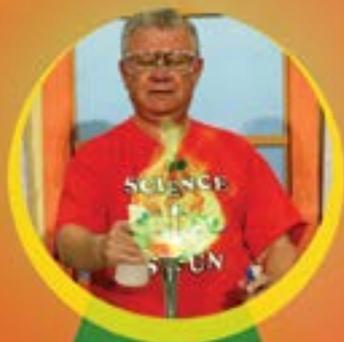


48TH ANNUAL

Once Upon

A CHRISTMAS CHEERY
IN THE LAB
OF SHAKHASHIRI



DECEMBER 2 & 3, 2017
CHEMISTRY BUILDING
UW-MADISON

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, and to question nature directly whenever anyone discovered something out of the ordinary.

Once Upon a Christmas Cheery In the Lab of Shakhashiri

In December of 1970, near the end of my first semester on the faculty of UW-Madison, I presented the first ONCE UPON A CHRISTMAS CHEERY IN THE LAB OF SHAKHASHIRI in my freshman chemistry class. Colorful displays of exciting chemical transformations were used and the audience was thrilled. Word spread that the Christmas Lecture was a fun event and the following year the lecture hall overflowed with students and their friends. In 1972 the Christmas Lecture was given in two evening sessions and opened to the public. In 1973 Wisconsin Public Television offered to videotape the program for broadcast during the week of Christmas. Thus began an uninterrupted collaboration with UW-Extension to bring science to audiences throughout Wisconsin, and on PBS stations.

Since then, variations of this program have played to packed houses at the National Academy of Sciences and the Smithsonian's Air and Space Museum in Washington, the halls of the US Congress, Boston's Museum of Science, elsewhere across the country and around the world. The goal of the Christmas Lecture has remained the same over the years: *connectivity with the audience*. My ultimate purpose is to trigger cerebral and emotional engagement to heighten the audience's joy in learning and to celebrate the role of science in society.

It is my good fortune to mark this 48th anniversary with appreciation for the wide interest and support that all my work enjoys locally and globally.

>> **Bassam Z. Shakhashiri**

***I expect to pass through the world but once.
Any good therefore that I can do, or any kindness
that I can show to any fellow creature, let me do it now.
Let me not defer or neglect it,
for I shall not pass this way again.***

>> **Attributed to Etienne de Grellet du Mabiller
(1773-1855)**

Fostering COMMUNITY APPRECIATION OF SCIENCE

Science literacy enlightens and enables people to make informed choices, to be skeptical, and to reject shams, unproven conjecture, and to avoid being bamboozled into making foolish decisions where matters of science and technology are concerned. Science literacy is for everyone—scientists, artists, humanists, all professionals, the general public, youth and adults alike.

>> **Bassam Z. Shakhshiri**



“Public sentiment is everything. With public sentiment, nothing can fail; without it nothing can succeed.”

>> **Abraham Lincoln**



Bassam Z. Shakhshiri

is professor of chemistry at the University of Wisconsin-Madison and since 2001, the first holder of the William T. Ewjue Distinguished Chair for the Wisconsin Idea. He has given over 1400 invited lectures and presentations around the world. He is the recipient of 7 honorary doctoral degrees and over 35 awards from the American Association for the Advancement of Science, Madison Metropolitan School District, American

Chemical Society, National Science Board, Council of Scientific Society Presidents and more. He is the recipient of the 2018 ACS Grady-Stack Award for Interpreting Chemistry for the Public.

In 1977 Bassam became founding chair of the UW System Undergraduate Teaching Improvement Council, now called the Office of Professional and Instructional Development. In 1983 he founded the Institute for Chemical Education (ICE) and served as its first director. From 1984-90 he served as NSF Assistant Director for Science and Engineering Education. In 2002 he founded the Wisconsin Initiative for Science Literacy (WISL) and continues to serve as its director. He served as the 2012 President of the American Chemical Society.

Bassam has been featured in newspapers, magazines, national and local radio and television, and appears as a regular guest on the Ideas Network of Wisconsin Public Radio. He and his wife June live in Madison. Their daughter Elizabeth, a 2007 alumna of UW-Madison, graduated in 2010 from the University of Michigan Law School and lives in Chicago with her husband Bob and their daughter Violet.

