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

**Overview**

**Subject Focus:** Science, Biology  
**21st Century Skills Focus:** Critical Thinking, Communication  
**Suggested Timing:** 60 minutes plus time outside of class

**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 Idea**

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 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

**Resources & Materials**

- What’s the Link? PowerPoint [.ppt]
- Radiation in the Body Rubric [.doc] [.pdf] (optional)
- Radiation in the Body Guide Sheet (for teacher use)
- Curriculum alignment [.html]
- LCD projector or Interactive whiteboard
- Student notebooks
- Electronic devices with internet access

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From the Outside in: Biological Effects of Radiation

### MINDS-ON

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<thead>
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<th>Suggested Timing: 20 minutes</th>
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<tbody>
<tr>
<td>Begin by showing the students the <strong>What’s the Link? PowerPoint</strong>. In this presentation, students will see images of objects and devices which people use to protect themselves from ionizing radiation.</td>
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<tr>
<td>Explain to the students that they should view the images and write in their notebooks what they think each object is.</td>
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<tr>
<td>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:</td>
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<tr>
<td>- <strong>What did all of the objects have in common? Why do you think this?</strong></td>
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<td>- All of the images showed objects which protect people from ionizing radiation.</td>
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<td>- <strong>Why do you think a space suit and lunar habitat were included?</strong></td>
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<td>- 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.</td>
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<tr>
<td>- <strong>What is the purpose of a fallout shelter?</strong></td>
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<td>- 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).</td>
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<tr>
<td>- <strong>Why do people need to protect themselves from ionizing radiation?</strong></td>
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<td>- Ionizing radiation can have some very serious health effects.</td>
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### ACTION

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<tr>
<th>Suggesting Timing: 10 minutes plus research time outside class</th>
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<tr>
<td>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?”</td>
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<tr>
<td>Provide each student with a copy of the <strong>Radiation in the Body Assignment BLM</strong>, the <strong>Radiation in the Body Web Links BLM</strong> and the <strong>Radiation in the Body Rubric</strong> or create your own assessment tool.</td>
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<tr>
<td>Arrange the students into small groups (or have the students arrange themselves into small groups).</td>
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<tr>
<td>Review the assignment to ensure that all students understand what is required.</td>
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<tr>
<td>In order to assist with assessing knowledge and understanding, a <strong>Radiation in the Body Guide Sheet</strong> has also been provided. It includes answers to all of the questions that the students have on the Radiation in the Body Assignment BLM.</td>
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### Implementation Option

- 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 Ionizing Radiation page on the TeachNuclear web site.

### CONSOLIDATION

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<tr>
<th>Suggested Timing: 40-50 minutes</th>
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<tr>
<td>Have each group submit their assignments. Time permitting, each group could present their assignment to the class.</td>
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<tr>
<td>Distribute the <strong>Radiation in the Body Quiz BLM</strong> 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.</td>
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**Quiz Answers**

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

- The students could apply their knowledge of the biological effects of radiation in the lesson *Attack of the 50 Foot Mutant: Radiation in Popular Culture*.
- 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.

ADDITIONAL RESOURCES — Canadian Nuclear Association

**TeachNuclear Web pages**
- Biological Effects of Radiation: Introduction
- How Ionizing Radiation Enters the Body
- Effects of Ionizing Radiation on DNA
- Irradiation vs Contamination
- Ionizing Radiation
- Alpha Decay
- Beta Decay
- Gamma Rays

**Related TeachNuclear Lesson Plans**
- Attack of the 50 Foot Mutant: Radiation in Popular Culture
- Flying the Radioactive Skies: Is Radiation a Health Issue for Long-Distance Fliers?
- It’s All Greek to Me: Radioactive Decay
- Radioactive Half-Life: The Whole Story
- What Is Radiation? Jeopardy

ADDITIONAL RESOURCES — CurioCity by Let’s Talk Science

**Articles**
- Cosmic & Neutron Radiation
- Radiation Effects on Cells & DNA
- Radiation Effects on the Body

**Videos**
- Scientists Keep Radiation in its Place
- What is Radiation? (CNSC)

**Career Profiles**
- Radiation Physics Specialist / Radiation Safety Officer

**Educator Resources:**
- RADN2 & You Action Project
**BACKGROUND/ADDITIONAL INFORMATION**

- **Environmental Protection Agency (USA) – Commonly Encountered Radionuclides** (Retrieved Dec. 2, 2014)
  
  On this page there is information about commonly encountered radionuclides (radioisotopes). You can click on links for individual radionuclides to get further information, including how the various radionuclides enter the body and what they do once inside the body.

- **Health Canada – How can I become contaminated by radiation?** (Retrieved Dec. 2, 2014)
  
  This page (archived) has information about radiation exposure pathways, surface exposure, external exposure and internal exposure.

- **Health Canada – How would radiation affect my body?** (Retrieved Dec. 2, 2014)
  
  This page (archived) has information about cellular effects of radiation, cellular repair, cellular death and cellular mutation, as well deterministic and stochastic effects.

- **Kansas State University – Mutation, Mutagens, and DNA Repair** (Retrieved Dec. 2, 2014)
  
  This page contains information about how radiation causes mutations, as well as DNA repair.

- **National Safety Council (USA) – Understanding Radiation in Our World** (Retrieved Dec. 2, 2014)
  
  This guidebook contains information about ionizing radiation and the risks of radiation to human health.

  
  This module has information about exposure of ionizing radiation to the body including genetic effects and prenatal effects.