THE VORTEX

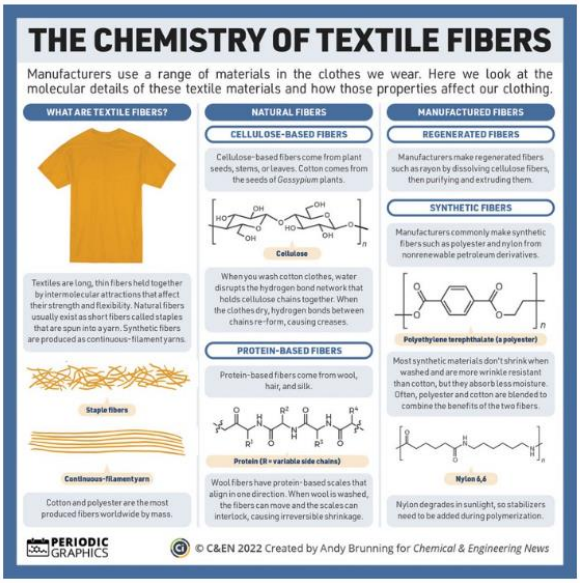
The American Chemical Society
California Section Newsletter

October 2022, Issue 10, Volume 84

WHAT'S INSIDE

Meetings, Activities, and News

History and Education



Review (s)

The Vortex is published monthly except July and August by the California Section, American Chemical Society. Opinions expressed by the editors or contributors to *THE VORTEX* do not necessarily reflect the official position of the Section. The publisher reserves the right to reject copy submitted. Subscription included in the annual dues payment. Nonmember subscription $25.

MAGAZINE OF THE CALIFORNIA SECTION, AMERICAN CHEMICAL SOCIETY

Editor:
Donald MacLean
Donald.maclean.acs@gmail.com

Article Contributors:
Nicki Davis
William Motzer

Office Administrator Manager:
Julie Mason
2950 Merced St. #225
San Leandro, CA 94577
510-351-9922
office@calacs.org
web site: http://www.calacs.org

Editorial Staff:
Outreach: Alex Madonik
Editor: Jim Postma and Linda Wraxall
Web Page Posting and Editor: Al Verstuyft

Cover Photo Credits: Top Canva.com – Blue and Orange Summer Bucket List Engagement Facebook Post. Chemistry and Engineering News, June 27, 2022. Middle: Bottom: Photos at Marine Mammal Center by Donald MacLean

Looking for material for The Vortex. If you have material you think is worthy, submit it to the Donald.maclean.acs@gmail.com.

Note these are being republished from the September issue with updates. These may be out of date when The Vortex is published.

Oct 3 - Social Networking – LA Angels vs Oakland A's game (Oakland)

By Fanny Frausto

CALACS at the Oakland Coliseum! **Monday October 3rd – LA Angels vs Oakland A's at 6:40pm**.

Thank you to Vanessa Marxs for securing our seats this year near First Base.

The cost of the tickets is $40.00, which includes fees and a 20$ concessions credit. Once we receive your payment, you will be sent a link to get your tickets! Members are encouraged to bring their families, friends, and colleagues to this fun event. Contact office@calacs.org.

Location:

Oakland Coliseum
7000 Joe Morgan Wy
Oakland
CA 94621

2022 Bay Area Chemistry Symposium

Organizer: Patrick Lee

Date: November 10, 2022

Location: Pauley Ballroom (UC Berkeley)
2495 Bancroft Way Berkeley, CA / Hybrid

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 2022 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 happening across the Bay Area's outstanding institutions.

This year's featured academic speakers:

Prof. Tom Maimone - UC Berkeley

Prof. Annaliese Franz - UC Davis

Prof. Ian Seiple - UCSF

Sponsors:

AbbVie, ACS, Cytokinetics, Maze Therapeutics, Merck, Novartis, Nurix

Ascendis, Eikon Therapeutics, Genentech, Schrodinger

See calacs.org web site to register. Seats will be limited to 250 people and an additional limit on the number of people from the same institution.

Cost: TBA

Cal ACS Local Section Wins P3 Award

The Cal ACS section was selected as the winner of the 2022 WRM P3 (Western Regional Meeting, Partners for Progress and Prosperity) award for BACS (Bay Area *Chemistry* Symposium). A member from the local section will attend the award ceremony on October 22 at 5:30 pm (Las Vegas).

Information about the award can be found at

https://www.wrm2022.com/partners-for-progress-and-prosperity-regional-award.html

Solano Stroll Thank You Participants

By Alex Madonik

We had a very successful day at the Solano Stroll -- thank you, Greti Séguin, Michael Cheng, Jen Schmitt, Jerry Oliveras, Emiko Yoshizumi, and their friend Joyce! Hundreds of visitors stopped to try hands-on activities (UV-color-changing beads and dyeing of different types of fibers). They collected Periodic Table wallet cards, NCW buttons and stickers, and copies of Celebrating Chemistry. Special thanks to Eileen Nottoli for working with me to create test cards with strands of acrylic, cotton, rayon, and wool for testing with various dyes.

Section Officers Nominees Election Call

For Michael Cheng

The section has an election coming up. Many positions are open, please email the Cal ACS section at office@calacs.org with title directed for Alicia Taylor if interested.

The following are open positions (number open slots):

1. Chair elect (1) – 3 year Chair sequence
2. Secretary (1) – 2 years
3. Councilor (3) – 3 years
4. Alternate Councilor (4) – 3 years
5. Director at large (1) – 2 years
6. Member at large (5) – 2 years

Please note that there will not be a ballot item for Alternate Councilor; the ballot item will be for Councilor. The top three will be Councilor, and the others will be Alternate Councilor.

The CalACS election roster indicates all voting members (2246) have email. The election is done electronically, usually by an email link to Survey Monkey. Contact Julie Mason at office@calacs.org if you need a paper ballot. A ballot will be mailed to you.

August 2022 Cal ACS Membership Breakdown

By Donald MacLean

The Cal ACS section membership numbers are declining steeply. Going forward the decline will be due in part with reclassification of nonpaying / late paying member to Community Associate, but as of July 31, 2022 only 1 person is classified as Community Associate. The information that is provided by National ACS is a bit confusing as there is ongoing transition with moving nonpaying members into the Community Associate category and not counting them as members. Some of the decline can also be from Covid related fatigue, lower meeting attendance, and reduced industrial support. The following show the number trend and demographics.

