



Activity 7: Radiation: Fact or Fiction

Objectives

Students will examine their understanding of radiation as well as any misconceptions they have about exposure.

Next Generation Science Standards

The concepts in this activity can be used to support the following science standard:

- PS4. Waves and Electromagnetic Radiation.

Materials and Resources

- Radiation Exposure: Teacher Background Information.
- Vocabulary Materials.
- Superheroes Worksheet (one per student, pair or group or group) and Superheroes Teacher Answer Key (optional).
- Radiation: Fact or Fiction? Quiz (one per student, pair or group) and Radiation: Fact or Fiction? Teacher Answer Key (optional).
- Student access to computers or research sources (optional).

Time

45-60 minutes.

Vocabulary

- Ionizing radiation
- Radiation
- Radiation exposure
- Radioactive atom
- Radioactive atom
- Radioactive material

Directions

1. Start with a vocabulary activity if students are not familiar with radiation and the terms used in this activity, or provide students with the terms and definitions.
2. Ask students to name superheroes that received or lost their powers when exposed to radiation or distribute the *Superheroes Worksheet* for students to complete in small groups.
3. Explain that cartoons, comics or movies may help fuel myths about radiation.
4. Ask students to provide examples of myths that people may have about radiation exposure (e.g., radiation exposure will make you glow) and potential sources of this misinformation such as movies, comics, video games, other media sources and people.
5. Explain that we may receive misinformation from various sources and perceive it to be true. That is why it is important to verify information with reliable resources. Have students complete one or more of the following activities:

Option A: Radiation Fact or Fiction? Quiz. Have students complete the quiz and work in groups to rewrite fictitious statements as factually accurate statements providing as much detail as possible. Review the correct responses and students' factually accurate statements.

Option B: Research Project. Have students:

- Brainstorm and list what they know or have heard about radiation in general, or particular radiation sources and any questions or concerns they have about radiation.
- Predict whether the information they have received is fact or fiction.
- Conduct research, listing the sources, to confirm whether the statements are fact or fiction, answer any questions raised, and address any concerns. Rewrite any fictitious statements as factually accurate statements.
- Submit a written report, develop a presentation or use technology (e.g., post to an educational wiki or create a video or online game) to share findings and educate classmates.

Option C: Superhero Research Project. Have students:

- Brainstorm what they know about a particular superhero (e.g., Superman; Spider-Man; the Incredible Hulk; Daredevil; the Fantastic Four; Doctor Solar, Man of the Atom; or Radioactive Man)
- Predict what perceptions or misconceptions about radiation existed or what radiation-related events occurred around the time of the superhero's creation.
- Conduct research, listing the sources, to identify the radiation perceptions or misconceptions that existed or the radiation events that occurred before or at the time of the superhero's development. For example, Superman was developed as an action comic character in the 1930s when people were beginning to understand the effects of ionizing radiation and the need for protection. Spider-Man, the Incredible Hulk, Daredevil, and the Fantastic Four were created in the 1960s after the development of the atomic bomb or during the nuclear arms race and widespread nuclear weapons testing.
- Submit a written report, develop a presentation or use technology (e.g., post to an educational wiki or create a video or online game) to share findings and educate classmates.

6. Conclude the activity with the following questions; you can have students respond orally or in writing:
- How can you tell the difference between fact and fiction? **This can sometimes be a challenge when made up, misleading, or misinterpreted information (fiction) is believed to be fact. However, a fact can be proven true with evidence and fiction cannot.**
 - Why do you think knowing the difference between fact and fiction is important when you are learning about radiation? **Knowing the facts about radiation and radiation protection can help people effectively protect themselves from harmful and unnecessary exposure to radiation.**
 - We are presented with lots of information and misinformation about radiation. How can you ensure you have accurate information? **Use reliable resources to verify the information you receive—textbooks, professional journals, books and papers and websites of professional organizations related to radiation and health physics, federal agencies like the U.S. Environmental Protection Agency (EPA), and state and local agencies like departments of health.**

- What misconceptions did you have about radiation and what did you learn when correcting those misconceptions? **Answers will vary.**

Superheroes Worksheet

Name: _____

Date: _____

Name the superhero described:

Spider-Man A high school student is bitten by a radioactive spider while visiting a science exhibit. Afterward he gains spider-like powers including super-strength, the ability to climb walls and throw webs, and phenomenal jumping skills.

Hulk A physicist develops a gamma ray bomb. While testing the bomb, he is exposed to the blast as he saves a teenage boy driving into the test area. Afterward, he develops a split personality and turns into a large, strong, green monster when angry.

Ninja Turtles After being exposed to radioactive sludge, four turtles — Michelangelo, Raphael, Leonardo and Donatello — mutate into human-sized ninjas and fight criminals, aliens and other evil characters.

