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REACTIONS

FROM THE AMERICAN NUCLEAR SOCIETY TO TEACHERS INTERESTED IN THE NUCLEAR SCIENCES

ReActions makes a change...

Our Last *Printed* Edition has arrived...

ReActions goes online for 2013

After many years as a printed and mailed publication with an online archive of many past issues, *ReActions* will become an online only publication. The issue you are reading will be our last full printed edition.

We will sometimes produce a limited number of printed copies of *ReActions* for distribution at workshops or conferences, but, moving forward, our regular production and distribution will be online.

We will continue to provide you and other educators with news about applications of nuclear science and technology and with ideas for teaching about those topics in your classrooms. We'll keep you posted with information about upcoming workshops and events.

Online publication will enable us to provide you with more exciting information on a very timely basis. We will have more freedom – freedom from the constraints imposed by the printed page and its space limitations, freedom from the time delays of printing and mailing, and freedom from the harsh realities of the increasing costs of printing and mailing to a list of more than 18,000 educators.

We're eager to serve you with this new approach!

We'll need your help to assure that you keep receiving *ReActions* on a regular basis. You'll need to sign up for email notification of future issues.

Do it now!

Go to http://*ReActions*.ans.org today and sign up for email notification of *ReActions*.

LAST PRINTED ISSUE!

Investigators hope to "strike gold" in their search for dark matter

Detector nears activation in SD mine

Photo Credit: Matt Kapust

University of California, Davis, physicist Jeremy Mock inspects the LUX detector, the cylinder in the center, inside its protective water tank, which now has been filled with ultra-pure water.

In 1876, miners were searching for treasure in the Homestake Gold Mine, located in Lead, South Dakota. In 2013, scientists are searching for treasured evidence of dark matter with equipment located in the depths of that same gold mine. Their project is called Large Underground Xenon (LUX) experiment.

Current thinking by scientists is that the universe consists of only about 5% of the matter that we are accustomed to seeing. But, something called dark matter is believed to constitute about 70% of the universe. What about the rest? Well, it is thought that something called dark energy accounts for approximately 25% of the universe.

These terms – dark matter and dark energy – are not something most people have heard or understand. Scientists, in fact, are working hard to learn about these mysterious entities. For that reason, researchers have established the LUX project in a research facility –the Sanford Underground Research Facility – 4,850 feet below the earth's surface.

If we know so little about dark matter, what evidence is there of its existence? Scientists cite the evidence of otherwise unexplained gravitational pull related to the changing rate for expansion of the universe.

The deep underground location helps researchers remove the influence of "fake sources" that could give false alarms as they seek to detect dark matter. For example, cosmic radiation makes detection efforts for dark matter impossible at the earth's surface.

In November 2012, researchers lowered an extremely sensitive detector, which contains xenon in both gas and liquid form, into a 70,000 gallon water tank, 4,850 feet underground. The water is treated with reverse osmosis filters to deionize it and keep it clean. Special treatment equipment will continuously purify the xenon.

Now that the construction phase is completed, investigators hope to begin making measurements in February 2013. If they are successful in their search, they could "strike scientific gold" with evidence for the mysterious dark matter. ■

Homestake Gold Mine was shuttered in 2003 and over a period of several years converted into a research facility. Information about some of the milestones in that transformation can be found at
http://www.sanfordlab.org/about/deep-science-frontier-physics

Information about the LUX dark matter detector is found at
http://www.sanfordlab.org/science/lux

Information about the Sanford Underground Research Facility is found at
http://www.sanfordlab.org/

News release announcing when the LUX detector was submerged is at
http://www.sanfordlab.org/news/press_release/dark-matter-detector-submerged-water-tank

Background information about dark matter can be found in these sources.
(Check the NASA link for information about MACHOS AND WIMPS.)
http://en.wikipedia.org/wiki/Dark_matter
http://science.nasa.gov/astrophysics/focus-areas/what-is-dark-energy/
http://imagine.gsfc.nasa.gov/docs/teachers/galaxies/imagine/act_dark_matter.html
http://astro.berkeley.edu/~mwhite/darkmatter/dm.html
http://science.howstuffworks.com/dictionary/astronomy-terms/dark-matter.htm

Information about the Black Hills Gold Rush in the 1870's is at
http://en.wikipedia.org/wiki/Black_Hills_Gold_Rush

Information about the Homestake Visitor Center is at
http://www.homestakevisitorcenter.com/

Upcoming Opportunities

National Engineering Week is February 17-23, 2013.

