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REACTIONS

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

School Lunches – Occasion for Radiation?

NOTE: In the months ahead, schools will be deciding whether to order irradiated beef for their lunch programs. It is likely that some of the conversations and concerns about this choice will be intense. Scientists and science teachers value facts over fears. So, in this issue we re providing you with information about food irradiation information that can benef it you, your students and others in the school community as the discussion evolves.

Thanks to the United States Department of Agriculture (USDA), the National School Lunch Program has added irradiated beef to the menu options. Protecting the public from food borne illness is one of the USDA s top priorities. That is why the USDA decided to offer irradiated foods, which provide an additional assurance of food safety.

Beginning in 2004, schools will have a choice whether to order treated beef. In the meantime, the USDA has been distributing information packages on food safety for school districts to share with food service personnel, parents, and local communities. Local schools will make decisions on whether or not to serve irradiated beef and how to notify students and parents of their decisions.

Irradiated beef is treated with radiation to destroy disease-causing bacteria like E. Coli. The USDA joins the Centers for Disease Control, the American Public Health Association and many other professional groups in supporting the use of irradiation to add a measure of safety and quality to our food.

The technology has been around since the 1930 s to help preserve perishable food. The process enhances the safety of food while keeping it flavorful and nutritious. Restaurants and retailers, committed to reducing food borne illness, offer irradiated food across the country. ■

For more information about Food Irradiation see page 2.

The Radura

So that consumers can make informed purchases and find irradiated products in their local supermarkets, all irradiated meat and poultry is labeled with the radura logo. This symbol, which resembles a stylized flower inside a circle, indicates that a product has been treated with radiation. Products with the radura require the same safe handling procedures used with all meat and poultry.

US food regulators have approved irradiation for a number of purposes. It is used to treat wheat, white potatoes, spices, and fresh fruits. It is also approved by the FDA for non-food functions such as sterilization of medical products including surgical gloves, bandages, and gauze, as well as destroying bacteria in makeup. ■

Microelectronic Nose Recognizes Gases to Save Lives

A microelectronic nose now offers the potential to save effort, money and human life by determining the type of materials setting off a smoke detector, determining the species of termite eating a house, or analyzing poisonous gases and determining their concentrations.

The "nose" for this microelectronic device is smaller than a dime. Combined with software for measurement and analysis, it can fit into a package about the size of a cell phone. The "nose" is a solid state ceramic-metallic sensor which is inexpensive to make. The chip has a sensor on one side and a tiny heater on the other.

Small amounts of chemical vapors adhere to the chip's surface as they pass by it. Heating the chip causes the chemicals to interact with the surface, creating electrical resistance and a unique electronic signature. This signature can be used to identify the chemicals and their concentrations.

As a practical example, the microelectronic nose would be able to detect whether the smoke setting off a smoke alarm is from a serious, life threatening fire or burned toast. In a hospital, this knowledge could help avoid an expensive and unnecessary evacuation of patients.

In addition, the technology has potential applications in monitoring groundwater contaminants, detecting leaks in pipelines, breeding livestock, monitoring airborne chemicals in public areas, and more.

For more information about the development of this technology and possible future refinements, visit
http://www.anl.gov/OPA/logos20-3/smartsensor01.htm ■

Irradiation can reduce food borne illness by killing harmful bacteria

- Treating raw meat and poultry with irradiation could eliminate bacteria commonly found on raw meat and raw poultry, such as *E. coli* O157:H7, *Salmonella*, and *Campylobacter.*
- Irradiation can reduce or eliminate bacteria in many raw vegetables.
- Both fresh and frozen foods can be treated.
- Packaged food can be sterilized, enhancing its safety for people with deficient immune systems.
- Unlike traditional washing, irradiation kills bacteria throughout the food, not just on the surface.

It can increase shelf life by slowing ripening and spoilage

- Strawberries treated with a low dose of radiation will not mold for up to two weeks even without refrigeration
- Irradiated potatoes, yams and onions can be stored for an extended period even if not refrigerated, which increases their availability in underdeveloped countries
- Bananas, mangoes and papayas often last two to three times as long after irradiation.

It can reduce food lost to insect infestation

- Irradiation is one of very few viable alternatives to methyl bromide, an ozone-depleting chemical used to fumigate grains against insects.
- It is an internationally approved method of eliminating insects like fruit flies from fresh tropical fruits - like Hawaiian papayas - that would otherwise be subject to quarantine.
- Unlike chemical treatments, irradiation leaves no residue on the food.

