

SIEMENS STEM DAY ACTIVITY

EFFECTS OF RADIATION

OBJECTIVES

Students will be able to:

- **explain** the similarities and differences between ionizing and non-ionizing radiation
- **understand** the benefits and risks associated with radiation exposure, specifically as related to the medical field
- **create** a storyboard that portrays information about radiation and ways to reduce exposure

THIS LESSON FOCUSES ON

Engineering Design Cycle

- Communicating results

21st Century Skills

- Communication
- Creativity

OVERVIEW

Radiation exists all around people in both natural and man-made ways. Students will use digital and/or print resources to learn about ionizing and non-ionizing radiation and the benefits and risks associated with radiation exposure. Additionally, students will discover ways that they can protect themselves from radioactive materials and create a storyboard that displays their learning.

STEM incorporates Science, Technology, Engineering, and Mathematics to focus on real-world issues and problems guided by the engineering design process. This type of instruction supports students in developing critical thinking, collaboration, reasoning, and creative skills to be competitive in the 21st-century workforce.

Each Siemens STEM Day classroom activity highlights one or more components of the engineering design cycle and an essential 21st-century skill.

MATERIALS

- *Basics of Radiation* handout, one per student
- Digital or print resource (<https://www.epa.gov/radiation/radiation-basics>)
- Computers with Internet access (optional)
- *Is This a Benefit or Risk of Radiation Exposure?* handout, one per student
- *Radiation Storyboard Template*, one per student
- “*Protecting Yourself from Radiation*” article (optional)

HAVE YOU EVER WONDERED . . .

Why radiation can be both helpful and harmful?

MAKE CONNECTIONS!

How does this connect to students?

When getting an **x-ray of a broken bone**, a lead-lined apron is placed on patients to protect them from potential harmful effects of exposure to the radiation equipment. To minimize damage, this safety precaution must be taken.

It is important for students of all ages to learn that their bodies, our Earth, some foods, and even the air we breathe contain radioactive materials or gases. Additionally, it is critical for students to understand that there are both **helpful and harmful effects of radiation**.

How does this connect to careers?

Doctors who specialize in both diagnosing and treating patients using medical imaging technology are called **radiologists**. By interpreting X-rays, ultrasounds, CT scans and MRIs, radiologists identify health problems and present these results to patient's physicians.

Nuclear engineers direct the operations and maintain all operational activities at nuclear power plants. They apply principles of nuclear energy and radiation as they work to design processes and systems at the nuclear plant. Safety precautions protect nuclear engineers from exposure to dangerous levels of radiation.

With rising cancer rates, a **radiation oncologist** harnesses the therapeutic properties of radiation to treat and cure cancer.

How does this connect to our world?

"Radioactivity is a part of our earth—it has existed all along."¹

Radiation exists all around people in both natural and man-made forms. For example, radioactive elements in the soil and stones and the radiant rays of sunlight are natural means of radiation that cause matter to become electrically charged or ionized. On the other hand, many man-made sources of radiation exist, in products such as microwave ovens, smoke detectors, and X-ray security systems.

Radiation is widely used **within the medical field** and has saved people's lives. Diagnostic scans and cancer treatment are two of the most beneficial uses of radiation.

¹ Radiation in Everyday Life, <https://www.iaea.org/Publications/Factsheets/English/radlife#:~:text=Naturally%20occurring%20radioactive%20materials%20are,contain%20naturally%20occurring%20radioactive%20elements>.

