The 41st Annual

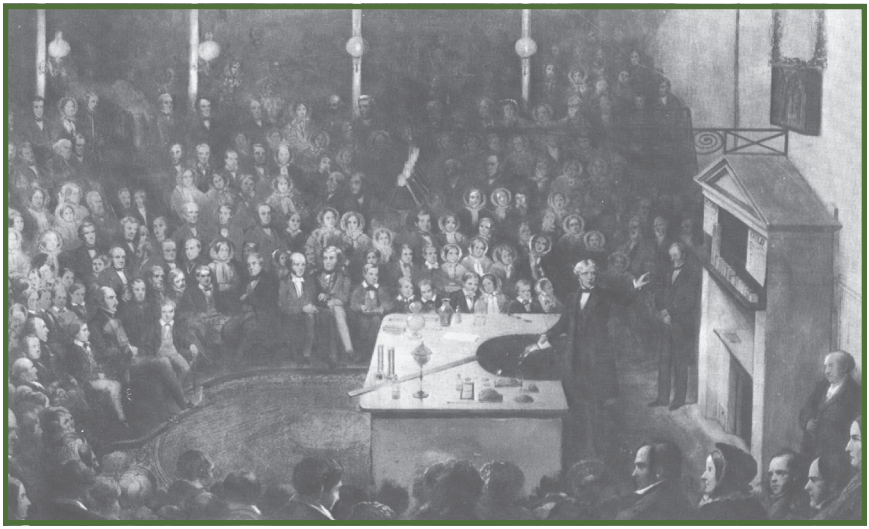
Once Upon A Christmas Cheery In the Lab of Shakhashiri

December 4 & 5, 2010

Chemistry Building, UW-Madison

www.scifun.org

Origin of the Christmas Lecture

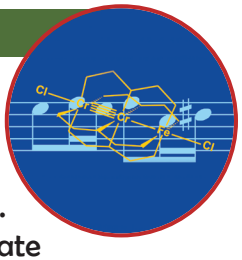


Michael Faraday, the noted English physicist and chemist, lived from 1791 to 1867. He was a gifted lecturer who began giving his Christmas Lectures for children and their families at the Royal Institution of Great Britain in the 1840s. Faraday loved simplicity, and he had a strong sense of the dramatic. His audience entered wholeheartedly into the world of science with his guidance. His ideas were still considered very unorthodox at that time, and children, who had not yet adopted conventional ideas, would react enthusiastically to the ones he presented. Eventually, the lectures became very popular, and even the Prince of Wales attended and learned about the mysteries of electricity. Faraday sought to awaken the sense of wonder in his listeners. He knew that once a person could be made to wonder about the world, it was only a short step to studying it. He strove to point out that if you looked closely at the most ordinary thing, such as the force of gravity, it ceased to be ordinary and became somehow miraculous. Throughout the 19 annual Christmas Lectures that he presented, Faraday did all he could to urge his listeners to see and judge for themselves, to experiment – to question nature directly – whenever anyone discovered something out of the ordinary.

Wisconsin Initiative for Science Literacy

The dual mission of WISL is to promote literacy in science, mathematics and technology among the general public and to attract future generations to careers in research, teaching and public service. Science literacy is important because it allows all of us to make informed decisions in a world that relies daily on science and technology. It is essential for the well-being of our society that all citizens develop an appreciation of science, the benefits of technology, and the potential risks associated with advances in both.

Science, the Arts and the Humanities



Creativity, passion and the urge for expression and exploration are essential human qualities that inspire science, the arts, and the humanities, and thus constitute a common bond among them. WISL helps people explore, discuss, and cultivate the intellectual and emotional links between science, the arts, and the humanities.

Chemical of the Week

The more we learn about chemicals the more we can appreciate their properties and uses. Every week you can learn fascinating facts and useful information by selecting one or more of these topics, available on the scifun.org website.

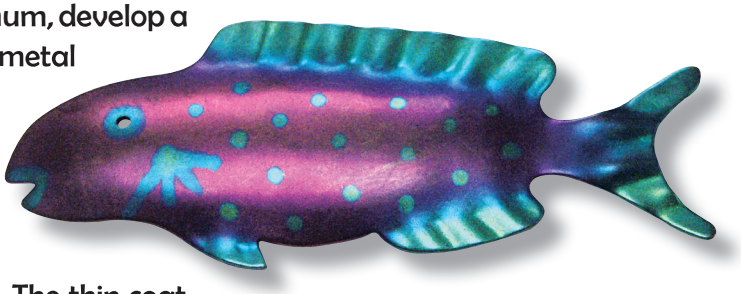
Science in the City

The program is designed to involve not only students and school personnel in learning, but also parents, guardians, families, school boards, and the community at large. By including the entire community in science education, Science in the City addresses the problems of lack of interest, understanding, and support that often exist in urban schools.