It is a proven, cost effective option for increasing usable food supplies

- As much as 25% of the world s food production is lost to insects, bacteria and rodents after harvesting.
- The Centers for Disease Control estimates that known pathogens, most of which can be reduced or eliminated by irradiation treatment, cause 14 million illnesses, 60,000 hospitalizations, and 1,800 deaths each year in the United States, a country with one of the safest food supply systems in the world.
- Large grocery chains in the US including Publix, Wal-Mart, Winn-Dixie, Giant and Brunos are all marketing irradiated products. ■

To Read More About Food Irradiation

http://www.cdc.gov/ncidod/dbmd/diseaseinfo/foodirradiation.htm
Information about food irradiation from Centers for Disease Control and Prevention

http://uw-food-irradiation.engr.wisc.edu/
University of Wisconsin Food Irradiation Education Group

http://www.iaea.org/worldatom/Press/Booklets/Food/q&a.html
Q&A about food irradiation from International Atomic Energy Agency (IAEA)

http://www.iaea.org/worldatom/Press/Booklets/Food/foreword.html
http://www.iaea.org/worldatom/Press/Booklets/Food/consumer.html
http://www.iaea.org/programmes/rifa/icgfi/documents/catch-the-wave.htm
Three additional resources on food irradiation from IAEA

http://www.oznet.ksu.edu/library/fntr2/samplers/MF2426.asp
Brochure from Kansas State regarding food irradiation

http://ccr.ucdavis.edu/
Center for Consumer Research at UC Davis; info on irradiation

http://ccr.ucdavis.edu/irr/oppose.shtml
Cites opposition to food irradiation and provides responses

http://www.fsis.usda.gov/OA/pubs/qa_irrad.htm
USDA info on irradiating meat and poultry

http://www.iaea.org/icgfi/
International Consultative Group on Food Irradiation web page

http://peaches.nal.usda.gov/foodborne/fbindex/Food_Irradiation.asp
USDA Foodborne Illness Education Center

http://www.ans.org/pi/np/food/
Info about food irradiation from American Nuclear Society ■

Irradiation: Crucial to Tissue Banks

Sterilized bone, skin and other tissues are grafted or transplanted to help provide healing for an enormous number of people around the world. Severe burn victims and people of all ages suffering from crippling diseases, blindness and birth defects are the prime beneficiaries of tissue transplants.

Sometimes grafts are from one part of the patient's body to another (autograft). More and more, tissues from other human or animal donors (allograft) are used for transplantation.

The use of allografts requires careful testing and preparation to assure that no disease or infection is transmitted to the recipient. Once the tissue is cleaned, cut into surgically useful shapes, and packaged, it is sterilized to eliminate bacteria.

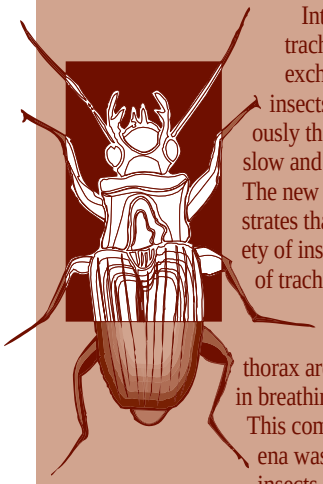
Irradiation is the preferred method for sterilizing most tissues used medically. The process exposes the tissue to controlled doses of radiation for specified times in a shielded facility.

The International Atomic Energy Agency (IAEA) has been instrumental in helping establish and encourage tissue banks around the world.

Information about previous and ongoing IAEA efforts with tissue banks can be found at
http://www.iaea.org/worldatom/Press/P_release/2002/prn0218.html
http://www.iaea.org/worldatom/Press/News/lima_lives.shtml
http://www.iaea.org/worldatom/Press/News/tissue_bank.shtml ■

X-ray Beam Reveals Insect Breathing

Scientists at the Field Museum and U.S. Department of Energy's Argonne National Laboratory used a powerful X-ray beam to document an insect breathing mechanism resembling lung ventilation in vertebrates.



Internal tubes called tracheae are known to exchange oxygen in insects. This was previously thought only to be a slow and passive process. The new study demonstrates that, for a wide variety of insects, rapid cycles of tracheal compression and expansion in the head and thorax are also involved in breathing.