JOIN IN SUSTAINING OUR SCIENCE OUTREACH AND MAKE YOUR GIFT TO **WISL TODAY**

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. WISL programs are supported by UW-Madison and by private donations. You may mail your tax-deductible contribution to the address below or contribute online at GO.WISC.EDU/SUPPORTSCIFUN

**THE SHAKHASHIRI SCIENCE EDUCATION FUND AT UW FOUNDATION
US BANK LOCKBOX 78807
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~ Your Gift is Much Appreciated ~

ELEMENT

48

Cadmium

This 48th annual *Once Upon A Christmas Cheery in the Lab of Shakhashiri* features the element with an atomic number of 48, namely CADMIUM.



Cadmium Metal

The element cadmium is a bluish-silver metal that is soft and easily bent. It resembles the element above it in the periodic table, zinc.

Although the metal is rather dull in appearance, some of its compounds are very colorful. One of its compounds, cadmium sulfide, is an intense yellow. Another compound, cadmium selenide, is a bright red. Both of these compounds are prized pigments in artists' paints.

The intensity of the paint's color depends on the amount of pigment used in the paint. Cadmium yellow light paint has less cadmium yellow pigment than cadmium yellow medium. Cadmium yellow light is bright yellow, while cadmium yellow medium is more orange. Similarly, one of the brightest red paints is cadmium red light.



Cadmium Red Pigment



Cadmium Yellow Pigment

When using cadmium paints, artists must be careful. Cadmium is very toxic, and if a person ingests even a small amount, it can make the person very sick, or even kill them. Artists know this, and they are careful. However, amateur painters might not be so careful, so most yellow, orange, and red paints are made with other pigments that are safer, but not as bright or stable.

These cadmium paints have been very popular among artists, because they are intensely colored and don't change over time. Paintings that have a lot of yellow, orange, or red usually have cadmium in them.



**Sunflowers
Vincent van Gogh
1889**

Although cadmium pigments are bright, the major use for cadmium is not in making paint. The major use is in making rechargeable batteries. The most common rechargeable batteries that use cadmium are called nickel-cadmium (NiCd) batteries. These were very common in consumer products only a few years ago.

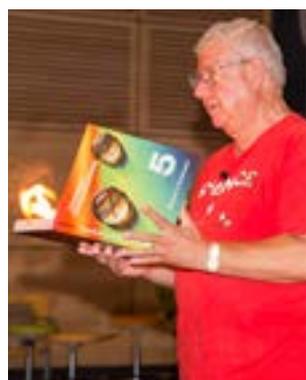
However, because cadmium is so toxic, the way in which worn-out batteries were discarded needed to be controlled carefully. This was hard to do. The technology for rechargeable batteries has also improved. So today, the most common rechargeable AA, AAA, C, and D cells do not use cadmium, but are nickel-metal hydride instead. Most electronic devices like cell phones and computers use lithium-ion batteries. Yet, for commercial applications, nickel-cadmium batteries are still common.



Another place where cadmium is used is in some nuclear power plants. In a nuclear power plant, the fuel is a radioactive material that decomposes when exposed to neutron particles. As the material decomposes, it releases neutrons. Therefore, the decomposition triggers more decomposition. To control how fast the reaction takes place, the amount of neutrons must be controlled. Cadmium can do this, because it absorbs neutrons without decomposing itself.



At left: Top of nuclear reactor showing tubes for fuel and for control rods. The core of a nuclear reactor is constructed with many parallel tubes. Most of the tubes contain nuclear fuel. However, some of the tubes are left empty, so rods of cadmium can be lowered into them to absorb neutrons and control the nuclear reaction.



~ Guests ~

Rodney Schreiner

Senior Scientist Emeritus at UW-Madison, has presented science shows in a wide variety of locations including the Epcot Center and has collaborated on 47 Christmas Lectures.

Bucky Badger

has participated in many of Bassam's Christmas Lectures and public events, and he always obeys the safety rules!

Jim Maynard

has led the department's demonstration lab since 2001.

Gery Essenmacher

is Associate Dean Emeritus in UW's College of Letters and Science, and has supported the Christmas Lecture for decades.

Renee Frontiera

holds the McKnight Land Grant Professorship in the University of Minnesota's Department of Chemistry, and in 2017 was [named one of *Chemical & Engineering News*' "Talented Twelve."](#)

Isabelle Krier

is a junior at Oregon High School and is concertmaster of the Wisconsin Youth Symphony Orchestra.