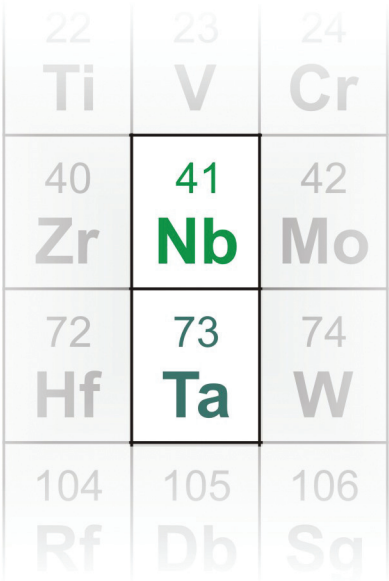
Niobium

The featured element in this year's 41st annual Christmas Lecture is Niobium, the element whose atomic number is 41. Niobium is not a well-known element, but it's a useful one. It makes beautiful jewelry and, when mixed with other metals to form an alloy, it makes them stronger and more resistant to heat. Niobium alloys are used in chemical facilities, nuclear plants, aircraft, and missiles. Some of niobium's alloys are superconductors. At very cold temperatures, superconductors offer almost no resistance to the flow of electricity. The strongest electromagnet in the world is made of an alloy of niobium and tin, and many MRI imaging instruments. Because niobium does not react with bodily fluids, its alloys are used in surgical instruments and implants. It is hypoallergenic, which is a big advantage in making jewelry.

The surface of niobium can be covered with shimmering, luminous colors by a process called anodizing. A metal is anodized by passing a direct electric current from the metal into a solution. During this process, the metal is oxidized. Some metals, such as niobium and aluminum, develop a coating of metal oxide. In niobium, anodizing creates colors on the surface. The thin coating of niobium oxide is transparent, allowing light through to the metal surface. Some light is reflected off the surface of the oxide,

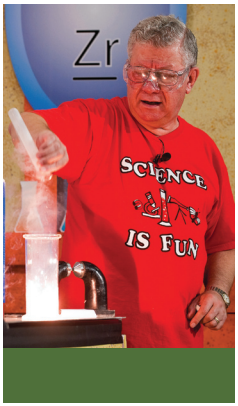


while some goes through and is reflected off the surface of the pure metal under the oxide. The two reflected light waves can interfere with each other, creating different colors. The colors are produced in the same way as the colors reflected from the surface of a compact disc or the iridescence of hummingbird feathers.



The color of anodized niobium depends on the thickness of the oxide layer, and a higher voltage creates a thicker layer. Artists can "paint" color on niobium by using an electrified brush. Varying the voltage varies the thickness of the oxide, and so varies the color. A deep yellow can be produced with 35 volts, while 60 volts produces violet, and 80 volts results in green. Artists have been able to create every color but red.

Niobium got its name because for many years it was confused with the element tantalum. Any ore that contains tantalum also contains niobium. They are very similar, and in the Periodic Table, niobium is just above tantalum. Tantalum was discovered in 1802, by Anders Gustaf Ekelberg, who thought the search for new elements was "tantalizing." Both the word and the name of the element come from the ancient Greek myth of Tantalus, who angered the gods, and for punishment, was placed up to his neck in water. Whenever he bent to drink, the water receded. When he reached for fruit hanging overhead, it stayed just beyond his reach, tantalizing him. When Henrich Rose finally proved, in 1844, that niobium is a separate element, he naturally named it for Niobe, the daughter of Tantalus.



Bassam Z. Shakhashiri is professor of chemistry at the University of Wisconsin-Madison and the first holder of the William T. Evjue Distinguished Chair for the Wisconsin Idea. The Encyclopedia Britannica cites him as the "dean of lecture demonstrators in America."

♦He has given over 1300 invited lectures and presentations around the world. He has been featured widely in the media including the New York Times, Washington Post, Newsweek, Time, the German language Business Week, NBC Nightly News, National Public Radio, CNN, and the Larry King show. He appears as a regular guest of Larry Meiller on the Ideas Network of Wisconsin Public Radio.

♦He is the recipient of seven honorary doctoral degrees and over 35 awards, including the 2003 American Association for the Advancement of Science Award for Public Understanding of Science and Technology, "for his tireless efforts to communicate science to the general public, and especially children."

♦Inducted in 2004 into the Hall of Fame of the national chemistry fraternity Alpha Chi Sigma.