This compression phenomena was not found for all insects studied. However, three closely studied species (wood beetle, house cricket and carpenter ant) exchange up to 50 percent of the air in their tracheal tubes each second. This compares to the air exchange in a person doing moderate exercise.

Researchers believe the work offers the possibility of developing a powerful new technique for studying how living animals function and providing insights into human health mechanisms.

The complete story and images showing the tracheal compression and expansion cycle are available at http://www.anl.gov/OPA/news03/news030124.htm ■

Project #68 – Modeling Activity

Modeling Radioactive & Stable Atoms

Use this as a demonstration or as a hands-on activity for students.

Introduction:

A zip-close plastic bag represents the nucleus of an atom and holds representation for protons and neutrons. If the atom is stable, zip the bag closed. If atom is radioactive, bag is left open to emit ionizing radiation (alpha particles, beta particles and/or gamma rays).

Materials:

- large marshmallows
- mini-marshmallows
- quart size zip-close plastic bags
- fine point permanent marker
- Periodic Table of the elements
- pipe cleaners (optional)
- toothpicks
- white school glue
- Chart of the nuclides (optional)

Directions:

1) Mark 7 large marshmallows with a positive (+) sign. They represent protons.
2) Select 7 unmarked large marshmallows to represent neutrons.
3) From the group above, select 2 protons and 2 neutrons ; use toothpicks and glue to join these into a group of four . This represents an alpha particle.
4) Mark the sides of a mini-marshmallow with a negative (-) sign; it represents an electron. Stick, but do not glue, a toothpick into this mini-marshmallow. Glue the other end of the toothpick into the side of a proton (so the positive sign is partially covered). This now represents a neutron.
5) Put the alpha particle from step #3 into an empty zip-close bag. Add 4 protons and 4 unmarked marshmallows (neutrons). Zip bag closed.

The closed bag represents the nucleus of a stable atom. The binding energy can contain all the protons and neutrons within the nucleus; atom is stable.

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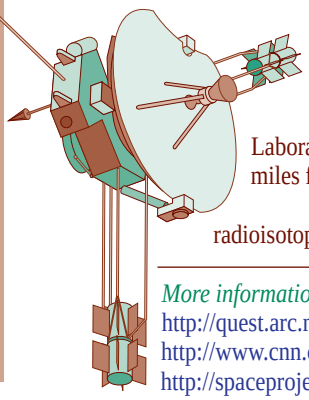
Radioisotopes Powered Pioneer 10



Early in 2003, the Pioneer 10 spacecraft fell silent, after traveling billions of miles from Earth over a period of nearly 31 years. It was the first spacecraft to venture out of the solar system.

The last signals were received January 22, 2003 by Jet Propulsion Laboratory's Deep Space Network. At the time, Pioneer 10 was 7.6 billion miles from Earth.

The spacecraft's communication system was powered by four radioisotope thermoelectric generators (RTG).

More information about Pioneer 10 can be found at
http://quest.arc.nasa.gov/sso/cool/pioneer10/mission/
http://www.cnn.com/2003/TECH/space/02/25/pioneer.10.ap/index.html
http://spaceprojects.arc.nasa.gov/Space_Projects/pioneer/PN10&11.html ■

Beethoven – Heavy Metal Made Him Sick

Composer Ludwig van Beethoven, a classical music mainstay, seems unlikely to have had any connection to heavy metal. But, there's new evidence that exposure to heavy metal was a factor in Beethoven's chronic illness and may have contributed to his death.

"Beethoven lived in the 19th century," you may object. "How could he have been exposed to heavy metal?" Well, it wasn't heavy metal music that made him sick. It was lead poisoning.

Scientists from the Health Research Institute and Argonne National Laboratory (ANL) collaborated to study a sample of Beethoven's hair. The sample had been cut and kept as a memento, following his death in 1827.

The research team performed nondestructive x-ray fluorescence analysis studies on six of the Beethoven hairs using ANL's Advanced Photon Source. They found that lead levels in the six Beethoven hairs averaged 60 parts per million (ppm). This compares to a lead level of only 0.6 ppm in the hair of average Americans today.

Beethoven reportedly consulted many physicians for bad digestion, chronic abdominal pain, irritability and depression. Lead poisoning could explain his life-long illnesses, but the researchers doubt it caused his deafness.