The week provides a special opportunity to highlight the role of engineers in our society and give your students the opportunity to learn about a career option they may not have considered. A special web page is available for teachers and students at
www.discoverengineering.org

You may want to contact an engineer who would come for a classroom visit and talk about the career as well as provide students the opportunity to learn how engineers work through a hands-on activity. The parent of one of your students may be an engineer. Or, you can search for a local engineering society which is able to provide a presenter.

There are Local Sections of the American Nuclear Society in many locations, see
http://www.new.ans.org/const/local/
You can also contact **outreach@ans.org**

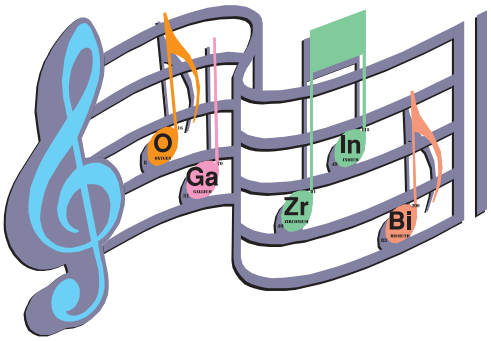
National Nuclear Science Week will be observed October 21-25, 2013.

Preliminary information is at
http://www.nuclearscienceweek.org

Each day of the week will provide a specific focus. Details will be forthcoming in summer of 2013.

Activity

Radioactive Orchestra



You and your students can make music using radiation data. But, before you begin, let's review some background information.

Background

Humankind has always lived in a vast sea of ionizing radiation. It comes from the earth and from outer space, from our food, our air, and our water, from natural sources. Every radioactive substance gives off a specific pattern of emissions. These may be alpha particles, beta particles, or gamma rays — or some combination of these.

We can utilize a radiation monitor or Geiger counter to measure the level of radiation we're exposed to at a specific moment. We can use the monitor to compare how much radiation comes from two different materials. (You may have a Geiger counter in your classroom to demonstrate this.) We can estimate our annual exposure to radiation and see that it depends upon where we live, the activities in which we engage, and upon the medical x-rays and ct-scans we may undergo. An interactive radiation dose chart is available at **http://www.new.ans.org/pi/resources/dosechart/**

Getting to the Music

A group of scientists and musicians have been developing a new – and fun – way to recognize, understand and appreciate the radiation from various materials by working with musical representation of the gamma radiation emitted from each. Their work is explained and demonstrated on a web site at **http://www.radioactiveorchestra.com**

What You'll find

At that site you will find a variety of resources. The materials will provide useful background for you and will help you to interest and inspire your students.

You will find a video that bears a title "Nuclear Musicians: Radioactive Orchestra at TED". It is an 18 minute introduction to radiation, specifically gamma rays, and the process by which the team has begun to create music. (Suggestion: view the video and decide how much you will show your students.) As a part of the presentation (at about 11 minutes into the video) they begin a demonstration of their "musical instrument" which consists of a radiation detector and electronic equipment to amplify the signals and make interesting sounds.

You'll find a video bearing the title "The Radioactive Orchestra Making Music with Radiation." This video provides a wealth of visual and auditory stimuli. The people who speak in this video do not speak English, but an English translation is provided in subtitles.

You'll also find reference to an album of music by the Radioactive Orchestra featuring Axel Boman. Below what appears to be a white album cover, you will find audio samples of six difference pieces of music. These audio samples will allow you to show others how music may result.

You Can Have Some Fun

In addition, you'll find reference to an Online Music Composer. You WILL want to experiment with this fun activity. By positioning your cursor on the Chart of the Nuclides, you'll be able to get a sample of the sounds that developers have associated with the various radiation patterns of various isotopes. You can collect several sound samples and combine them. If you create a musical masterpiece, you can even export your work!

Challenge Your Students

Of course, you'll want to carefully choose a way to introduce this fun activity to your students and get them interested in this resource.

But, you can offer them some challenges and stimulate their interest in uses of isotopes!

You could have them use a browser and search for a list of isotopes used in medicine and create music based on that. One source might be **http://library.thinkquest.org/C003973F/Peace/Medicine/isotopes%20used%20in%20medicine.htm**

A search for Isotopes FOUND in a nuclear power plant could lead to this site **http://nuclearinfo.net/Nuclearpower/TheScienceOfNuclearPower**

You could suggest that students search for lists of isotopes used in industrial processes, food irradiation, space probes, etc. You could refer to "A Day with the Atom" found at **www.ans.org/pi/atom** to get ideas about topics for which students might gather lists of isotopes.