Table 1. Local Section Membership Numbers

Year	Section Members	Voted in Section Election	Percent Voted	Change in members from previous year	Percent change from previous year
Aug 2022	2339	NA	NA	NA	New classification started in summer
End 2021	2774	268	9.7%	-278	9.1%
Mar 2021	2950	NA	NA	NA	NA
End 2020	3052	250	8.2%	-58	1.9%
End 2019	3110	240	7.7%	-206	6.2%
End 2018	3316	271	8.2%	-117	3.4%
End 2017	3433	335	9.8%	NA	NA

Table 2. Cal ACS Member Type as of July 31, 2022

Group	**Count**	**%**
Community Associate	1	0.04
Emeritus Member	460	19.55
Local Section Member	3	0.13
Regular Member	1374	58.39
Regular Student Member	165	7.01
Retired Member	118	5.01
Society Affiliate	120	5.10
Student Member - UnderGrad	112	4.76
Total	**2353**	**100.00**

The majority of members are classified as Regular members, followed by Emeritus Members (criteria are at least 35 years as member and at least 70 years old).[1]

Table 3. Cal ACS Gender as of July 31, 2022		
Group	**Count**	**%**
Female	620	26.35
Male	1514	64.34
Non-binary/third gender	9	0.38
Prefer not to say	8	0.34
Prefer to self-describe	1	0.04
N/A	201	8.54
Total	**2353**	**100.00**

The overall section membership is 64.34% male (Table 3). ACS has published a diversity report that reports based on 10 year periods.[2] What is interesting is the increasing percent of women going from 31+ years after PhD attainment (16.9%), 21 to 30 years (21.3%), 11 to 20 years (26.3%), then about the same percentage for the 0 to 10 year period (26.1%) (data not shown).

Table 4. Cal ACS Years of Service and Age as of July 31, 2022						
	In Service			**Age**		
Service (years)	**Count**	**%**		**Age (years)**	**Count**	**Sum 5 year period for age**
0	22	0.93		11-20	20	NA
1	505	21.46		21-25	114	114
2	192	8.16		26-30	132	132
3	165	7.01		31-35	141	141
4	102	4.33		36-40	114	114
5	78	3.31		41-45	95	95
6-10	292	12.41		45-50	122	122
11-15	199	8.46		51-55	133	133
16-20	148	6.29		56	31	166
21-25	134	5.69		57	31	
26-30	68	2.89		58	33	
31-35	46	1.95		59	34	
36-40	72	3.06		60	37	
41-45	75	3.19		61	24	174
45-50	77	3.27		62	40	
51-55	65	2.76		63	34	
56-60	46	1.95		64	31	
61+	67	2.85		65	45	
				66	28	156
				67	33	
				68	40	
				69	27	
				70	28	
				71+	566	NA
				NA	420	
Total	**2353**	**100.00**		**Total**	**2353**	

For years of Service note the high 1-year value then sharp drop at 2 years (Table 4). It is interesting that the 31-35 group has a dip that picks up in the 1990's. The relative high number at 40+ years probably reflect a higher membership number in the past. Assuming that the average BA / BS degree is award at age 23, 31 years added to that would place the 31-35 year group at age 54 to 59 years. The real dip is age 61. Combine that with PhD being award around age 28 (5 years later), the age dip at 61 years correlates. There is also a dip for the 41-45 year group.

References:

[1] Alexander A. Taylor, Chemistry and Engineering News, 94 (41), October 17, 2016.

[2] ACS Publications Diversity Data Report 2021, American Chemical Society.

The Irony of Iron
Part 8
by
Bill Motzer

Introduction: In Part 7 (September 2022 *The Vortex*), I discussed how one mantle (volcanic) plume probably caused one of the Earth's greatest extinctions and how iron (Fe) in the mineral pyrite (iron sulfide or FeS_2) was an indicator of almost world-wide anoxia with the depletion of oceanic soluble hydrous ferrous [Fe(II)] oxides. However, oceanic Fe concentrations soon returned to normal as the Earth biosystems recovered and complex life (principally vertebrates and some invertebrates) continued using Fe in the form of blood hemoglobin (Hb). But when did complex life develop and begin using it as an O_2 transporter? More about that later, but first let's discuss Hb.

Some Hb Fundamentals: Hb is the Fe-containing O_2-transport metalloprotein contained in red blood cells (erythrocytes) of almost all vertebrates (except for the *Channichthyidae* fish family) and some invertebrate tissues. Hb in blood transports O_2 from the respiratory organs (i.e., lungs or gills) to the rest of the body's tissues, where it releases O_2 permitting aerobic respiration providing the energy for an organism's metabolism.

In most mammals, chromoprotein comprises approximately (~) 96% of red blood cells' dry content (by mass), and ~35% of total when water is included. Hb's oxygen-binding capacity is 1.34 mL O_2/g, increasing total blood capacity about 70 times when compared to dissolved O_2 in blood. Mammalian Hb molecules can bind up to four O_2 molecules. In humans, Hb ranges from 12 to 20 g of Hb for every 100 mL of blood.

Hb also transports other gases, including ~20 to 25% of the body's respiratory carbon dioxide (CO_2) as carbaminohemoglobin (CO_2Hb), where CO_2 is bound to the heme protein. Twenty-three percent of blood CO_2 is carried in this form with 70% converted into bicarbonate (HCO_3^-) by carbonic anhydrase, a metalloenzyme group that catalyzes conversion between CO_2 and water and dissociated ions of carbonic acid [i.e., HCO_3^- and hydrogen (H^+) ions]. This enzyme also maintains acid-base balance and aids in CO_2 transport in plasma. The remaining 7% of blood CO_2 is dissolved as free CO_2 in plasma. CO_2Hb also carries and transports the important controlling nitric oxide (NO) molecule that's bound to a thiol group in the globin protein, releasing it at the same time as oxygen.