The Flash A group of four individuals gain superpowers after being exposed to cosmic rays during a scientific space mission. Afterward, each individual develops a different power, including the ability to stretch to incredible lengths and shapes, the ability to become invisible and project powerful force fields, the ability to generate flames, and the gift of superhuman strength and endurance.

X-ray Man This superhero is more powerful than a locomotive, can fly and has x-ray vision. His weakness is kryptonite. Lead is the only substance that will block and save him from kryptonite. It is also the one material he cannot penetrate with his x-ray vision.

Answer the following questions.

2. What do these superheroes have in common?

3. What thoughts or events do you think led to the development of these characters?

Superheroes: Teacher Answer Key

1. Name the superhero described:

- A. A high school student is bitten by a radioactive spider while visiting a science exhibit. Afterward he gains spider-like powers including super-strength, the ability to climb walls and throw webs, and phenomenal jumping skills. **Spider-Man.**
- B. A physicist develops a gamma ray bomb. While testing the bomb, he is exposed to the blast as he saves a teenage boy driving into the test area. Afterward, he develops a split personality and turns into a large, strong, green monster when angry. **The Incredible Hulk.**
- C. After being exposed to radioactive sludge, four turtles — Michelangelo, Raphael, Leonardo and Donatello — mutate into human-sized ninjas and fight criminals, aliens and other evil characters. **The Teenage Mutant Ninja Turtles.**
- D. A group of four individuals gain superpowers after being exposed to cosmic rays during a scientific space mission. Afterward, each individual develops a different power, including the ability to stretch to incredible lengths and shapes, the ability to become invisible and project powerful force fields, the ability to generate flames, and the gift of superhuman strength and endurance. **The Fantastic Four.**
- E. This superhero is more powerful than a locomotive, can fly and has x-ray vision. His weakness is kryptonite. Lead is the only substance that will block and save him from kryptonite. It is also the one material he cannot penetrate with his x-ray vision. **Superman.**

Answer the following questions.

2. What do these superheroes have in common?

Their stories are based on fictional effects of radiation exposure.

3. What thoughts or events do you think led to the development of these characters? **Answers will vary. Perhaps the characters are a reflection of the perceptions or misperceptions of radiation and events that were occurring around the time of their creation.**

Radiation: Fact or Fiction? Quiz

Name: _____

Date: _____

Read each statement. Mark "Fact" or "Fiction" for each statement depending on what you think or believe to be correct.

-
- | | | |
|--------------------------------------|---|---|
| <input type="checkbox"/> Fact | <input type="checkbox"/> Fiction | 1. Radioactive waste remains radioactive forever. |
|--------------------------------------|---|---|
-
- | | | |
|--------------------------------------|---|--|
| <input type="checkbox"/> Fact | <input type="checkbox"/> Fiction | 2. People who live in Denver, Colorado, receive more exposure to cosmic radiation than people living in Florida. |
|--------------------------------------|---|--|
-
- | | | |
|--------------------------------------|---|--|
| <input type="checkbox"/> Fact | <input type="checkbox"/> Fiction | 3. Radiation from a tanning bed is more harmful than radiation from the sun. |
|--------------------------------------|---|--|
-
- | | | |
|--------------------------------------|---|---|
| <input type="checkbox"/> Fact | <input type="checkbox"/> Fiction | 4. If you are exposed to radiation you will develop cancer. |
|--------------------------------------|---|---|
-
- | | | |
|--------------------------------------|---|--|
| <input type="checkbox"/> Fact | <input type="checkbox"/> Fiction | 5. Suntans are the result of skin damage from the sun. |
|--------------------------------------|---|--|
-
- | | | |
|--------------------------------------|---|---|
| <input type="checkbox"/> Fact | <input type="checkbox"/> Fiction | 6. Most radiation that we are exposed to is man-made. |
|--------------------------------------|---|---|
-
- | | | |
|--------------------------------------|---|--|
| <input type="checkbox"/> Fact | <input type="checkbox"/> Fiction | 7. Living near a nuclear power plant poses less risk of radiation exposure than living in a home or area with high radon levels. |
|--------------------------------------|---|--|
-
- | | | |
|--------------------------------------|---|---|
| <input type="checkbox"/> Fact | <input type="checkbox"/> Fiction | 8. You should keep track of the number of medical x-rays and scans you have received. |
|--------------------------------------|---|---|
-
- | | | |
|--------------------------------------|---|---|
| <input type="checkbox"/> Fact | <input type="checkbox"/> Fiction | 9. Exposing food to radiation makes it radioactive. |
|--------------------------------------|---|---|
-
- | | | |
|--------------------------------------|---|---|
| <input type="checkbox"/> Fact | <input type="checkbox"/> Fiction | 10. All glow-in-the-dark items contain radioactive sources. |
|--------------------------------------|---|---|
-
- | | | |
|--------------------------------------|---|--|
| <input type="checkbox"/> Fact | <input type="checkbox"/> Fiction | 11. Radiation was discovered during World War II when the atomic bomb was developed. |
|--------------------------------------|---|--|
-
- | | | |
|--------------------------------------|---|--|
| <input type="checkbox"/> Fact | <input type="checkbox"/> Fiction | 12. Radiation exposure will cause you to glow. |
|--------------------------------------|---|--|
-
- | | | |
|--------------------------------------|---|--|
| <input type="checkbox"/> Fact | <input type="checkbox"/> Fiction | 13. Cigarettes are a source of radiation exposure. |
|--------------------------------------|---|--|
-
- | | | |
|--------------------------------------|---|---|
| <input type="checkbox"/> Fact | <input type="checkbox"/> Fiction | 14. Children are more sensitive to radiation than adults. |
|--------------------------------------|---|---|
-