Give the students the challenge to create music for a future date and then schedule an opportunity for them to show off their creative work. While they are having fun with audio and video stimulation, they can also be building a new interest and appreciation for nuclear science and technology. ■

Also worth reading:

Why Music Moves Us **http://news.yahoo.com/why-music-moves-us-230101404.html**

This article reports research which suggests that universal emotions are expressed in nearly the same way in both music and movement across cultures.

ANS Teacher Workshops – 2013

Phoenix, AZ – Sunday, February 24, 2013

A full-day workshop in conjunction with WM2013.
Workshop announcement and registration information are at
http://www.new.ans.org/pi/edu/teachers/workshops/
Register by January 31 for reduced cost.

Atlanta, Georgia – Saturday, June 15, 2013

Details to come. Info will be posted at
http://www.new.ans.org/pi/edu/teachers/workshops/

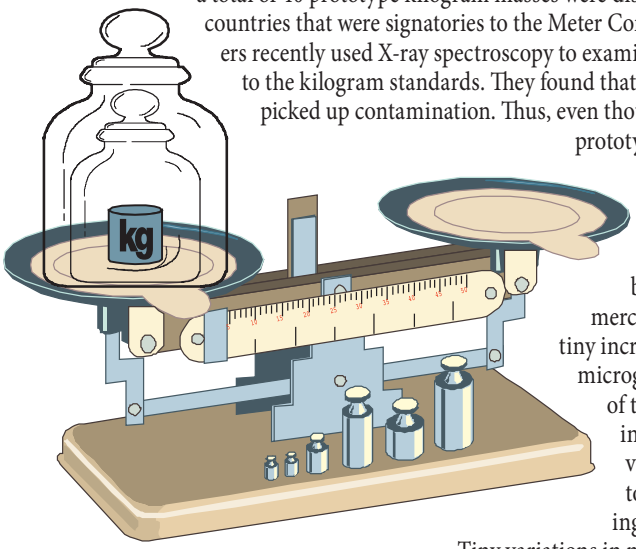
Washington, DC – Saturday, November 9, 2013

Details to come. Info will be posted at
http://www.new.ans.org/pi/edu/teachers/workshops/

You thought gaining weight was a problem just for you?

The challenge of keeping our weight under control familiar, particularly after indulging in holiday treats. Scientists and engineers are facing a mass gain problem of their own. The challenge may mean that scientific measurements are thrown into question.

After the kilogram was adopted as an international standard in 1875, a total of 40 prototype kilogram masses were distributed to those countries that were signatories to the Meter Convention. Researchers recently used X-ray spectroscopy to examine surfaces similar to the kilogram standards. They found that those surfaces had picked up contamination. Thus, even though the kilogram prototypes are carefully stored in filtered laboratory air, surface contamination (carbon-based materials and mercury) has caused tiny increases (just tens of micrograms) in the weight of the prototypes. The increases are likely to vary from prototype to prototype, depending upon their location. Tiny variations in mass become particularly important when measuring radioactive materials.



Various approaches have been suggested to clean the kilogram prototypes. But, scientists are also exploring a way to base the mass standard on some fundamental law of nature rather than a hunk of metal.

To read more, go to
http://news.yahoo.com/kilogram-gained-weight-005533827.html

Coming Soon... Small Modular Reactors

The idea of small modular reactors recently made a splash in the news, when the Department of Energy announced a grant for "small modular reactor" (SMR) development. The USA's first SMR nuclear power plant is planned for the Clinch River site in Oak Ridge, Tennessee. Alternative SMR designs are also being developed by companies all over the world.

So, what is a small modular reactor? Well, it is a new generation of nuclear power reactors, much smaller than existing nuclear power reactors, and transportable by conventional modes such as railroad or truck. And it is modular, meaning it can be manufactured in a factory and brought to a construction site fully assembled, instead of being built piece-by-piece at the site.

The idea is to save construction costs via factory assembly and offer flexibility by providing a small but potent power source for places and uses in which a big conventional nuclear power reactor wouldn't make sense. Financing conventional plants is a big hurdle, and the lower cost of an SMR would lower this barrier as well. Using modern technology, most SMR designs incorporate safety features such as natural circulation for cooling using no moving parts or pumps that could break down. An SMR may also incorporate fuel designs that cause a fission reaction to automatically slow down if temperature increases.

The American Nuclear Society in November 2012 conducted a technical session on SMR development. For more information see: **http://ansnuclearcafe.org/2012/11/14/smr-designs-once-again-a-focus-at-ans-winter-meeting-2012/**

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The Future is in the Atom

LAST PRINTED ISSUE!

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