Hb Structure and Activity: Hb has a quaternary-type structure, occurring in many multi-subunit globular proteins. Most Hb amino acids form alpha helices connected by short non-helical sections with hydrogen bonds stabilizing the protein's interior helical sections. This produces intermolecular attractions, causing folding of each polypeptide chain into a specific

shape. Hb's quaternary structure occurs from its four subunits in a rough tetrahedral assembly (**Figure 1**).

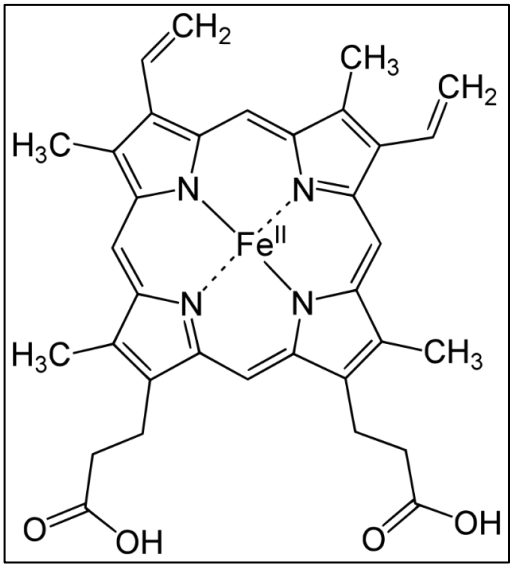


Figure 1: Part of hemoglobin (Hb) structure showing a porphyrin ring, which contains a central iron (Fe) group, linked to four nitrogen (N) atoms of all pyrrole rings of porphyrin. See text for complete description. Source: Memon, et al., (2018).

In most vertebrates, the Hb molecule is built from four globular protein subunits each composed of a protein chain associated with a non-protein prosthetic (the structural non amino acid component of hetero- or conjugated proteins linked to the apoprotein or apoenzyme required for the protein's biological activity) heme group. Each protein chain assembles as a set of alpha-helix structural segments connected together in a globin fold arrangement, which is the same folding pattern employed by other heme/globin proteins (i.e., myoglobin). This folding pattern contains a pocket strongly binding the heme group.

A heme group consists of a Fe ion in a heterocyclic ring (aka porphyrin ring) with four pyrrole molecules, cyclically bound by methine (CH^-) bridges. These are center bound with the Fe ion, the site of oxygen binding, coordinating with the four nitrogen (N) atoms in the ring's center, all arranged in one plane. Heme is strongly covalently bound to the globular protein via the N atoms of the imidazole ($C_3N_2H_4$) ring of a histidine ($C_6H_9N_3O_2$) amino acid residue (aka proximal histidine) below the porphyrin ring. A sixth position can reversibly bind O_2 by a coordinate covalent bond, completing the octahedral group of six ligands. This reversible bonding with O_2 why Hb is so useful for transporting O_2 throughout the body. O_2 binds in an "end-on bent" (where generally the central atom has two lone electron pairs associated with two bond pairs) arrangement, where one oxygen atom binds to Fe and the other projects at an angle. When oxygen is not bound, a very weakly bonded water molecule fills the site, forming a distorted octahedron. Although CO_2 is carried by Hb, it doesn't compete with oxygen for Fe-binding positions because it's bound to the protein chain's amine groups that are attached to the heme groups.

Oxidation Chemistry: In Hb, the Fe ion may occur in ferrous [Fe(II)] or ferric [Fe(III) oxidation states. However, methemoglobin [aka ferrihemoglobin or ferriHb because Fe occurs as Fe(III)] cannot bind oxygen. In binding, oxygen temporarily and reversibly oxidizes ferrous Fe to ferric Fe with oxygen temporarily turning into a superoxide (O_2^-) ion. Therefore, Fe must exist as Fe(II) to bind oxygen. If the O_2^- associated to Fe(III) is protonated, Hb Fe will remain oxidized and incapable of binding oxygen. In such cases, the enzyme ferriHb reductase will be able to eventually reactivate ferriHb by reducing the Fe center.

Hb Origins are lost in antiquity. Did oceanic chlorophyll-containing cyanobacteria, that are believed to have produced Earth's first free O_2, at some point evolve into Fe fixing bacteria? And

did these chlorophyll producing organisms, which has a structure similar to Hb, evolve into Hb producing organisms? Cyanobacteria have extensive fossil records with the oldest known forms from 3.5 billion year old Precambrian (Archaean Eon) rocks of western Australia, They are some of most recognizable microfossils with group morphologies remaining unchanged for billions of years and also leaving chemical fossil traces as pigment breakdown products. Microfossil cyanobacteria have been extracted from Precambrian rock, and studied through scanning (SEM) and transmission electron (TEM) microscopy.

Modern analogs of these ancient bacteria occur in present-day oceanic prokaryotic microbes. These have an important role in oceanic Fe cycling, because they accumulate most offshore water's biogenic Fe. In North Pacific subarctic surface populations, heterotrophic microbes assimilate more than 50% of dissolved Fe, thereby directly competing with phytoplankton for this limited resource. In oligotrophic tropical and subtropical waters, photosynthetic bacteria become more important in Fe cycling with increasing unicellular cyanobacteria populations. For example, N-fixing filamentous cyanobacteria genus *Trichodesmium* (aka sea sawdust) contain the most abundant biogenic Fe in the mixed marine layer. Similar to their terrestrial counterparts, heterotrophic and phototrophic marine bacteria produce Fe-binding siderophores that chelate and acquire Fe. Research has demonstrated that these bacteria may modify Fe marine chemistry through the production of these ligands, thereby playing a significant role in regulating production of eukaryotic phytoplankton. Paleogenetists have used such bacterial DNA to model Hb evolution (**Figure 2**).

