

chapter 4

Radiation and Treatment

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.

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 or to provide lists of definitions. It is here to assist the teacher in the incorporation of new concepts and terminologies into the learning activities.

anaesthesia	barium enema
biopsy	brachytherapy
Chernobyl	cobalt
collimator	colonoscopy
esophagus	fractionated treatment
gamma knife	intensity modulated radiation therapy (IMRT)
intracranial	linear accelerator (linac)
neurosurgeon	photodynamic therapy
radiation oncologist	radioisotope
radium	systemic radiation
teletherapy	

Chapter Summary: Chapter 4 discusses types of treatment involving radiation, including radioisotope therapy, brachytherapy, systemic radiation, teletherapy, and the gamma knife. At the end of the chapter is a featured biography of Dr. David McMillan, photojournalist and professor of arts at the University of Manitoba who has contributed two images of the setting around the science city, Pripjat, in Ukraine in the wake of 20 years of isolation from human activity. You can access a number of Dr. McMillan’s images online at: <http://home.cc.umanitoba.ca/~dmcmill/>. He has made at least six visits to the area since 1994, and his images provide a haunting time series of nature reclaiming a “dead zone.”

Page 42 | “Question”

Is your water source chlorinated?

Students can contact the local municipal water treatment facility or their town council office to find out whether their local town water supply is chlorinated. What if their water source is a well? How might this alter the ability to have a water supply that is sufficiently free of, say, coliform bacteria? Also, consider the protocols for testing that are often put in place for wells after overland flooding events have occurred in agricultural regions.

Page 42 | “Activity: A Personal Cancer Journey”

Be sure to respect those students who do not wish to share details of close family and friends who may have experienced cancer.

Page 46 | “Question:”

Would there be complications if this technology (photodynamic therapy) were used to treat children?

This type of technology could be used on children, however the dosage amounts would have to be adjusted accordingly. If not, complications such as radiation poisoning could occur.

activity

In the Movies

“Erin Brockovich” (Jersey Films, 2000) tells the story of a concerned citizen who acted on behalf of Hinkley CA residents when their environment became toxic. Most viewers are of the opinion that this is a “radioactivity story.” Through your research, find out if this is the case, or, whether the effects seen in the local residents were related to “chemical” influences of a non-radioactive nature.



Page 49 | “Activity: Flashlight ‘Beamlets’:”

What problems occur? What variables do you need to control or change to obtain a better result? How do these results help in understanding IMRT?

Some problems are that the flashlight beams are not concentrated enough to light up only the image; the beams spread as they travel further away from the source; one flashlight beam may be brighter than another. To obtain a better result, we need to be able to concentrate the light and control the beam so it does not spread with distance away from the source. IMRT is similar in that these types of variables are controlled to ensure that only cancerous tissue is irradiated and healthy tissue is not damaged.

Page 51 | “Questions for Further Research:”

1. Which type of radiation therapy discussed in this chapter is the least invasive? Which one has the least impact on quality of life immediately after treatment?

Photodynamic therapy, systemic therapy, or IMRT are the least invasive. All therapies which do not involve surgery have the potential to have the least impact on quality of life immediately after treatment as the patient can go home almost immediately after. If an isotope is taken internally, such as with systemic therapy, the patient may have to remain in hospital for a few hours until the radiation has left his/her body.

2. What types of treatment is your water plant using to make sure drinking water is safe? How have methods changed with time? Acknowledge your sources of information.

Many answers are possible.

3. Why do you think it took more than 30 years to obtain gamma knife technology in Canada from the time of its invention? Justify your answer.

Many answers are possible.

4. Research the Three Mile Island disaster that took place in Pennsylvania in 1979. Discuss the similarities and differences between this disaster and the Chernobyl disaster of 1986, both in terms of damage to the environment and in how the government handled the public health situation after that. Acknowledge your sources of information.

On March 28, 1979, some of the coolant pumps failed on the second reactor at Three Mile Island (TMI) facility in Pennsylvania. This is unlike the Chernobyl disaster, which was ironically caused after safety tests went horribly wrong. The TMI disaster built up pressure in the reactor core: radiation was released to alleviate the pressure on March 30th. At the time, it was described as uncontrolled radiation release, however it was later determined that it was planned by the officials involved. This is similar to the Chernobyl disaster in that officials tried to hide at least some of the details from the public. All official reports of radiation exposure in the TMI area indicate that no person received a radiation dosage greater than what natural background radiation would provide in the environment over a calendar year.

(Many more answers are possible.)

EXTRA ACTIVITY FOR CHAPTER FOUR:

“In the Movies:”

Research what the effects of this element were on the people of Hinkley, CA. Did the movie accurately portray the somatic and genetic effects?

Hexavalent chromium is toxic and carcinogenic. Hinkley drinking water had 0.58 parts per million of hexavalent chromium, well above the accepted level of 0.1 ppm. As a result, more than 25% of children ages five and up showed some form of disability or illness or even cancer. Liver cancer; kidney failure, respiratory and circulatory problems, gastrointestinal problems, reproductive problems (including miscarriages), and cancers of the brain and other body organs were some of the effects this isotope had on the population of Hinkley. Note: Be sure to distinguish for students that hexavalent chromium is NOT an isotope of chromium... it is a specific oxidation state of chromium. (Oxidation states may be worth exploring briefly if students have or are currently taking Chemistry courses.)