THE VORTEX

AMERICAN CHEMICAL SOCIETY CALIFORNIA SECTION

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"Family Science Night," at Martin Luther King Jr. Middle School in Berkeley

Table of Contents

CHAIR'S MESSAGE	PAGE 3
NCW; FAMILY SCIENCE NIGHT	PAGE 4
GOLDILOCKS AND THE THREE ZONES (W. MOTZER)	PAGE 6
SECTION ELECTION RESULTS	PAGE 9
POSITIVE MEDIA COVERAGE	PAGE 10
BUSINESS DIRECTORY	PAGE 11
INDEX OF ADVERTISERS	PAGE 11

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Chair's Message

Jim Postma

I have often used this column to share ideas about getting involved in ACS activities. Here is another one that each member can participate in, provided you are travelling to Asia or other remote parts of the chemical universe. The proposal originated with Attila Pavlath with help from Wally Yokohama and Bryan Balazs.

The ACS has members all over the world, and many of the members outside the U.S. are also members of other chemical societies in their countries of residence. The ACS recognizes that many of these non-U.S.-based members feel isolated from ACS activities and may wish to develop connections with other ACS members, both inside and outside of the U.S. To address this, the ACS established in its bylaws the capability for International Chemical Science Chapters.

There are five of these chapters in existence, with three of them in Asia: Thailand, Hong Kong and Shanghai. Given the economic and technical connections between the West Coast and these three Chapters, the California and the Santa Clara Valley Sections want to develop ways to strengthen and help these Chapters. This can be done in various ways, but the first step is to establish closer contact with them. Another need is for those of us who would be willing to give a technical talk on their areas of expertise to these Chapters, as these chapters are eager to have visitors from the U.S. at their meetings.

In contrast to the ACS local sections, these Chapters do not receive any financial support from the ACS, and they cannot participate in speaker service. Many of our members have relatives, friends, or some type of professional/business relations in Asia and travel to Asia. We would like to find out more about our members' connections to these Asian areas, to explore the possibility of having you help us reach out to these Chapters and to act as an ACS ambassador. If you are planning such a trip in the future and would be willing to give a talk at one of these Chapters, please let us know. We will alert them and put you in contact with their leadership. Of course, we are not requesting any effort that would affect your existing travel plans or the costs, and the Chapter's program can be adapted to your schedule.

Will you help by considering a visit to any of these Chapters when your travel takes you to these locations? Please let me or Wally know of your willingness to get involved, even if you do not have a trip in the immediate future.

National Chemistry Week 2012: Family Science Night at King Middle School

Alex Madonik
NCW Coordinator

National Chemistry Week (NCW) was October 21st to October 27th, and the California Section held a kickoff event, "Family Science Night," at Martin Luther King, Jr. Middle School in Berkeley on Thursday, October 18th, 2012 with hands-on activities, dramatic demonstrations, and music to show that science rocks!

We're celebrating the 25th anniversary of NCW, the brainchild of UC Berkeley Professor George Pimentel. In 1987, when he was ACS President, he saw the need to convey to the public the vital role that chemistry plays in our lives. He wanted to combat the prevalent negative view of chemicals and promote the basic understanding needed to make wise decisions on issues related to science. The Lawrence Hall of Science helped launch NCW that year, as busloads of school children joined the public in discovering the fun of doing chemistry.

Ever since, Local Sections have mounted imaginative outreach events during NCW, directed especially at students. NCW went truly "National" in 1997, and the California Section joined the fun with our first Family Science Night, organized by Marinda Li Wu, now ACS President-Elect. This year continues an unbroken tradition, and our FSN program now includes spring events as well – we have visited over 20 middle schools throughout the Bay Area. This fall, we were back in Berkeley as the City Council read the Mayor's resolution proclaiming National Chemistry Week and this year's theme, "Nanotechnology - The Smallest BIG Idea in Science."

At the King Middle School auditorium, Jeanne Pimentel welcomed hundreds of students and their families with a brief history of National Chemistry Week, while displaying the proclamation issued by the City of Berkeley. Then Dr. Bryan Balazs of the Lawrence Livermore National Laboratory made "elephant's toothpaste," ignited a rocket powered by oxygen and plastic, and set off several colorful explosions; later, the high-decibel "Scientific Jam" band returned to the stage with lyrics straight from their day jobs as middle school science teachers.