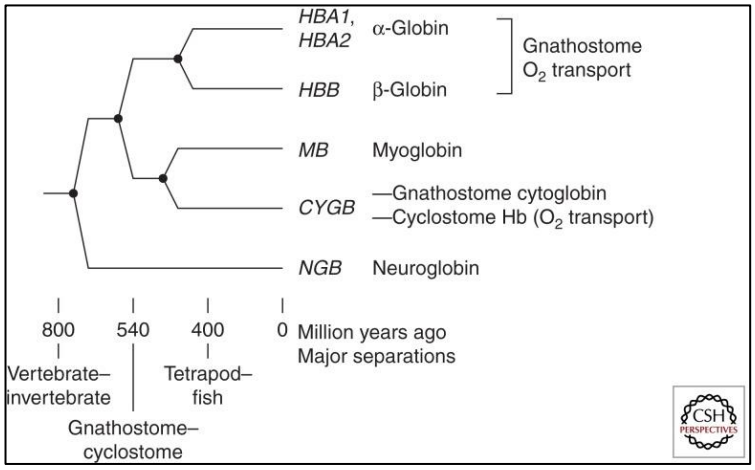


Figure 2: Evolutionary model or "tree" of vertebrate globin genes. Horizontal axis shows possible duplication and divergence times in millions of years ago. Contemporary human globin genes are shown as HBA1 and HBA2. Major duplication events in globin gene evolution are noted along the tree, and time of origin of some major animal groups is also indicated along the horizontal axis. Source: Hardison (2012).

Fossilized blood and animal circulatory systems are extremely rare because soft animal body parts invariably decay after death; therefore, most fossil remains are those containing only hard parts (i.e., shells, bones, and teeth). One of the earliest a recently discovered fossil containing soft body parts is a shrimp-like animal (arthropod) that lived during the early Cambrian Period ~520 million years ago (Ma). This fossil has remarkably well preserved brain, tubular heart, and blood vessels leading to eyes, antennae, a brain, and legs (**Figure 3**). Its digestive, nervous and vascular system are similar to modern day shrimp-like crustaceans. Researchers have

suggested that animals with cardiovascular systems probably lived earlier than this creature, but fossil evidence is still lacking in the fossil record.

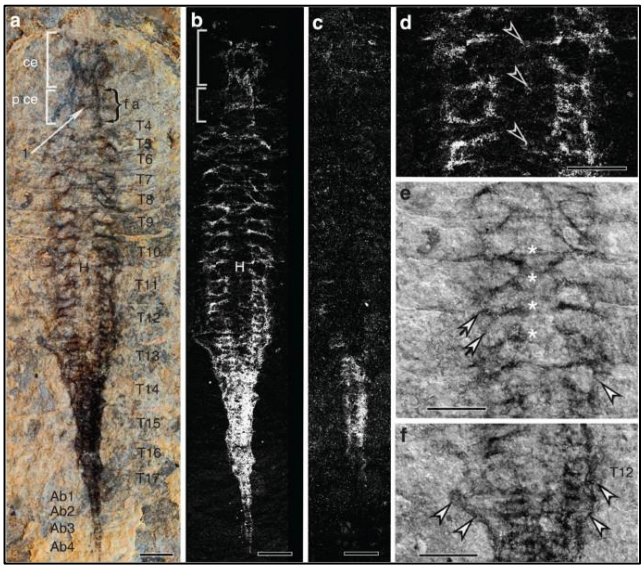


Figure 3: Preserved cardiovascular system (CVS) of fossil arthropod *F. protensa*. (**a**) image of entire cardiovascular system showing a broad heart (H) at arrow's end; (**b**) energy-dispersive X-ray spectroscopy (EDX) showing CVS represented by a carbon film. See Ma, et al (2014) for complete description. Scale bar, 2 mm long.

References:

Hardison, R. C., 1996, A brief history of Hemoglobins: Plant, Animal, Protist, and Bacteria: Proceedings of the National Academy of Sciences, v. 93, n. 12: 5675–5679.

Hardison, R.C., 2012, Evolution of Hemoglobin and Its Genes: Cold Spring Harbor Perspectives in Medicine: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3543078/

Ma, X., Cong, P., Hou, X., Edgecombe, G. D., and Strausfeld, N. J., 2014, An Exceptionally Preserved Arthropod Cardiovascular System From The Early Cambrian: Nature Communications: p. 7: doi:10.1038/ncomms4560.

Memon, R. B., Lakshmi, V. S., Aiswarya, M.U., Raju, K., and Nair, S.C, 2018, Porphysomes-A Paradigm Shift in Targeted Drug Delivery: International Journal of Applied Pharmaceutics, v. 10, issue 2: 6.

Tortell, P.D., Maldonado, M.T., Granger, J., Price, N.M., 1999, Marine Bacteria and Biogeochemical Cycling of Iron in the Oceans: FEMS Microbiology Ecology, v. 29, Issue 1: pp 1-11: https://doi.org/10.1111/j.1574-6941.1999.tb00593.x

University of California Berkeley, ~1993, Cyanobacteria: Fossil Record: https://ucmp.berkeley.edu/bacteria/cyanofr.html

Red Flesh Apples

By Donald MacLean

Apples come in a few colors, green, yellow, red, and black, based on their skin appearance. They can be a single color (Granny Smith), streaky (Gravenstein), or patchy (McIntosh). But the flesh is always white to yellow. But apple flesh is never thought of being red.

A fruit related to the apple is quince. The flesh is off white to white - yellow color, but when boiled the flesh can turn red or at least tint red. The bulk fiber is separated, and the juice is used to make quince jelly, something that is difficult to properly set as the pectin levels are variable. A reheat to set the jelly results in darker red jelly and sometimes a jelly that is more like glass than jelly.

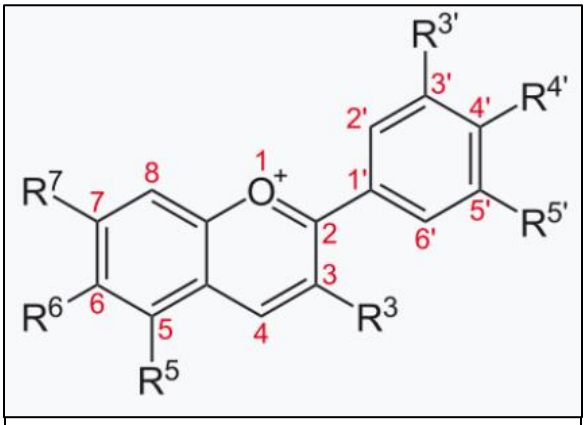


Figure. Generic Structure for Anthocyanins.[1]

This brings to this month's Farmer experience, the red flesh apples. They are interesting, though not necessarily tasty apples. The red flesh is natural, not generically modified as the Pearl Apple was introduced in 1944, long before the GMO craze. This unique red color is due to Anthocyanins — which are a type of water-soluble polyphenolic pigment — giving fruits and vegetables their signature shades of red, purple, blue or black. Anthocyanins are powerful antioxidants, however elevated concentrations of anthocyanins and phenols have a bitter taste. This red color probably makes an interesting apple sauce.