ACKNOWLEDGEMENTS

The 48th Annual Christmas Lecture
is made possible through
the cooperation and support of:

University of Wisconsin-Madison

Department of Chemistry

Wisconsin Public Television

Donors to the
Shakhashiri Science Education Fund

Science & Society

Today our biggest challenge is to help sustain Earth and its people in the face of:

- Population Growth
- Finite Resources
- Malnutrition
- Spreading Disease
- Deadly Violence
- War
- Climate Change
- *And the denial of basic human rights, especially the right to benefit from scientific and technological progress.*

We advance chemistry through research, education, and innovation. Basic research in science greatly increases our understanding of nature, triggers creative waves of invention and innovation, and

Proficiency or technical skill alone does not ensure responsibility and stewardship. In a free and civil society, people must be virtuous as well as skilled.

prompts technological breakthroughs that can serve society well in the future. Solutions to the world's problems demand thinking "outside the box" and encouraging radical innovation, both coupled with transformative changes in education.

We must aim to effect comprehensive, fundamental, and systemic change in our own attitudes and in our behavior as scientists and as responsible citizens. Purposeful communication of the critical role of science and technology in society can help alter attitudes of the general public and can also foster collaboration among people across

geographic boundaries to work together to solve global grand challenges. We have the talent and the capacity to succeed, but as scientist-citizens we must also help develop the will to take action.

Science and society have what is essentially a social contract that enables great intellectual achievements but comes with mutual expectations of benefiting the human condition and protecting our planet.

>> **Bassam Z. Shakhshiri**

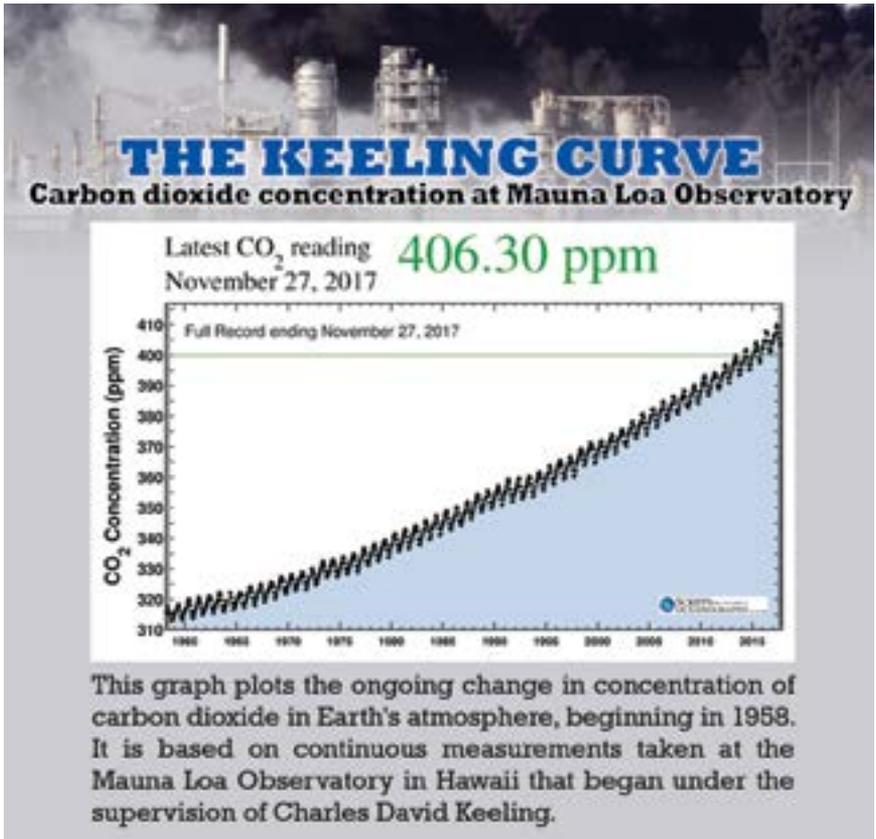
GLOBAL WARMING IS UNEQUIVOCAL

■ -35F to -40F ■ -30F to -35F ■ -25F to -30F ■ -20F to -25F ■ -15F to -20F ■ -10F to -15F



The zone color key shows the lowest observed winter temperatures in that area.

Illustration by Brandon Raygo, The Capital Times / Data Source: U.S. Dept. of Agriculture, PRISM Climate Group, Oregon State University



WISCONSIN PUBLIC TELEVISION TELECASTS



December 15 — 6:30 a.m.
December 16 — 7:00 a.m.
December 18 — 8:00 a.m.
December 20 — 12 noon
December 22 — 4:30 p.m.
December 23 — 8:00 a.m.
December 24 — 5:00 a.m.
December 25 — 12 noon
December 25 — 4:30 p.m.

**WHA-TV Madison • WHLA-TV La Crosse • WHRM-TV Wausau
WHWC-TV Menomonie • WLEF-TV Park Falls
WPNE-TV Green Bay**

Check local listings for telecast times elsewhere around the country.



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