BLUEPRINT FOR DISCOVERY

1. To engage students in learning, ask them to share with a partner what comes to their minds when they hear the word “radiation.” After sufficient share time, ask the students to share their responses with the whole class. Quite often, students think of nuclear power plants, cancer, and other harmful effects of radiation. However, they may be surprised to hear that there are both positive and negative effects of radiation.
2. Explain to students that radiation is energy that travels in the form of waves as energized particles. This first activity will provide the students with some background knowledge of radiation including the two types: non-ionizing and ionizing radiation. Pass out *The Basics of Radiation* handout, one per student. If students have access to the Internet, then they will need a device. If not, in addition to the handout, also make copies of the “*Radiation Basics*” article available for the students to reference.
3. Facilitate a group discussion about the basics of radiation and the two types. Emphasize that non-ionizing radiation causes the atoms in a molecule to vibrate or move and thus does not cause harm or damage. On the other hand, ionizing radiation has high amounts of energy that remove electrons from atoms, which produces ionization.
4. Pass out the *Is This a Benefit or Risk of Radiation Exposure?* handout to each student. Instruct the students to sort the different descriptions into two categories based upon whether they perceive them as a benefit or risk of radiation exposure. When students have completed this activity, use the provided answer key to discuss their results.
5. Ask students to select a partner for the last activity. Explain that the objective of this activity is to collaborate to create a storyboard that depicts what they learned today about radiation. Pass out the *Radiation Storyboard Template* to each student; explain that the students may choose whether to complete it by hand or digitally. Here are a few websites they may use if they choose to work digitally: www.pixton.com or www.storyboardthat.com. Tell the students to also include ways people can protect themselves from the harmful effects of radiation. Instruct them to reference the EPA article, “*Protecting Yourself from Radiation*” (<https://www.epa.gov/radiation/protecting-yourself-radiation>) or print copies of the article, if students do not have access to the Internet. Suggest that students include a minimum of eight scenes in their storyboards.
6. Conclude the lesson by providing time for the students to share their completed radiation storyboards. Then, sprinkling a little bit of glitter into the air, ask the students how this glitter correlates to today’s activities about radiation. It is likely that students will conclude that radiation is everywhere. However, students may have other creative responses as well.

TAKE ACTION!

- Are you interested in knowing how much ionizing radiation you are exposed to annually? If so, print the student document from ScienceNetLinks (<http://sciencenetlinks.com/media/filer/2011/10/07/dangers-ss1.pdf>), which will show students how to calculate an estimated yearly exposure to ionizing radiation. Also, radiation exposure is an excellent topic for claim, evidence, reasoning writing. Ask students to write a Claim-Evidence-Reasoning that responds to the following prompt: Do you perceive radiation exposure to be more beneficial or harmful for society?

NATIONAL STANDARDS

<p>Standards for Technology Literacy</p>	<p>Standard 14: Students will develop an understanding of The Designed World. This includes selecting and using medical technologies.</p>
<p>Next Generation Science Standards</p>	<p>HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.</p>