Example varieties are Weirouge, Pink Pearl, Mountain Rose, Hidden Rose, Airlie Red Flesh.

Both apples and quince belong to the Rosaceae family (pears belong here as well).

Red flesh apples are true red, not like apples that are cut with their flesh exposed to the air which will oxidize and change its color from yellow-white to pink and then eventually reddish-brown. This can happen with any type of apple and is not limited to white or red-fleshed ones.

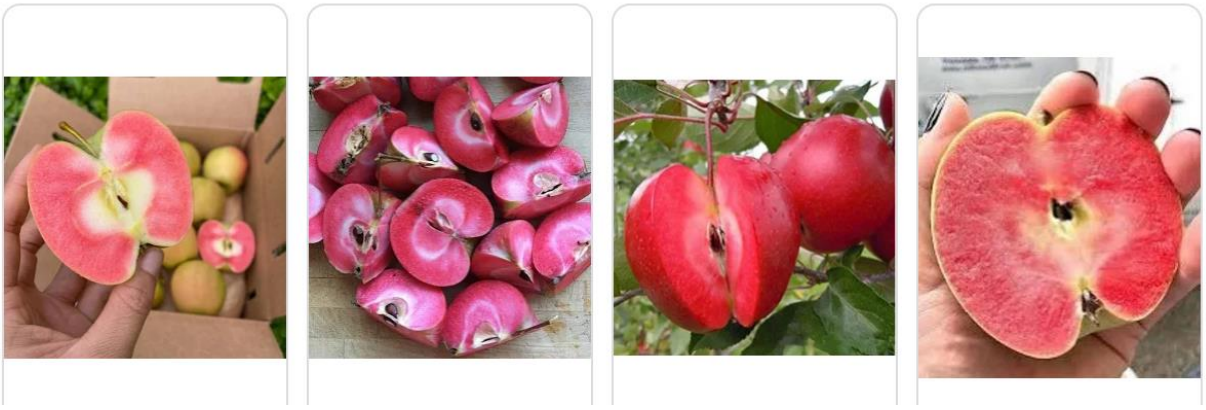


Figure: internet search with term red flesh apples (Hidden Rose, Redlove, Redlove, Mt Rose.[2]

Left: Depending upon tree, Gala apple may have solid white flowers or may have pink on one side or on the edge. Flowers from a Pearl apple is more pink throughout, almost like a crabapple flower. Bottom: Red flowers for Weirouge apple.[5]

Another interesting observation is the flower color. The flowers are pink and red on both front and back.

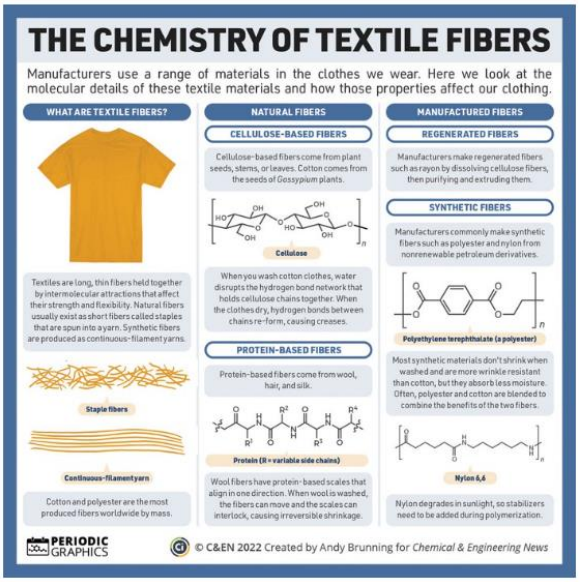
References:

1 Wikipedia, https://en.wikipedia.org/wiki/Anthocyanin
2 Sources: Miami Fruit.org, Etsy.com, eBay, Etsy.com)
3 Pacific Grove Nursery - https://www.pacificgroves.com/apples
4 Wikipedia - Pink Pearl Apple
5 http://www.suttonelms.org.uk/weirouge.html

More Details on Textile Fibers

By Donald MacLean

In the June 27, 2022 edition of Chemistry and Engineering News[1] there is the Periodic Graphics for textile fibers. As usual this is a short informational piece dealing with chemistry. Here, fibers were classified as Natural and Manufactured. In the past we probably all performed the Nylon 66 experiment; it is easy to do, we even added a dye at the time we pull out the string and wound it around a pencil, but making a consistent thin string was never as easy to do as the videos shows. Nylon 66 is made at the interface of 2 chemicals, hexamethylenediamine and adipic acid. In the Periodic Graphics the Cellulose-based example is cotton, while the protein-based example is wool. What is not shown are the steps that are taken before the product becomes that shirt or jumper, ergo why a chemist is not likely to have first-hand experience with the natural products.



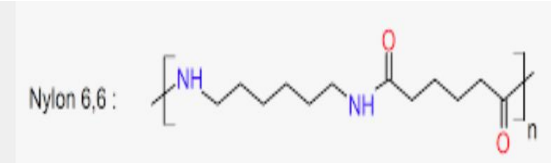


Figure. The 6,6 refers to the number of carbon atoms between the nitrogen atoms (from hexamethyene diamine) and carbonyl group (from adipic acid).[2]

Wool is a bit trickery to explain. Wool has several qualities that distinguish it from hair or fur: it is crimped, it is elastic, and it grows in clusters. Not all wool has the same quality. The Merino wool is considered the best wool and is king of Australian production due to its small diameter fiber. Merino Sheep are grown in California's Central Valley (information source is my sheep shearer for the last 5 years). This is the wool of choice for knitting, but it is relatively expensive. Wool from meat sheep tends to go into carpets as their fibers are thicker. An in between wool comes from the Jacob sheep which is prized by hand knitters for its natural multicolors.

That nice wool ball from in the craft store is the final product in a series labor intensive steps.