♦In 2005, received the Madison Metropolitan School District Distinguished Service Award for a Citizen, the CHEMICAL PIONEER Award from the American Institute of Chemists, the American Chemical Society Helen M. Free Award for Public Outreach for "lifelong accomplishments and for explaining and demonstrating science with charisma and passion," was elected Fellow of the Wisconsin Academy of Sciences, Arts and Letters and cited in the Answer Book of Capital Newspapers as "the coolest UW professor."

♦National Science Board 2007 Public Service Award for "extraordinary contributions to promote science literacy and cultivate the intellectual and emotional links between science and the arts for the public."

♦In 2010 he was voted 2011 President-Elect of the American Chemical Society. He will serve one-year terms as president in 2012 and immediate past president in 2013.

♦Bassam and his wife June live in Madison. Their daughter Elizabeth, a 2007 alumnus of UW-Madison, graduated in May 2010 from the University of Michigan Law School and practices law in Chicago.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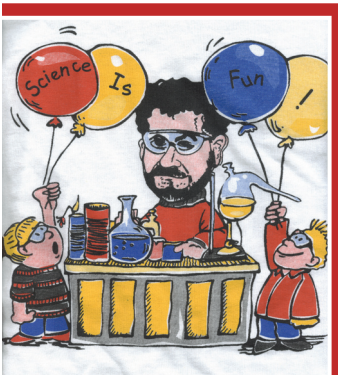
SCIENCE IS FUN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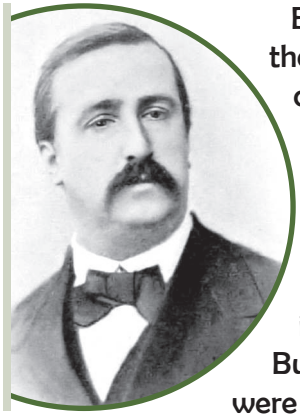
Science & Music

Very few people become famous not for their professional accomplishments but through their hobby. Alexander Borodin is one such person. His profession was as a professor of chemistry at the University of St. Petersburg, while his avocation was music. Although he made many valuable contributions to the science of chemistry and was well known for them during his life, it is through his music that his name lives on today.

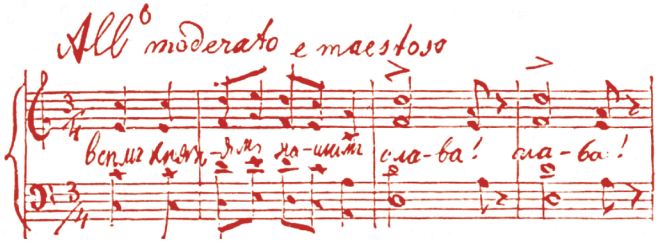
Borodin was born in St. Petersburg, Russia, in 1834 with an aristocratic background. He showed musical talent early, starting to compose at the age of nine, and having written a concerto for flute and piano at 13. He also mastered as a child the playing of an assortment of instruments, including piano, flute, cello, oboe, clarinet, and horn.



Borodin's father, however, determined that music was an unsuitable profession for an aristocrat and decided that the young man should study medicine instead. Borodin earned the degree of Doctor of Medicine by the age of 24 and practiced as an army surgeon. However, after two years, he went to study chemistry in Heidelberg in Germany, where Bunsen, Kirchoff, Kekulé, and Erlenmeyer were advancing the science, and where Mendeleev, the inventor of the periodic table, was also a student. After three years there, Borodin returned to Russia as professor of chemistry at the University of St. Petersburg.

As professor of chemistry, Borodin investigated reactions of fluorides with organic acids and published several papers about his discoveries. Then, he turned his attention to the reactions of a class of organic compounds called aldehydes. At the time, compounds were classified by their properties, and aldehydes were known generally for their fragrance, and for a few

characteristic reactions. First, Borodin studied the reactions of aldehydes with metals and with alkali. He then turned his attention to their reactions under the influence of strong mineral acids, such as hydrochloric acid. During these studies he discovered one of the now characteristic reactions of aldehydes, the aldol condensation. A condensation reaction is one in which two (or more) smaller molecules combine into a larger one. In aldol condensations, molecules such as aldehydes combine by forming a bond



between two carbon atoms. In modern organic synthesis, the aldol condensation is an important method for making such bonds.

Simultaneously with his professional work in chemistry, in his spare time Borodin studied musical composition with Mily Balakirev and Modest Mussorgsky (the composer of "Pictures at an Exhibition"). Through them he met two other amateur composers, Cesar Cui, a military engineer, and Nikolai Rimsky-Korsakov, a naval officer (and composer of "Flight of the Bumblebee"). Together these friends constitute what is called the "Mighty Five" of Russian composers. Because most of his time was devoted to his professional work, Borodin composed only sporadically, and often left works incomplete. He did complete two symphonies, several chamber works, and a tone poem "In the Steppes of Central Asia." He left incomplete his opera "Prince Igor," but it was well-enough developed to be completed by Rimsky-Korsakov, and it premiered to great acclaim three years after his death. He died of a heart attack during a gathering of musical friends at his home in 1887 at the age of 52.