Skipping from classroom to classroom, students tried their hands at making "slime" and "ancient ink", tasted liquid nitrogen ice cream, and tested the identity of various plastics by melting them with a heat gun or floating them on different liquids. In keeping with the nanoscience theme, they made paper models of the 60-carbon cluster whose structure is identical to a soccer ball. Its 1984 discoverers named it buckminsterfullerene after the famous architect, but informally these clusters are known as "buckyballs." But, Mother Nature invented nanotechnology long ago – cells are factories with thousands of nanoscale parts, including DNA for data storage. The DNA/RNA base-pairing game showed students how the genetic code works. Plants capture light energy in chloroplasts, and convert sugars to many other unique compounds, that students could recognize by their smell, and then try to construct using molecular model kits.

At every station, eager students learned the thrill of discovery for themselves. Their infectious enthusiasm was shared by the staff, including a longtime custodian, who put down his broom to watch the demonstrations and activities. On leaving, one student summed it up this way: "Hey, chemistry is cool!"

King Middle School's science department chair Akemi Hamai worked with ACS NCW coordinator Alex Madonik to plan this event. Activities were conducted by numerous volunteers, including Dr. Martin Mulvihill and students from the UC Berkeley College of Chemistry (members of Alpha Chi Sigma and Iota Sigma Pi), and by Dr. Margareta Sequin and her students from San Francisco State University. Chevron supported this event with materials for slime as well as extra safety glasses, and their slime team was indefatigable as always. Dow Chemical provided materials for Kent Campbell's varied and colorful demonstrations. Other returning volunteers included John and Anne Frazer (pH Workshop), Mark Frishberg (who guided the investigation of graphite con-

(continued on page 5)

(Continued from page 4)
ductivity), Blanca Domingo, who showed visitors how to assemble paper models of C60, Birgit Drews (who explained DNA/RNA base pairing), and Margaret Elliott with her beloved UV-sensitive beads. New volunteers included Alec Brozell (who assisted with colorful electrolysis) and UC Berkeley graduate students Hoang Doan and Latisha Pau U, Iota Sigma Pi members who supervised the Ancient Ink activity. Ann Morales, Professional Committee Chair for Alpha Chi Sigma, led the ice cream and colored flames teams.

Vice-Principal David Gold forwarded this tribute from a King Middle School parent:

"Family Science night was absolutely great! My ten year old attended as well and was so inspired by all the experiments and science people that he has spent most of his time since last Thursday doing a wide variety of chemistry experiments. He now wants to become a chemist and has set up a lab for himself with three workstations and has found online sites from which he is terribly eager to order all the chemicals and lab equipment he feels he needs to go further. He has recreated some of the experiments from Family Science night many times and done variations on them. I was amazed at the amount of effort and talent that went into your Science Night. It was terrific the way you made it a family event so that my 8th grade son James was able to bring both his older and his younger brother. Just wanted you to know it triggered an explosion of learning in my youngest son. He has literally been doing chemistry from the time he wakes up in the morning till late at night with breaks when he has to attend to other subjects."

Goldilocks and the Three Zones (Part 2)

Bill Motzer

In Part 1 of Goldilocks Zones (Vortex, September 2012), I described the habitable zone (HZ) concept as the distance from a star that a terrestrial-like planet could maintain liquid water on its surface and consequently form and contain terrestrial-like life. Much of the HZ concept is a function of the right type of chemistry at the right time, and even if a planet is within a HZ, there are additional criteria for life to form, evolve, and endure. These are explained in more detail below.

(1) A stable metal-rich star: Based on nucleocosmochronology, the Sun formed about 4.57 billion years ago (Ga) from the collapse of a giant molecular cloud composed mostly of hydrogen and helium (H and He). The Sun is a G2 main sequence star consisting of 74.9% H and 23.8% He; heavier elements (i.e., metals in astronomy) with less than 2% of its mass as oxygen (O =~1%), carbon (C=0.3%), neon (Ne=0.2%), and iron (Fe=0.2%). It is approximately halfway through its main-sequence stage of core nuclear fusion of H to He, occurring at a rate of more than 4 x 10^6 metric tons per second and converted into energy as neutrinos and radiation. If a star's metallicity is too low, Earth-like planets composed mostly of O, Mg, Si, and Fe may not form. These elements are produced primarily by massive stellar supernovas enriching the originally pure H and He interstellar gas with their processed ejecta including elements above Fe on the periodic table. An Earth-mass planet may form from H, He, and water at lower metallicity, but it might be far less habitable (see below).

