

# From the Outside In: Biological Effects of Radiation

How do various types of ionizing radiation enter and effect the body?



## overview

### LESSON CONTEXT

People are exposed to ionizing radiation everyday. This radiation comes from natural sources such as the Sun and also from human-made sources such as CT scans and dental x-rays. How ionizing radiation affects the human body depends on several factors, including the type of radiation and the type and number of cells affected.

### LEARNING GOALS

- Recognize that human health can be negatively affected by ionizing radiation.
- Understand how ionizing radiation enters the body.
- Understand the causes of cell and DNA damage due to various types of ionizing radiation.

### LEARNING ACTIVITIES

In this lesson, students will explore how various types of ionizing radiation enter the body and the effects the radiation can have once in the body. They will demonstrate their understanding by creating a visual presentation (e.g. poster, PowerPoint, video, etc.).

### BIG IDEAS

Each type of ionizing radiation (alpha particles, beta particles and gamma rays) has its own characteristics, including how it penetrates the body. All types of ionizing radiation can cause damage (somatic and reproductive) to cells and DNA.

## assessment & evaluation

### PRIOR KNOWLEDGE AND SKILLS

- Familiarity with various types of ionizing radiation (alpha particles, beta particles and gamma rays)
- Experience representing information visually
- Experience working in cooperative small groups
- Experience locating legitimate information using internet sources

### SUCCESS CRITERIA

- Students participate during PowerPoint activity
- Student research demonstrates understanding of the causes of cell and DNA damage due to various types of ionizing radiation

### ASSESSMENT STRATEGIES

- Assessment of student assignments using predetermined rubric
- Multiple choice quiz



time

60-80

MINUTES PLUS TIME  
OUTSIDE OF CLASS



subjects

SCIENCE  
BIOLOGY



skills

CRITICAL THINKING  
COMMUNICATION

## resources & materials required

### **What's the Link? PowerPoint**

  **BLM – Radiation in the Body Assignment** – one per student

  **BLM – Radiation in the Body Quiz** – one per student

  **BLM – Radiation in the Body Web Links** – one per student

  **BLM – Radiation Info Sheet** – one per student

  **BLM – Radiation in the Body Rubric** – one per student (optional)

 **BLM – Radiation in the Body Guide Sheet** – for teacher use

 Curriculum alignment

- LCD projector or interactive whiteboard
- Student notebooks
- Electronic devices with internet access

## minds-on

 20 MINUTES

- Begin by showing the students the **What's the Link? PowerPoint**. In this presentation, students will see images of objects and devices which people use to protect themselves from ionizing radiation.
- Explain to the students that they should view the images and write in their notebooks what they think each object is.
- After seeing all of the images (slides 3-9), show slides 10-18. For each of the slides, have the students share what they think the object is, then click for the animation which brings up a label for the object. Once all of the objects have been identified, have a discussion about each object. Questions for discussion can include:
  - » *What did all of the objects have in common? Why do you think this is?*  
All of the images showed objects which protect people from ionizing radiation.
  - » *Why do you think a space suit and lunar habitat were included?*  
In space, astronauts are exposed to ionizing radiation such as protons, gamma rays and x-rays from solar flares and cosmic rays. Unlike here on Earth, there is no atmosphere to shield the astronauts from this radiation.
  - » *What is the purpose of a fallout shelter?*  
A fallout shelter is an enclosed space specially designed to protect people from radioactive fallout (debris, radiation) resulting from a nuclear explosion. Many fallout shelters were constructed as civil defence measures during the height of the Cold War (1950s and early 1960s).
  - » *Why do people need to protect themselves from ionizing radiation?*  
Ionizing radiation can have some very serious health effects.

## action

 10 MINUTES PLUS RESEARCH TIME OUTSIDE CLASS

- Explain to the students that they will be finding out about how ionizing radiation enters the body and what damage it can do once inside the body by answering the question, "Can ionizing radiation negatively affect human health?"
- Provide each student with a copy of the **Radiation in the Body Assignment BLM**, the **Radiation in the Body Web Links BLM** and the **Radiation in the Body Rubric BLM** or create your own assessment tool.
- Arrange the students into small groups (or have the students arrange themselves into small groups).
- Review the assignment to ensure that all students understand what is required.
- In order to assist with assessing knowledge and understanding, a **Radiation in the Body Guide Sheet BLM** has also been provided. It includes answers to all of the questions that the students have on the **Radiation in the Body Assignment BLM**.

### IMPLEMENTATION OPTIONS

- Ideally, students will be familiar with various types of ionizing radiation, in particular alpha particles, beta particles and gamma rays. If not, students could participate in the **It's All Greek to Me: Radioactive Decay** lesson or read the **Radiation Info Sheet BLM**.

## consolidation

 40-50 MINUTES

- Have each group submit their assignments. Time permitting, each group could present their assignment to the class.
- Distribute the **Radiation in the Body Quiz BLM** to each student and have them complete the quiz. The quiz could be taken up as a class, checked over together by small groups of students or marked by the teacher. After assessing the results, revisit any concepts that the students appeared to have difficulty with.

## extensions

- The students could apply their knowledge of the biological effects of radiation in the **Attack of the 50 Foot Mutant: Radiation in Popular Culture** lesson.
- Have the students explore how mutations caused by ionizing radiation can cause cancer.
- Have the students describe some genetic disorders that are caused by genetic mutations.
- Have the students re-examine the objects in the **What's the Link? PowerPoint** to find what type(s) of ionizing radiation the objects are protecting against.

### QUIZ ANSWERS

- 1 - d
- 2 - b
- 3 - a
- 4 - c
- 5 - c
- 6 - b
- 7 - b
- 8 - d
- 9 - b
- 10 - a

## additional resources

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### CANADIAN NUCLEAR ASSOCIATION WEB PAGES

- [What is radiation?](#)
- [Quantifying radiation](#)
- [Effects on the body](#)

### RELATED TEACHNUCLEAR LESSON PLANS

- [Attack of the 50 Foot Mutant: Radiation in Popular Culture](#)
- [Flying the Radioactive Skies](#)
- [It's All Greek to Me: Radioactive Decay](#)
- [Radioactive Half-Life: The Whole Story](#)

## background information

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[Retrieved August 2019]

- [Radionuclides – United States Environmental Protection Agency](#)  
Information about commonly encountered radionuclides (radioisotopes). Click on the links of individual radionuclides to get further information, including how they enter the body and what happens once inside the body.
- [How can I become contaminated by radiation? – Health Canada, Government of Canada](#)  
Radiation exposure pathways, surface exposure, external exposure and internal exposure (archived).
- [How would radiation effect my body? – Health Canada, Government of Canada](#)  
Cellular effects of radiation, cellular repair, cellular death and cellular mutation, as well deterministic and stochastic effects (archived).
- [Mutation, Mutagens and DNA Repair – Kansas State University](#)  
A look at how radiation causes mutations, as well as DNA repair.
- [Understanding Radiation in Our World: A Companion Guide for Teachers – National Safety Council's Environmental Health Center](#)  
This guidebook contains information about ionizing radiation and the risks of radiation to human health.
- [Radiation Safety Manual – Environmental Health and Safety, Princeton University](#)  
Official text of the Princeton University Radiation Safety Manual.