

chapter 6

Other Applications of Radiation

Prior Knowledge: The Bohr Model of the atom was introduced in Grade 9 science. As well, the four fundamental forces were introduced in Grade 11 physics. A review of subatomic particles

Terms You Should Know: There is a list here and at the end of the chapter highlighting important terms. Teachers could use this list as either a knowledge activation activity—have students create a concept map or definitions frame—or as a review of concepts.

Note that this list of terms is not intended to be a list for memorization. It is there to help the teacher incorporate new concepts into activities.

accelerator physicist	Atomic Energy of Canada Limited (AECL)
blogger	Canadian Nuclear Safety Commission (CNRC)
Chalk River Laboratories	electron beam
erythema	gamma ray
gamma scan	germicidal lamp
gigahertz	ionization
radiofrequency	radiowave
smoke detector	sterilization
synchrotron	World Health Organization (WHO)

Chapter Summary: Beyond diagnosis and treatment, this chapter looks at other uses of radiation. These uses include sterilization, tanning beds, communications, and microwave ovens.

Page 65 | “Did You Know: Research Question”

What are the effects of thallium poisoning on the human body? In what everyday products can thallium be found?

Thallium can be found in rat poison. Because thallium is so easily ingested into the system, consequences of thallium poisoning can be quick and severe. Stomach aches and damage to the nervous system can occur. With acute exposure to thallium, the damage is so irreversible that death occurs. If the individual survives poisoning, often irreversible damage to the nervous system occurs with shaking, paralysis, and joint pain being common.

Page 66 | “Questions:”

1. Can you identify what might be potential areas of concern in this bone scan?
It looks like there is a fracture in the small toe bone.
2. Research what type of radiotracer might be used to enable doctors to see tendons on a scan.
Typically, the fluorine-18 isotope is used.



Page 66 | “In the Media: Research Question”

Read the public written and verbal statements made by both the CNRC and the AECL (which can be found online). If you were the Health Minister for the federal government and you had to make the decision whether or not to shut down the reactor—albeit temporarily—what would you decide? Justify your decision.

Many answers are possible.

http://www.nuclearfaq.ca/cnf_sectionD.htm#nru-safety As of November 2008, this website has, under #17, a summary of the November 2007 incident. AECL’s comments on the CNRC position can be found at http://www.nuclearfaq.ca/AECL_NRU_Jan2008.htm. You can find the CNRC and CNSC (Research and Safety Commissions) opinions on the CNSC website at <http://www.nuclearsafety.gc.ca>: using their search engine, type “November 2007 shutdown” and there will be many article choices to find quotes.

Page 68 | “Research Questions:”

1. Which new frequencies did the Canadian government recently open up to allow for more competition amongst cellular service providers? How does a cellular service provider or radio station obtain an operating frequency?

Over 100 MHz of new spectrum was released in 2008 for companies to purchase bandwidths for cellular service. To obtain an operating frequency, an individual (such as a “ham radio” operator) must pass a licensing examination covering basic concepts. They then have access to larger segments of the radiofrequency spectrum. Cellular service providers and radio stations purchase a bandwidth or section of the radiofrequency spectrum for their company’s use.

2. Why are radio station signals sometimes more clear at night than during the day?

AM radio signals have relatively long wavelengths which interact with layers of the atmosphere above the earth’s surface. Because of shifts in the layers of the atmosphere from daytime to night-time, AM radiowaves propagate differently at night. During daytime hours, reflection of AM waves from the ionosphere does not occur to any great degree. The radiowaves travel by conduction over the surface of the earth during the day. At night, however, the same radiowaves are reflected off the ionosphere and can travel hundreds of kilometres further than they can during the day, a phenomenon called “skywave” propagation. Because of this, AM stations are required to drastically decrease their operating power at night to decrease interference.

Page 70 | “Activity: Marshmallows, Microwaves, and Mathematics:”

If measurements are made carefully and the marshmallows are not left in the microwave too long, answers should be very close to 3.0×10^8 m/s. Mini chocolate chips, if lined up tightly together, may be used instead of marshmallows.

Page 70 | “For Further Research:”

How do smoke detectors use alpha-particle emitters? Is it ionizing or non-ionizing radiation that is used? Create a presentation of your results.

Ionizing smoke detectors have an ionizing chamber and a source of ionizing radiation. Typically, the source of radiation is an isotope of americium. The ionizing chamber has two plates separated by a small distance. The battery provides electricity to the plates. Because the americium constantly releases alpha particles in the chamber, these alpha particles ionize the air enough to allow current to flow from one plate to the other.

When smoke enters the ionization chamber, the ions are neutralized and the current no longer flows from one plate to another. This causes an alarm to sound.