(2) A metal-rich rocky planet. Terrestrial planets all have similar structures: a central metallic, mostly iron-rich core generally surrounded by a silicate mantle and a stable outer crust. A metallic (Fe-Ni) core is important because it generates a planet's magnetic field by a dynamo effect (see below). Terrestrial planets also possess more carbon-rich secondary atmospheres, either generated through internal volcanism or by cometary and perhaps even asteroid impacts, as opposed to the gas giants that have primary atmospheres of mostly H and He captured directly from the original solar nebula. Several types of terrestrial planets have been postulated:

Silicate planets: the standard type (e.g. Venus, Earth, and Mars) as seen in our Solar System, composed primarily of a silicon-based rocky mantle with a metallic (iron) core.

Iron-rich planets consisting almost entirely of iron having greater density and a smaller radius than terrestrial planets of comparable mass. Mercury has a metallic core about 60 - 70% of its planetary mass. Iron-rich planets may form in high-temperature regions close to a star, particularly if the protoplanetary disk was also iron-rich.

Carbon planets with metallic cores surrounded by carbon-based minerals. They may be considered a type of terrestrial planet if metals dominate over carbon. The Solar System's carbonaceous asteroids may represent "failed" carbon planets.

Coreless planets consisting entirely of silicates with no metallic core. The Solar System contains no coreless planets, but chondrite asteroids and meteorites are common. Coreless planets are believed to form farther from the star where volatile oxidizing material is more usual.

Super-Earths are planets with masses between Earth and Neptune. They may be gas planets or terrestrial, depending on their mass and other parameters. The latter represent the upper-end of the terrestrial-planet mass range.

(3) A strong constant magnetic field protecting the planet's surface from solar charged particles (aka solar wind) by deflecting most charged particles that would strip away either its atmosphere over geologic time or the ozone layer protecting a planet from harmful ultraviolet (UV) radiation. CO_2 loss calculations of Mars' atmosphere by solar wind scavenging is consistent with a near-total loss of its atmosphere since Mar's magnetic field turned off, perhaps as early as 4.0 Ga. Paleomagnetic studies of Australian volcanic rocks suggest the presence of

(Continued on page 7)

(continued from page 6)

Earth's magnetic field since at least 3.45 Ga.

(4) A stable almost circular orbit: The current changing Earth-Sun distance results in an increase of only 6.9% in solar energy reaching Earth at perihelion relative to aphelion. A stable orbit keeps a planet within its HZ throughout its orbital year allowing for a stable climate. Highly elliptical orbits may result in a planet being periodically outside of its HZ resulting in wide climate variations. Additionally, highly elliptical orbits of gas giants may also result in inward migration affecting a habitable planet's orbital stability.

(5) A planetary rotation with a stable axis is extremely important to its habitability because its rotation period affects day to night temperature variations, obliquity stability (see below), and perhaps magnetic field generation. A very slow rotation results in greater day to night temperature differences because the prolonged absence of light may inhibit any photosynthetic life. Where synchronous rotation occurs, water may freeze-out on the dark hemisphere (see below) resulting in continuous freeze-out. Fortunately, Earth's current 23.4^o axial tilt relative to its orbital plane has been stable over geologic time, although cycles of precession or "wobbles" occur. This stability is attributed to Earth's moon. Mars and perhaps Venus lack such stability due to the lack of a large moon. Mars' obliquity is probably chaotic, varying from 0° to 60° over several millions of years, depending on planet perturbations.

(6) A dense (but not too dense or thin) atmosphere: Most of the Solar System terrestrial planets' atmospheres are carbon-rich. Venus has a dense CO_2 atmosphere and Mars has a tenuous CO_2 atmosphere. Much of Earth's original CO_2 atmosphere is now in the form of carbonates precipitated from dissolved CO_2 in Earth's oceans largely as a result of shell-producing organisms (see December 2007 Vortex: Where Has All the Carbon Dioxide Gone?). If a planet has an oxygen-rich atmosphere and possesses a magnetosphere, it should also form an ozone layer that filters out tissue damaging UV.

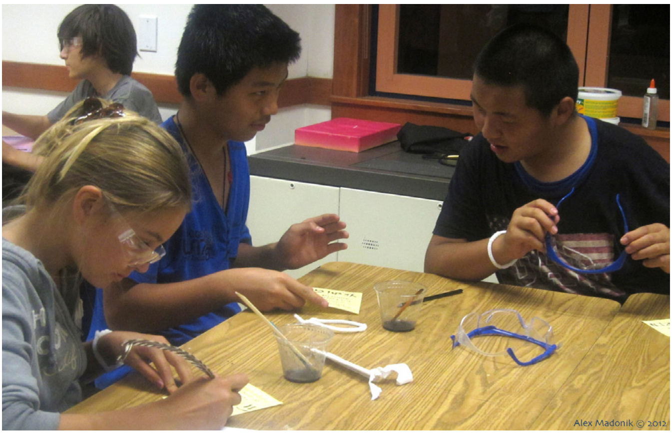
(7) A world ocean. Earth's global ocean is the largest confirmed surface ocean of all observable planets. Approximately 71% of the Earth's surface (~3.6×10^8 km^2) is covered by saline water. Because it is the principal component of Earth's hydrosphere, the ocean is integral to all known life, forming an important part of the carbon cycle, and influencing climate and weather patterns. Its total volume is approximately 1.3×10^9 km^3 with an average depth of 3,790 m. It is habitat to 230,000 known species; perhaps 2 million marine species may exist. Life most likely originated in the ocean by a process of abiogenesis. Mars and Venus are believed to once have had large oceans but Mars lost its atmosphere and oceans and a runaway greenhouse effect probably boiled away Venus' original global ocean.