Radiation: Fact or Fiction? Teacher Answer Key

-
- Fact Fiction 1. Radioactive waste remains radioactive forever.
Some radioactive materials and radioactive waste may remain radioactive for hundreds or thousands of years, while others only remain radioactive for seconds or days.
-
- Fact Fiction 2. People who live in Denver, Colorado, receive more exposure to cosmic radiation than people living in Florida.
Even though Florida is known as the “Sunshine State,” people at higher altitudes receive more exposure from cosmic radiation than people who live at a lower altitude.
-
- Fact Fiction 3. Radiation from a tanning bed is more harmful than radiation from the sun.
Our bodies do not differentiate between types of radiation; they absorb radiation as energy regardless of the source, dose or type.
-
- Fact Fiction 4. If you are exposed to radiation you will develop cancer.
We are regularly exposed to some amounts of radiation. Our bodies have “repair genes” that help cells repair themselves from radiation exposure, much like the way our bodies heal from a sunburn or injury. However, large doses or long-term exposure to radiation may damage our body’s DNA to the extent that it cannot repair itself. The extent of the damage depends on the total amount of energy absorbed, the time period (duration) and dose rate of the exposure, and the particular organs exposed. Also, everyone reacts differently to radiation exposure.
-
- Fact Fiction 5. Suntans are the result of skin damage from the sun.
Suntans and sunburns are both types of sun damage. The fading of a suntan is a sign of the skin repairing itself.
-
- Fact Fiction 6. Most radiation that we are exposed to is man-made.
Approximately half of our annual radiation exposure comes from natural sources like cosmic rays from outer space or radon gas in the soil. This is called “background radiation.” The other half of our annual exposure comes from man-made sources of radiation.
-
- Fact Fiction 7. Living near a nuclear power plant poses less risk of radiation exposure than living in a home or area with high radon levels.
Radon exposure accounts for 37 percent of our annual exposure to radiation, and living in a home or area with high radon levels can be very harmful to your health. Nuclear power plants implement many radiation protection measures to limit your exposure to radiation. Therefore, living near a power plant barely increases your radiation exposure.

-
- Fact** **Fiction** 8. You should keep track of the number of medical x-rays and scans you have received.
By tracking the number of medical x-rays and scans, you can better assess and control your exposure to radiation.
-
- Fact** **Fiction** 9. Exposing food to radiation makes it radioactive.
Food irradiation is a technology for controlling spoilage and eliminating foodborne pathogens (e.g., salmonella). Like pasteurization, irradiation kills bacteria and other pathogens that could otherwise result in spoilage or food poisoning. Irradiation is safe and does not cause food to become radioactive.
-
- Fact** **Fiction** 10. All glow-in-the-dark items contain radioactive sources.
When radium was discovered in the early 1900s, people were fascinated with its mysterious glow. The hands and faces of some clocks, watches, and ship and airplane instruments were painted with radium to make them glow in the dark. Over time, however, experts discovered that radium is highly radioactive and emits alpha, beta, and gamma radiation. Some glow-in-the-dark items like road signs, exit signs, clock dials and watches may contain tritium or promethium. However, non-radioactive sources are also becoming more widely used. If unsure of the glow-in-the-dark source, you should take precautions to handle and/or dispose of the item safely.
-
- Fact** **Fiction** 11. Radiation was discovered during World War II when the atomic bomb was developed.
Radiation is all around us and has been present since the birth of this planet.
-
- Fact** **Fiction** 12. Radiation exposure will cause you to glow.
While many fictional movies and the media have portrayed this, radiation does not cause you to glow.
-
- Fact** **Fiction** 13. Cigarettes are a source of radiation exposure.
Naturally-occurring radioactive minerals accumulate on the sticky surfaces of tobacco leaves as the plant grows, and these minerals remain on the leaves throughout the manufacturing process.
-
- Fact** **Fiction** 14. Children are more sensitive to radiation than adults.
Children are growing more rapidly than adults. There are more cells dividing and a greater opportunity for radiation to disrupt the growth process. Recent U.S. Environmental Protection Agency (EPA) radiation protection standards take into account the differences in sensitivity due to age and gender.
-