NUCLEAR SCIENCE MERIT BADGE WORKBOOK

This Scoutmaster Bucky Merit Badge Workbook is based off the current *Scouts BSA Requirements*.

Consider also using the Nuclear Science merit badge class preparation page for clarification and expections when participating in a Scoutmaster Bucky merit badge opportunity (online or in-person).

https://scoutmasterbucky.com/merit-badges/nuclear-science/

Scout's Name:

REQUIREMENT 1: Do the following:

REQUIREMENT 1 A: Tell what radiation is.

REQUIREMENT 1 B: Describe the hazards of radiation to humans, the environment, and wildlife. Explain the difference between radiation exposure and contamination. In your explanation, discuss the nature and magnitude of radiation risks to humans from nuclear power, medical radiation (e.g., chest or dental X-ray), and background radiation including radon. Explain the ALARA principle and measures required by law to minimize these risks.

Hazards of radiation

Difference between radiation exposure and contamination

ALARA principle and measures required by law

REQUIREMENT 1 C: Describe the radiation hazard symbol and explain where it should be used. Tell why and how people must use radiation or radioactive materials carefully.

REQUIREMENT 1 D: Compare the amount of radiation exposure of a nuclear power plant worker to that of someone receiving a chest and dental X-ray.

REQUIREMENT 2: Do the following:

REQUIREMENT 2 A: Tell the meaning of the following: atom, nucleus, proton, neutron, electron, quark, isotope; alpha particle, beta particle, gamma ray, X-ray; ionization, radioactivity, radioisotope, and stability.

Atom, nucleus, proton, neutron, electron, quark, isotope

Alpha particle, beta particle, gamma ray, X-ray

Ionization, radioactivity, radioisotope, and stability

REQUIREMENT 2 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. Use the three models to explain the difference between atomic number and mass number and the difference between the atom and nuclear and quark structures of isotopes.

☐ First element	☐ Second element	☐ Third element

Difference between atomic number and mass number

Difference between the atom and nuclear and quark structures of isotopes

REQUIREMENT 3: Do ONE of the following; then discuss modern particle physics with your counselor:

Notes about modern particle physics

REQUIREMENT 3 A: Visit an accelerator (research lab) or university where people study the properties of the nucleus or nucleons.

☐ Completed

REQUIREMENT 3 B: Name three particle accelerators and describe several experiments that each accelerator performs.

REQUIREMENT 4: Do TWO of the following; then discuss with your counselor the different kinds of radiation and how they can be used:

REQUIREMENT 4 A: Build an electroscope. Show how it works. Place a radiation source inside and explain the effect it causes.

☐ Completed

REQUIREMENT 4 B: Make a cloud chamber. Show how it can be used to see the tracks caused by radiation. Explain what is happening.

☐ Completed

REQUIREMENT 4 C: Obtain a sample of irradiated and non-irradiated foods. Prepare the two foods and compare their taste and texture. Store the leftovers in separate containers and under the same conditions. For a period of 14 days, observe their rate of decomposition or spoilage, and describe the differences you see on days 5, 10, and 14.

REQUIREMENT 4 D: Visit a place where radioisotopes are being used. Using a drawing, explain how and why they are used.

REQUIREMENT 5: Do ONE of the following; then discuss with your counselor the principles of radiation safety:

REQUIREMENT 5 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. Explain how time, distance, and shielding can reduce an individual's radiation dose.

☐ Showed how counts per minute change

Explain any differences in the measurements

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

REQUIREMENT 5 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 concern related to radon gas and tell what steps can be taken to reduce radon in buildings.

REQUIREMENT 5 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. Explain the precautions taken and the importance of those precautions.

Precautions taken

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

REQUIREMENT 6 A: Make a drawing showing how nuclear fission happens, labeling all details. Draw another picture showing how a chain reaction could be started and how it could be stopped. Explain what is meant by a “critical mass.”

How nuclear fission happens

How a chain reaction could be started and how it could be stopped

What is meant by a "critical mass"

REQUIREMENT 6 B: Build a model of a nuclear reactor. Show the fuel, control rods, shielding, moderator, and cooling material. Explain how a reactor could be used to change nuclear energy into electrical energy or make things radioactive.

☐ Built a model

How a reactor could be used to change nuclear energy into electrical energy or make things radioactive

REQUIREMENT 6 C: Find out how many nuclear power plants exist in the United States. Locate the one nearest your home. Find out what percentage of electricity in the United States is generated by nuclear power plants, by coal, and by gas.

REQUIREMENT 7: Give an example of each of the following in relation to how energy from an atom can be used: nuclear medicine, environmental applications, industrial applications, space exploration, and radiation therapy. For each example, explain the application and its significance to nuclear science. workbook: - lines: 8 text: |- Nuclear medicine - lines: 8 text: |- Environmental applications - lines: 8 text: |- Industrial applications - lines: 8 text: |- Space exploration - lines: 8 text: |- Radiation therapy

REQUIREMENT 8: Find out about three career opportunities in nuclear science that interest you. Pick one and find out the education, training, and experience required for this profession and discuss this with your counselor. Tell why this profession interests you.