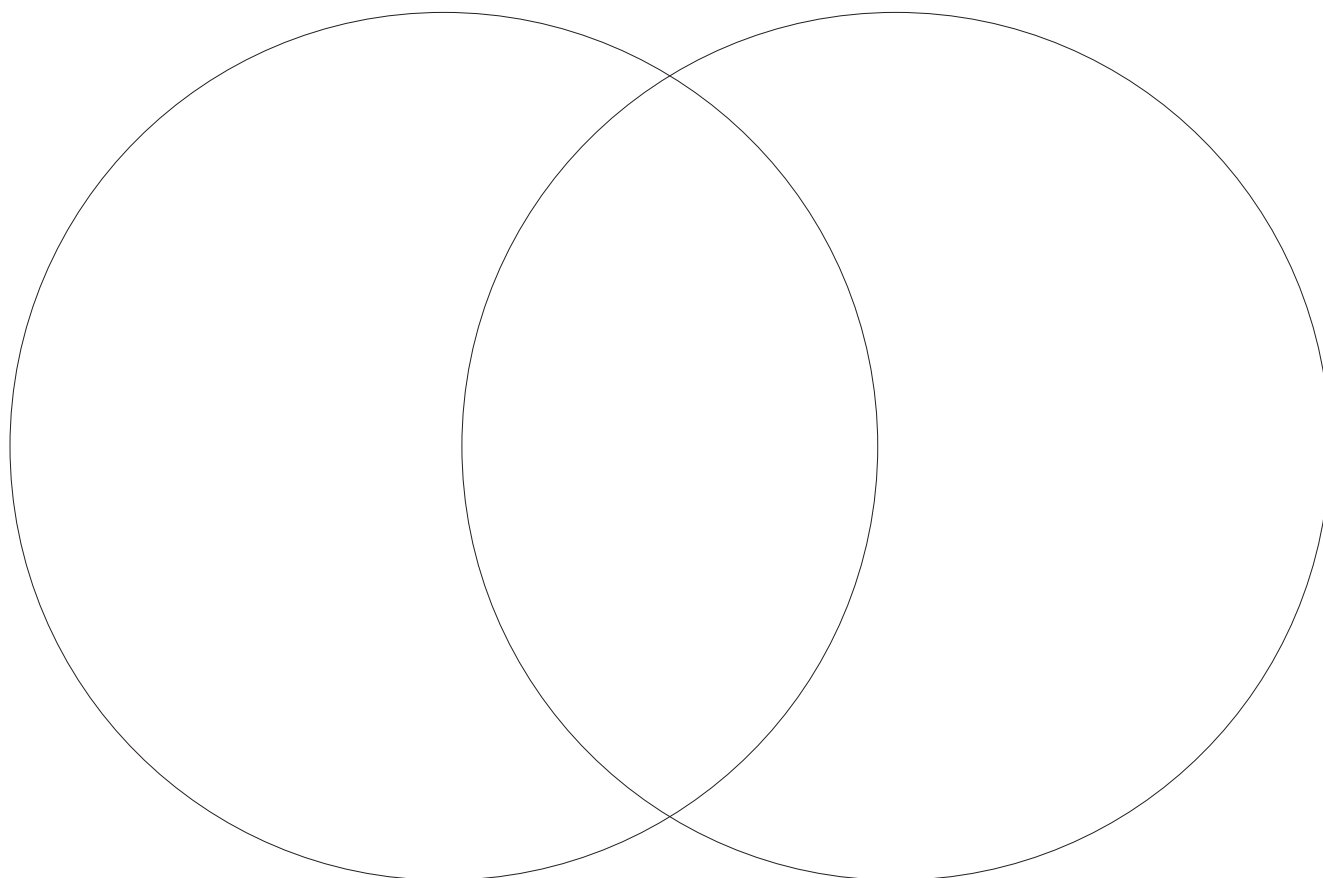
THE BASICS OF RADIATION

Read the information from the United States Environmental Protection Agency (EPA) about the basics of radiation. Use this information to complete the Venn diagram below, identifying the similarities and differences between these two types of radiation.

<https://www.epa.gov/radiation/radiation-basics>

Non-Ionizing Radiation

Ionizing Radiation



Write three sentences that summarize the information that you learned about radiation.

IS THIS A BENEFIT OR RISK OF RADIATION EXPOSURE?

Listed below is a mixture of benefits and risks associated with radiation exposure. With your partner, discuss each effect and determine whether you think it is a benefit or risk?

- Causes cancer
- Microwaves heat food
- Hair loss
- Radio waves transmit voices
- Radiation sickness: vomiting and diarrhea
- Cell phones use radiation
- Infrared radiation in cameras
- Intestinal damage
- Radiation therapy treats cancer
- Burns to skin
- Central nervous system damage
- Growth defects in unborn children
- Nuclear explosions
- X-rays provide medical images
- Diagnostic CT or CAT scans
- Produces nuclear energy
- Nuclear fusion in stars
- Internal bleeding
- Nuclear medicine
- Death

Benefits of Radiation Exposure	Risks of Radiation Exposure

IS THIS A BENEFIT OR RISK OF RADIATION EXPOSURE? ANSWER KEY

Benefits of Radiation Exposure	Risks of Radiation Exposure
<ul style="list-style-type: none"> • Microwaves heat food • Radio waves transmit voices • Cell phones use radiation • Infrared radiation in cameras • Radiation therapy treats cancer • X-rays provide medical images • Diagnostic CT or CAT scans • Produces nuclear energy • Nuclear fusion in stars • Nuclear medicine 	<ul style="list-style-type: none"> • Burns to skin • Causes cancer • Death • Central nervous system damage • Intestinal damage • Growth defects in unborn children • Internal bleeding • Hair loss • Radiation sickness: Vomiting and diarrhea • Nuclear explosions
<p>Can be viewed as both a benefit and risk:</p> <ul style="list-style-type: none"> • Low UV radiation in tanning beds 	

RADIATION STORYBOARD TEMPLATE

Scene 1	Scene 2
Scene 3	Scene 4
Scene 5	Scene 6
Scene 7	Scene 8