The source of the composer's lead poisoning is unknown. It could have been from dishes or from wine stored in lead-lined flasks or lead crystal. Mineral water at spas might have been a source.

Researchers plan additional studies of the hair sample. They hope to determine if the lead levels were due to diet and whether there were multiple high doses or high background amounts.

For additional information, including why researchers checked for the presence of mercury in Beethoven's hair, visit http://www.anl.gov/OPA/frontiers2002/c3facil.html

For information about ANL's Advanced Photon Source, visit
http://www.aps.anl.gov/overview/ovrvu/frnt/welcome.frntpg1.html
or http://www.anl.gov/OPA/frontiers/c1facil.html ■

Nuclear Sciences

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Q1. *How many positively charged marshmallows (protons) are in the bag? (Do not count the one whose positive sign is partially covered by the mini-marshmallow!) This is the atomic number of the atom.*

Q2. *What element is represented by this model?*

Q3. *How many neutral particles are in the bag? (You* ***do count*** *the particle where positive and negative charges cancel each other out!)*

Q4. *What is the atomic mass of this atom? (Each large marshmallow equals 1 atomic mass unit, regardless of charge.)*

6) Open the bag. Add two neutrons. Leave the bag unzipped; excess neutrons have now made it unstable.

7) To become stable, the nucleus will emit a beta particle. Find the neutron you made in step #4. Pull off the mini-marshmallow (now it is a beta particle) and toss it about 1-2 feet from you. Leave the remaining proton in the bag and zip it closed. The atom has changed and is stable again.

Q6. *What is the atomic number of the atom now?*

Q7. *What element does the atomic model represent now?*

Q8. *What is the atomic mass of the atom now?*

Summary:

- Radioactive atoms emitting beta particles will change into the element which is one atomic number higher, but they will have the same atomic mass as before.
- To show another radioactive atom that emits an alpha particle to become stable, place an alpha particle in an empty zip bag. Add 2 protons and 2 neutrons. This represents the nucleus of Beryllium-8. The atom emits an alpha particle, which will pick up two electrons to become a stable atom of Helium-4. The result is two atoms of Helium-4.
- Represent a Gamma ray emission by shining a flashlight through the bag. Although gamma rays are really not visible, you can use this to model the fact that gamma rays are not particles; they are a form of electromagnetic radiation. All three types of radiation (alpha, beta, gamma) are ionizing radiation; they have enough energy to remove electrons from ordinary atoms. These ions allow us to detect radiation using a Geiger counter, photographic film, or an electroscope.

If desired, you can add pipe cleaners onto the bag to represent the orbits or shells where electrons would be present; mini-marshmallows with a negative (-) sign on them can be attached to the pipe cleaners to represent orbital electrons. ■

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Some issues of *ReActions* are web-only editions. We will send registered readers an email notification when a new issue is available online.

Getting registered for email notification is easy. Visit http://www.ans.org/pi/teachers/reactions/. Click on Register for *ReActions* Email Notification and follow the directions. ■

ANS Exhibits at NSTA Regional Conferences

ANS will have an exhibit booth at all three NSTA area conventions this fall:

Minneapolis, MN
October 30 - November 1

Kansas City, MO
November 13-15

Reno, NV
December 4-6

A wide variety of free printed materials will be available at the ANS booth.

In addition, ANS will conduct one 75-minute introductory workshop titled, Detecting Radiation in Our Radioactive World, at each NSTA area convention. Attendance is limited to the seating capacity of the meeting room. Admission is free; seating is on a first-come first-served basis.

Consult the NSTA program at each convention for time and location, or go to http://www.ans.org/pi/teachers/workshops/ for more information. ■

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Presentation on Nuclear Careers Is Available for Download

Engineers and technicians trained in nuclear science and technology are needed in many application areas – energy, medicine, space, industrial processes, and more.

High school and middle school students (and their parents) may not know about the exciting opportunities in the field. Also, they may not know that many scholarships are available to help students pay for college studies in nuclear science and technology.

ANS has prepared a special presentation that tells about many applications for nuclear science and technology and the diverse career opportunities in the field.

The presentation is available in both PC and MAC versions and can be downloaded from the ANS web site. An update, which will include music, is being prepared and will also be available on CD. For more information, go to http://www.ans.org/pi/students/careers/#pres ■