Nuclear Science

Merit Badge Workbook

This workbook is not required but is designed to help you with this merit badge. No one can add or subtract from the Boy Scout Requirements #33215. Use page backs & add pages as needed. Please send comments to: craig@craiglincoln.com. Requirements revised: 2005, Workbook updated: January 2005.

Scout's Name: _____ Unit: _____

Counselor's Name: _____ **Counselor's Ph #:** _____

1. Do the following:

(a) Describe the biological effects and hazards of radiation to humankind, the environment, and wildlife. _____

_____

_____

Explain the difference between deterministic _____

_____

and stochastic effects. _____

_____

In your explanation, discuss the nature and magnitude of radiation risks to humans from

nuclear power, _____

_____

medical radiation, _____

_____

and background radiation. _____

_____

Explain the measures required by law to minimize these risks._____

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_____

(b) Describe the radiation hazard symbol _____

_____

_____

and explain where it should be used. _____

_____

Tell why and how people must use radiation or radioactive materials carefully. _____

_____

_____

2. Tell the meaning of the following:

ALARA, _____

alpha particle, _____

atom, _____

background radiation, _____

beta particle, _____

contamination, _____

curie and becquerel, _____

_____

gamma ray, _____

half-life, _____

ionization, _____

quark, _____

isotope, _____

neutron, _____

nuclear energy, _____

nuclear reactor, _____

particle accelerator, _____

rad and gray, _____

_____

radiation, _____

radioactivity, _____

radon, _____

rem and sievert, _____

_____

and X-ray. _____

3. Choose five individuals important to the field of atomic energy and nuclear science and explain each person's contribution.

Person **Contribution**

_____

_____

_____

_____

_____

4. 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. _____

Then do the following:

(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.

(b) Explain what is meant by a "critical mass." _____

_____

5. Do any THREE of the following:

(a) Build an electroscope. Show how it works. Place a radiation source inside and explain any difference seen._____

_____

_____

(b) Build a model of a reactor. Show the fuel, control rods, shielding, moderator, and any cooling material. Explain how a reactor could be used to change nuclear energy into electrical energy or make things radioactive. _____

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(c) Using a radiation survey meter and a radioactive source, show how the measurements per minute change as the source gets closer to or farther from the radiation detector. Place three different kinds of materials between the source and the detector, then explain any differences in the measurements per minute. Explain how time, distance, and shielding can reduce the radiation dose. _____

_____

_____

(d) 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. _____

_____

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_____

(e) Describe how radon is detected in homes. _____

_____

Discuss the steps taken for the long-term _____

_____

and short-term test methods, _____

_____

how to interpret the results, _____

and explain when each type of test should be used. _____

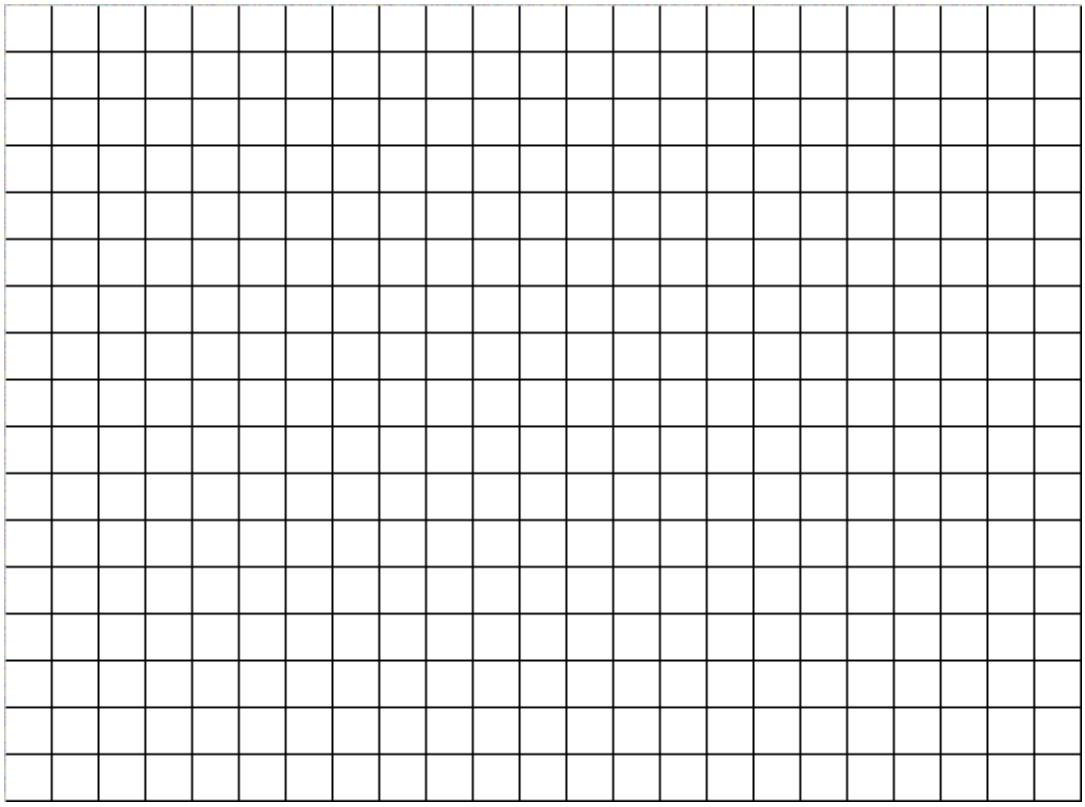
Explain the health concern related to radon gas _____

and tell what steps can be taken to reduce radon in buildings. _____

_____

(f) Visit a place where X-ray is used. _____

Draw a floor plan of the room in which it is used. Show where the unit, the unit operator, and the patient would be when X-ray is used.



Explain the precautions taken when X-ray is used and the importance of those precautions._____

_____

_____

(g) Make a cloud chamber. Show how it can be used to see the tracks caused by radiation. Explain what is happening.

_____

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_____

(h) Visit a place where radioisotopes are being used. Using a drawing, explain how and why they are used.

(i) Obtain samples of irradiated seeds. Plant them. Plant a group of non-irradiated seeds of the same kind. Grow both groups. List any differences you observe during a 30-day period. _____

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Discuss with your counselor what irradiation does to seeds. _____

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(j) Visit an accelerator (research lab) or university where people study the properties of the nucleus. After your visit, discuss what you have learned with your counselor. _____

_____

_____

6. Do ONE of the following:

(a) 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.

(b) 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. -

(c) Identify three particle accelerators in the United States. For each accelerator, describe three experiments that have been done or are in progress. Name three particle accelerators in the United States and describe the type of experiments each accelerator is designed to perform.

7. 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.