Borodin possessed a remarkable melodic gift, and his compositions are filled with memorable melodies. A number of these melodies were "borrowed" for the stage play, Kismet, winner of the 1954 Tony award for best musical and the source of a number of classic songs, including "Baubles, Bangles, and Beads," and "Stranger in Paradise."

This Year's Guests

Rodney Schreiner, Senior Scientist at UW-Madison, has presented science shows in a wide variety of locations including the Epcot Center and has collaborated with Prof. Shakhashiri on 40 Christmas Lectures.
Bucky Badger has participated in all 41 of Prof. Shakhashiri's Christmas Lectures, and he always obeys the safety rules!
C. Marvin Lang, Emeritus Professor of Chemistry, UW-Stevens Point, has presented hundreds of demonstration shows around the world.
Madison Youth Choirs, for singers ages 8 to 18, makes its first appearance at the Christmas Lecture this year.
Isabella Oehme, a 5th grade student from DeForest, WI.

Acknowledgements

The 41st Annual Christmas Lecture is made possible through the cooperation and support of:

University of Wisconsin-Madison

Department of Chemistry

School of Music

Madison Youth Choirs

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You can join Professor Shakhashiri and his friends in supporting the Christmas Lecture and other WISL programs by sending a gift to the University of Wisconsin Foundation. You may send your tax-deductible contribution to:

Shakhashiri Science Education Fund
(Attn. Wendy Richards)
University of Wisconsin Foundation, P.O. Box 8860
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Your gift is greatly appreciated.

Forthcoming February 2011

Chemical Demonstrations, Volume 5

A Handbook for Teachers of Chemistry
Bassam Z. Shakhashiri

"The most comprehensive set of chemical demonstrations handbooks ever created."

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"[This] series is a must for the classroom, library, and chemistry club at both the high school and collegiate levels."

– Joseph W. Kamsar, The Science Teacher

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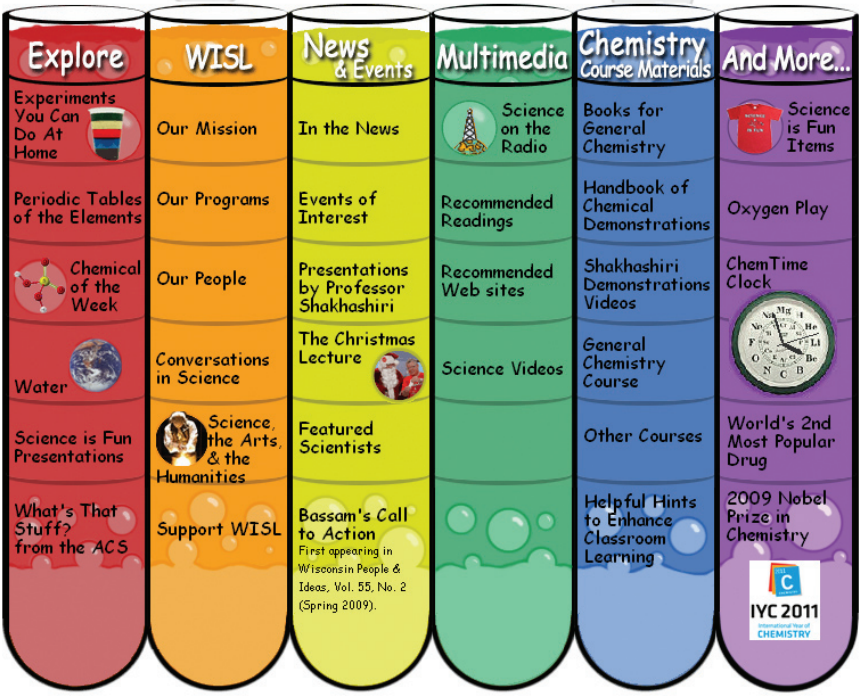
in the Lab of Shakhashiri

The master of chemical demonstrations and science policy advocate, University of Wisconsin-Madison Chemistry Professor Bassam Z. Shakhashiri, shares the fun of science through home science activities, public presentations, scholarship, and other programs of the Wisconsin Initiative for Science Literacy.

40 Years of Once Upon a Christmas Cheery, In the Lab of Shakhashiri ... And Beyond!



Wisconsin Public Television Telecasts

Monday, December 20 at 1:00 p.m.

Friday, December 24 at 1:00 & 4:30 p.m.

Sunday, December 26 at 7:00 a.m.

Check local listings for telecast times elsewhere around the country.

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