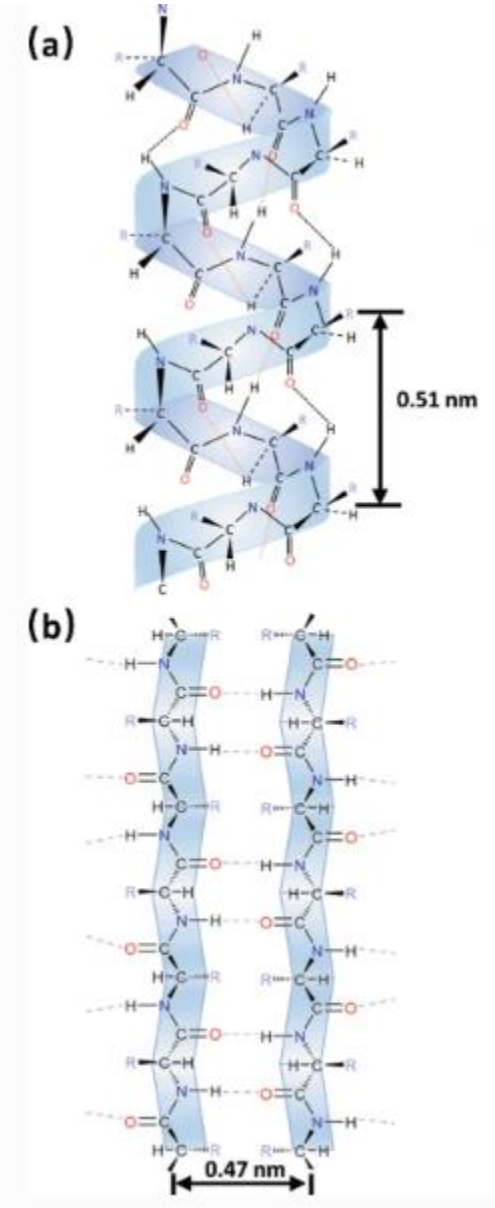
Figure. The piebald black and white sheep are in the shearing stage. The wool that has brown patches are the sun-bleached black spots.

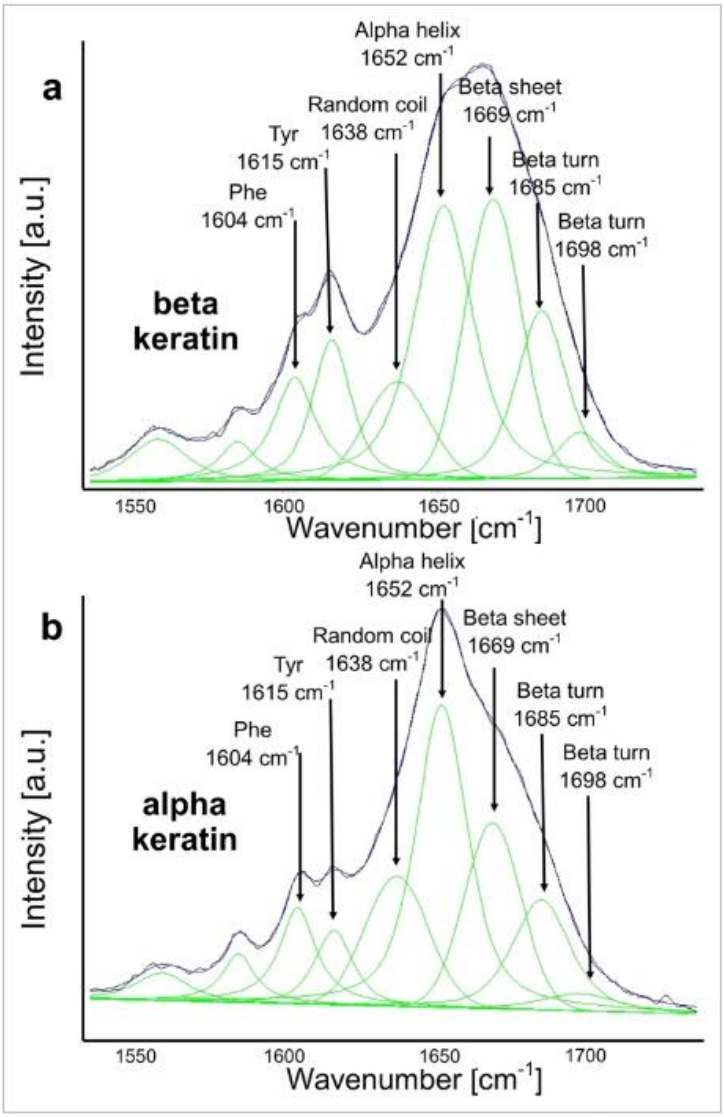
1. After shearing the wool is laid out and the matted material (belly area) is separated and disposed. If the wool is multicolor such as with the piebald Jacob, the black, brown (sun bleached black), white, and lilac are separated.
2. The wool is then soaked in hot water and detergent to remove the poop (more politely dirt) and lanolin (complex mixture long chain waxy esters, but not glycerol esters). After 5 wash cycles, the dry weight is now 50% the starting weight.
3. Picking out vegetable matter is the second stage, which can be done by hand or by something akin to the cotton gin, simply known as wool picker.
4. Carding is the third stage that is used to align the wool fibers into roving (a slightly twisted roll or strand).
5. Spinning is the fourth stage to make the yarn strand. This twisting gives the wool strength. Multiple strands are twisted together to make plied yarn. Unless the wool is dyed, this is the last stage before the wool is balled, skeined or hanked.

If you are interested in the amino acid sequence of wool or silk see reference 3.

Comparison Between Silk and Wool

One difference between silk (β-keratin, beta pleated sheet secondary structure) and wool (α-keratin, helical secondary structure) is that in silk the amino acids, glycine, alanine and serine are quite small with no bulky side-chains. When combined they do not form helices, instead lie on top of each other to give pleated sheets of linked amino acids with the glycine appearing on only one side of the sheets. The sheets then stack on top of each other. Below is the FTIR spectrum for the two types of keratin using the Amide I peak (carbonyl). The helix is noted by a single intense peak at 1652 cm^{-1}, while the beta sheets / beta turns have numerous peaks on either side of the 1652 cm^{-1} (Amide I peak is broader than the helix Amide I peak).