(8) Continental platforms and plate tectonics: On Earth, continents consist of "lighter" crustal granitic rocks "floating" on a layer of denser basaltic rocks. It's believed that this is from the denser basalt becoming saturated with water with subsequent melting during subduction into the less dense granite (see June 2012 Vortex: Crusty Chemistry). Therefore, continental formation requires abundant water, perhaps a world ocean. Stable continental platforms are important for the evolution of more complex life forms such as plants and animals.

[In remembrance of Neil Armstrong (1930-2012), Apollo Astronaut and first human to walk on the Moon.]

(Continued from page 5)

More photos from Family Science Night at the Martin Luther King Jr., Middle School in Berkeley



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Best Wishes for the Holidays and New Year

There are no Section programs scheduled for December. Check the website and calendar for information. www.calacs.org

The California Section together with the Santa Clara Valley Section will conduct a Western Regional Meeting in Santa Clara in October 2013. There is still room for members to participate in planning for both the technical and exposition programs. If you want to participate in the planning, send an email to the Editor.

Lou Rigali,
Editor
qpfans@qpfans.com

Positive Media Coverage

The San Jose Mercury News and The Berkeleyside were two local media that acknowledged the California Section and several of its members for the award winning Science Cafe and Family Science Night Programs. The San Jose Mercury also mentioned that the American Chemical Society awarded the California Section four ChemLuminary National Awards. The complete articles can be seen at the following links.

http://www.berkeleyside.com/2012/10/24/elephants-toothpaste-explosions-mark-national-chemistry-week/

http://www.mercurynews.com/top-stories/ci_21803304/lafayette-science-cafe-events-earn-national-

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Science

Elephant toothpaste, rockets for National Chemistry Week

October 24, 2012 12:00 pm by Guest contributor

Students at King Middle School study plant molecules at "Family Science Night" on Oct. 18. Photo: Alex Madonik

By Alex Madonik and Jeanne Pimentel

Lafayette 'Science Cafe' events earn national praise

By Lou Fancher
Correspondent
Posted: 10/18/2012 02:07:53 PM PDT
Updated: 10/19/2012 09:47:48 AM PDT

LAFAYETTE -- The California local section of the American Chemical Society took leadership to new heights with four ChemLuminary Awards announced at the annual ACS National Meeting in Philadelphia on Aug. 21.

Meanwhile, 2,963 miles away at the Lafayette Library and Learning Center, earning the national ACS nod for "Best Activity or Program in a Local Section Stimulating Membership Involvement" triggered a celebration louder than the Liberty Bell ever was.

The Science Cafés' recognition highlighted a concept that began in an Orinda restaurant.

Marinda Wu, the American Chemical Society's president-elect in 2012, was the revolutionary thinker whose Petri dish gatherings at local eateries for scientific shop talk grew to become a robust program on the library's calendar. Monthly chemical society-library collaborative meetings feature expert speakers who unpack the scientific marvels in everything from pianos to chocolate to origami to Civil War-era medicine.

Library foundation President Kathy Merchant heads the small but mighty steamship of loyal staff and volunteers who recruit the speakers and host the events.

Thrilled at the announcement, Merchant set off a volley of "Woo-Hoo!" emails between Wu, Dr. Margaret Race (an ecologist with the Mountain View-based SETI Institute and an early partner in the Science Cafés) and countless luminaries involved in the Science Cafés' success.

BUSINESS DIRECTORY

INDEX OF ADVERTISERS

Recruitment

ACS Vortex	7,11
Bay Bioanalytical Lab. Inc	BP
Delsen	11
Huffman Labs	11
MassVac	2
NDE Analytical	11
New Era Enterprises, Inc	11
NuMega Resonance Labs	11
Robertson Microlit	2
Vacuubrand	9

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