

Nuclear Science Merit Badge

Fillable Worksheet

<https://merit-badge.university/merit-badges/nuclear-science/requirements/>

Scout Name

Unit

Date

1. Radiation.

Do the following:

a. Explain radiation and the difference between ionizing and nonionizing radiation.

b. Explain the ALARA principle.

Explain what process you would go through to ensure your dose is kept ALARA when performing the requirements in this merit badge.

c. Describe the radiation hazard symbol and explain where it should be used.

d. Explain how we are exposed to ionizing radiation from outside the earth as well as on earth every day.

List four examples of Naturally Occurring Radioactive Materials (NORM) that are in your house or grocery store and explain why they are radioactive.

1.

2.

3.

4.

e. Explain the difference between radiation exposure and contamination.

Describe the hazards of radiation to humans, the environment, and wildlife.

Calculate your approximate annual radiation dose and compare it to a typical expected dose of someone who works in a nuclear power plant.

2. Basic Nuclear Science.

Do the following:

a. Explain the following terms: atom, nucleus, proton, neutron, electron, quark, isotope; alpha particle, beta particle, gamma ray, X-ray; ionization, radioactivity, radioisotope, and stability.

b. Choose an element from the periodic table. Construct 3-D models for the atoms of three isotopes of this element, showing neutrons, protons, and electrons.

Write down the isotope notation for each model including the atomic and mass numbers. In a separate model or diagram, explain or show how quarks make up protons and neutrons.

3. Modern Particle Physics.

a. Explain how a particle accelerator works.

b. Do ONE of the following:

Complete 1 of the following:

1. Visit an accelerator, research lab, or university and discuss with a scientist how they study the properties of the nucleus or nucleons.

Discussed with counselor

2. List three particle accelerators and describe several experiments conducted and their associated basic science and practical applications.

4. Classic Experiments. Do TWO of the following:

Complete 2 of the following:

- a. Build an electroscope.

Completed

Show how it works. Place a radiation source near the electroscope ball and explain the effect it causes.

Completed

- b. Make a cloud chamber.

Show how it can be used to see the tracks caused by radiation.

Completed

Explain what is happening.

- c. Perform an experiment demonstrating half-life.

Completed

Discuss decay chains.

Discussed with counselor

5. Radiation Safety. Do ONE of the following:

Complete 1 of the following:

- a. Using a radiation survey meter and a radioactive source, show how the counts per minute change as the source gets closer to or farther from the radiation detector. Place three different materials between the source and the detector, then explain any differences in the measurements per minute.

Completed

Explain how time, distance, and shielding can reduce an individual's radiation dose.

b. Describe how radon is detected in homes.

Discuss the steps taken for the long-term and short-term test methods, tell how to interpret the results, and explain when each type of test should be used.

Explain the health concerns related to radon gas and tell what steps can be taken to reduce radon in buildings.

c. Visit a place where X-rays are used.

Draw a floor plan of this room.



Show where the unit, the unit operator, and the patient would be when the X-ray unit is operated.

Completed

Explain the precautions taken and the importance of those precautions for the safety of the operator.

6. Nuclear Energy. Do ONE of the following; then discuss with your counselor how nuclear energy is used to produce electricity:

Complete 1 of the following:

- a. Make a drawing showing how nuclear fission happens.



Observe a mousetrap reactor (setup by an adult) and use it to explain how a chain reaction could be started.

Explain how a chain reaction could be stopped or controlled in a nuclear reactor.

Explain what is meant by a "critical mass."

- b. Visit a local nuclear power plant or nuclear reactor either in person or online (with your parent or guardian's permission).

Learn how a reactor works and how the plant generates electricity.

Find out what percentage of electricity in the United States and in your state is generated by nuclear power plants, and by other methods.

Make a graph of the information you find.



7. Beneficial Applications of Nuclear Science.

Give an example of each of the following and explain how nuclear science is used in these applications: nuclear medicine, environmental applications, industrial applications, space exploration, and radiation therapy.

For each example, explain the application and its significance to nuclear science.

8. Careers.

Explore careers related to nuclear science.

Research one career to learn about the training and education needed, costs, job prospects, salary, job duties, and career advancement. Your research methods may include—with your parent or guardian's permission—an internet or library search, an interview with a professional in the field, or a visit to a location where people in this career work.

Discuss with your counselor both your findings and what about this profession might make it an interesting career.

Discussed with counselor