Left: The secondary structure of Keratin. A is the alpha keratin which a coil (helix), B is the beta keratin which is sheet.[4]

Right: The FTIR Amide I band for the 2 types of Keratin.[5]

References:

1. Chemistry and Engineering News, June 27, 2022
2. Image clipped from polymerdatabase.com.
3. http://wwwchem.uwimona.edu.jm/courses/CHEM2402/Textiles/Animal_FibresJ.html
4. Wenwen Zhang & Yimin Fan, Structure of Keratin, Fibrous Proteins, 2021: 41-53.
5. Kinga Skieresz-Szewczyk,Hanna Jackowiak,Tomasz Buchwald,Mirosław Szybowicz, Localization of Alpha-Keratin and Beta-Keratin (Corneous Beta Protein) in the Epithelium on the Ventral Surface of the Lingual Apex and Its Lingual Nail in the Domestic Goose (Anser Anser f. domestica) by Using Immunohistochemistry and Raman Microspectroscopy Analysis, The Anatomical Record, 2017, 300 (8): 1361-1568. https://doi.org/10.1002/ar.23591
6. For more periodic graphics see https://cen.acs.org/collections/periodicgraphics.html

Marine Mammal Center (Sausalito, Marin County)

By Donald MacLean

On the west side of southern Marin County is the Marine Mammal Center best known for dealing with oil spill birds and sick seals. During the Covid shutdown it was closed for rehab. It is now open for visitors Friday to Monday. Every second and fourth Sunday of the month there is a marine science topic lecture intermixed with other topics on Saturday and Mondays.

View of from Rodeo Beach looking at the old military buildings.

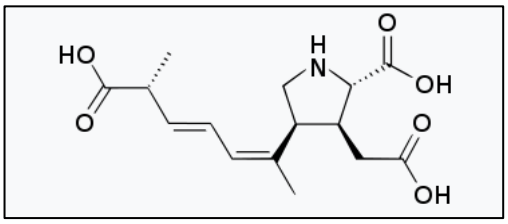
The drive to get to the Center is a bit interesting as you have to use a one direction at a time tunnel under Hwy 101 then travel on Bunker Road to Rodeo Beach. The area used to be Fort Cronkite with a scattering of artillery batteries emplacements. At the road end there is a lagoon, beach, and scattered pre-World War II Army style wood siding buildings. The modern building complex above the white buildings is the Marine Mammal Center.

The Center is a cross of a medical treatment, research, and education facility. The center has several educational stations and observational sites with informational panels. The back has pens each with a pool where the sea mammals are located. Here you might observe the staff feeding the animals using metal pails and shields to protect the staff from the animals during human interactions.

Sandwiched between the pens and the entrance are the kitchen, hospital, and diagnostic areas. There is plenty of information on what is going on at each location including view windows for the kitchen and for the clinical testing rooms.

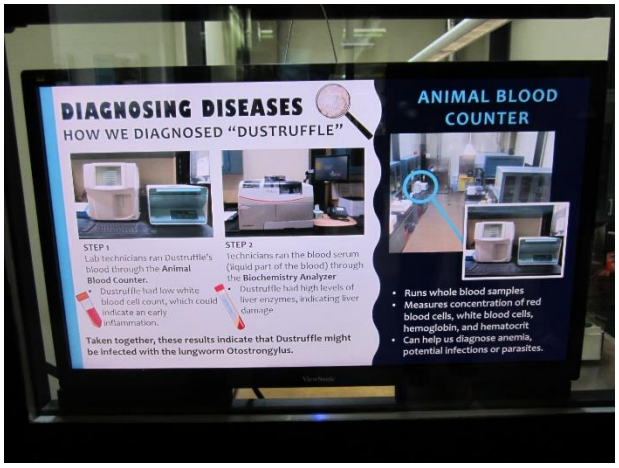
Pens each with pool containing sea mammals. Vacancy rate is seasonal.

The Center has dealt with oil-soaked birds, though at this time there are none. The continual focus is the mammal hospital. Here the mammals are rescued, receive treatment, then released. Trauma, abandonment (orphaned), and domoic poisoning are some of the reasons mammals are here. Obviously environmental issue such as ocean trash is placarded on the wall as a reminder of our influence on the ocean.



Chemical Structure of Domoic Acid.

Kitchen view, note the information panel.

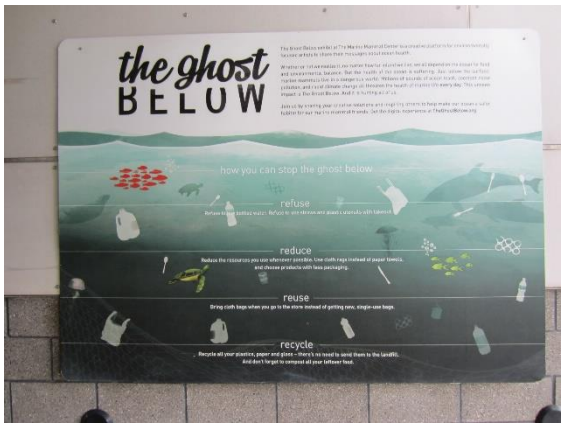


Top: Tech cleaning a diagnostic instrument. Bottom: Panel for this observation.

Domoic Acid

The Center receives sea mammals with domoic acid toxicosis. This poisoning type is most frequently heard around Dungeonous crab season causing the delay of crab opening season due to domoic acid buildup in crabs (approximately November 1 to July 31). This condition is caused by harmful algal blooms, sometimes referred to as "red tides." This neurotoxin accumulates in small fish, like sardines and anchovies, which are then eaten by sea lions in large quantities.

Domoic acid attacks the brain and the heart, causing seizures and heart failure. If left untreated, it usually causes permanent brain damage. The toxin will naturally flush from an animal's system over time, but sea lions repeatedly exposed to the toxin will suffer longer-lasting and more serious effects. If these



Panel: Man's garbage is the hazard for all ocean creatures.

animals come into the mammal center before significant damage occurs, they are often able to help flush the toxin from their systems by giving them fluids. Without saying, they also are provided with a fish source that is free of domoic acid. To control any seizures, veterinarians give these patients anti-seizure medications that are also used in humans.

