pharmacopoeia – https://www.whlw.go.jp
4. Q3D(R2) – Guideline for Elemental Impurities - https://www.fda.gov/regulatory-information/search-fda-guidance-documents/q3dr2-guideline-elemental-impurities
5. Q3D (R2) Draft Guideline - https://www.ich.org/news/ich-q3dr2-draft-guideline-available-now-ich-website
6. ICH guideline Q3D (R2) on elemental impurities Step 2b - https://www.ema.europa.eu/en/documents/scientific-guideline/draft-ich-guideline-q3d-r2-elemental-impurities-step-2b_en.pdf

The Stories We Tell as Women in Science: WCC Talk by Dr. Fanny Frausto Arellano, 2/12/2022

By: Greti Sequin

This year's first meeting of the California Section's Women Chemists' Committee (WCC) featured a talk by our current Section chair and WCC Co-Chair Dr. Fanny Frausto Arellano. The well-attended ZOOM gathering was introduced by Dr. Elaine Yamaguchi who cordially welcomed the attendees. She stressed what a valuable and supportive place these seminars are for networking, events in which "All Are Welcome". Before the beginning of the talk the various break-out rooms allowed for small groups of guests to get to know each other better and to exchange first ideas. Seminar attendees included students at various levels of their studies, advanced chemists, reporters, and retired scientists of diverse backgrounds,

After introductions Dr. Frausto presented a lively and encouraging talk on "The Stories We Tell As Women In Chemistry". Inspired by a professor who introduced an organic chemistry principle with a story she described the various stages of her life, with all their challenges, in stories that led from her early childhood to her present-day position as an accomplished chemistry professional.

Dr. Frausto was born in Mexico. Her father was an engineer. When she was a small child her family moved to Texas as undocumented immigrants. The new country presented serious challenges, mainly regarding language, but also regarding everyday life habits (food tasted different!). But she also discovered similarities with her earlier life in Mexico (like certain television programs). The media, including TV and especially the public library, provided a first community and an important introduction to the new country and its culture. As a child Frausto seriously studied English. She stressed how important her father's encouragement was. Going to a Magnet School for the Talented and Gifted and taking AP tests were further essential steps in her learning progress. She is most grateful to the teachers who believed in her and encouraged her in her education.

Entering college, in a bachelor's program at MIT, led her to a new and different story of her life, with new rules, new challenges, new experiences. She had to find a new community and learned that admission is not the same as acceptance. She greatly appreciated the encouragement of a woman professor and also gratefully acknowledged the scholarship support by ACS,

Her father's sudden illness forced her to obtain a job as a process chemist at a contract research firm. There she found that most chemists around her had Ph. D.'s. This led her to realize that this was what she needed, too. Subsequently she went on to obtain her Ph. D. from Tuft's University. Dr. Frausto is presently working as a Senior Scientist in formulation chemistry and data analytics at the Clorox Company.

At some point Dr. Frausto realized that aside from all the hard work that led to her successful professional progress it was most important to have a life, too, and not to get burned out, a point that she stressed repeatedly. Aside from the basic needs for life security and basic income, psychological needs and self-fulfillment are just as important. When she realized the need to destress, she took (and takes) time out for great traveling, hiking and other relaxing past time activities. She strongly advised to take out time for yourself, outside of your professional life. Dr. Frausto also finds great satisfaction and enjoyment in being a mentor.

At the conclusion she gratefully acknowledged the support of her family, especially by her father, and also by supportive teachers and by ACS.

There was a lively discussion after the talk and a chance for attendees to win ACS-themed prizes by answering questions based on Fanny's talk. In this trial experiment, a CA Section first, nine people from all over the country won prizes. The WCC is happy to recognize this volunteer participation.