As part of their research track, the Center's veterinary team is investigating new therapies to reduce the amount of inflammation and damage the brain experienced while the animal is recovering.

Leptospirosis

Leptospirosis is a blood infection caused by spiral-shaped Leptosira bacteria that affects human and animals. This bacterial infection affects the kidneys and can be lethal. If not treated, the bacteria can cause irreversible kidney damage. In humans, it can cause a wide range of symptoms, some of which may be mistaken for other diseases. Some infected persons, however, may have no symptoms at all.

Without treatment, Leptospirosis can lead to kidney damage, meningitis (inflammation of the membrane around the brain and spinal cord), liver failure, respiratory distress, and even death. Veterinarians can usually identify leptospirosis in a sea lion even before laboratory tests confirm a diagnosis because of the infection's distinctive symptoms in California sea lions, which include drinking water and folding the flippers over the abdomen. Marine mammals generally do not need to drink water because they receive all the hydration they need from food sources. But when they are infected with the Leptospira, their kidneys stop functioning properly and cannot filter toxins or regulate hydration. Sea lions diagnosed with leptospirosis are treated with antibiotics, fluids and other supportive care, such as gastroprotectants for stomach (the flipper thing stated above) and intestinal ulcers.

Cancer Prevalence

The Marine Mammal Center site web site states that 20% of sea lions die from cancer. Since cancer has many sources and may depend upon multiple factors, it is interesting that the herpesvirus is so prevalent in the mammals. Using samples collected from hundreds of patients, the Center's researchers proved that a sexually transmitted herpesvirus causes the alarming cancer occurrence, and that pollutants such as PCBs and DDT (found in blubber) play a significant role both as primary carcinogens (or cancer-causing substances) and as co-factors in the development of this cancer.

Shields are used to create a protective wall. From https://www.marinemammalcenter.org/get-involved/events/earth-week

Animal Release

The residence final stage occurs at the Lagoon with their release. This is the location where the Marine Mammal Center receives much publicity from the news outlets; people like a good story.

Other Activities

The fresh-water lagoon refuge has pelican and other birds. The beach transitions from gravel by the road to sandy by the waterline. There are walking trails on either side of beach. The surrounding area has military remnants such as artillery and missile concrete structures.

Volunteer

There are several volunteer opportunities; see the web site for list and location. In our area the coverage spans from Monterey / Santa Cruz, Sausalito and San Francisco, Sonoma / Mendocino, to San Luis Obispo.

Address
The Marine Mammal Center, 2000 Bunker Road, Sausalito, CA 94965

Parking – with the reserve appointment system in place, not an issue. The beach area is heavily used on the weekends.
Cost – free but must reserve tickets. Make a donation.
Covid: requires proof of vaccination
See website for events (in person) and volunteer opportunities.

References:

1. CDC: https://www.cdc.gov/leptospirosis/index.html#:~:text=Leptospirosis%20is%20a%20bacterial%20disease,have%20no%20symptoms%20at%20all.
2. MMC: https://www.marinemammalcenter.org/science-conservation/research-library

Malika Jeffries-EL and the WCC, Sept. 10, 2022

By Linda Wraxall

This excellent talk, Moving the Needle: How Key Interventions Can Increase Diversity, Equity, and Inclusion in STEM, by Dr. Malika Jeffries-EL showed her listeners not only where she came from but how she got to where she is now. Along the way she gave pointers on how to deal with the challenges that are inevitable in a world that limits opportunity, no matter how talented one is.

Malika grew up in Brownsville NY, the most dangerous neighborhood in Brooklyn at the time. Back then, the only way out of the 'hood' was through athletic prowess or movies. She read a lot of books and her mother helped by pointing her to interesting topics. Her parents both encouraged her to pursue her passion for science. She was amazed to learn that there was a black female astronaut (Mae Jemison), someone who looked like her. Also, the book "A Tree Grows in Brooklyn" by Betty Smith was a further source of education for her.

As a teenager, test preparation got her into an elite high school, concentrating on science, math, and engineering, and she recalled that there was a lot of pressure on kids to get into a good school. She graduated from Brooklyn Technical High School followed by Wellesley College, a liberal arts university for women only. There she found a life-long mentor/chemistry professor. Malika found out that where you go to school is more important to being hired as a professor than how technically good you are. She then upped the ante by getting a mentor for her Ph.D. program and post-doctorate program. While a mentor can be critical to getting through that difficult period, so is the ability to accept constructive criticism. Coaches can also provide guidance, especially to develop one's soft skills – how to speak in public, how to listen, etc. She found at ACS a great coach in the form of Janet Bryant but one piece of advice that stuck with her came from her Gran who told her to "make time for wellness or you will have to take time for illness".

She did observe that there was a lot of bias to hiring black female professors in any subject, not just the sciences. Most professors are white and male. In fact, 48% of black women and 47% of Latina professors reported being mistaken for administrative staff or custodians!

She also pointed out that who you know is very important to a successful career. This is very evident in the world of sports where coaches are often paid millions compared to academic teachers, and we all know how badly they are paid! Extraordinary outcomes begin with opportunities which you sometimes have to make yourself. This means being active in one's field of expertise, belonging to professional societies like the ACS, volunteering to help at events, and thereby getting your name and face known. Malika discovered NOBCChE (National Organization for the Professional Advancement of Black Chemists and Chemical Engineers) and the ACS Women Chemists Committee. She became a fellow at both the ACS and the UK's RSC (Royal Society of Chemistry), winning many awards along the way, becoming a staunch advocate for diversity and a good communicator to encourage students to pursue STEM degrees. This is particularly true in her current role as an Associate Dean of Arts and Sciences at Boston University, where she has put measures in place to retain graduate

students coming from underrepresented populations in her chemistry department. She also directs a very diverse research group studying organic semiconductors.

So, what is the takeaway for us, her audience? One is being encouraged, and parents play a key role here. Neither of her parents went to college but encouraged her to read and learn. Another is the extra preparation to get into a good school and the importance of finding a mentor or sponsor along the educational path. And, finally, joining a professional organization in your field and being an active part of it.

By becoming an agent for change, Malika is setting us a good example by making a difference in her scientific field, and you can too!