Merit Badge College 2018
Nuclear Science

You need to print this form and bring it with you to Merit Badge College.
Highlighted areas are to be completed outside of class.

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1. Do the following:
   - ☐ a. Tell what radiation is.
   - ☐ b. Describe the hazards of radiation to humans, the environment, and wildlife.
     - ☐ Humans: ☐ Environment: ☐ Wildlife:
   - ☐ Explain the difference between radiation exposure and contamination.
     - ☐ Exposure: ☐ Contamination:
     - In your explanation, discuss the nature and magnitude of radiation risks to humans from nuclear power, medical radiation, and background radiation including radon.
       - ☐ Nuclear power: ☐ Medical radiation: ☐ Background radiation including radon.
     - ☐ Explain the ALARA principle and measures required by law to minimize these risks.
   - ☐ 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.

2. Do the following:
   - ☐ a. Tell the meaning of the following: atom, nucleus, proton, neutron, electron, quark, isotope; alpha particle, beta particle, gamma ray, X-ray; ionization, radioactivity, and radioisotope.,
     - ☐ Atom: ☐ Electron: ☐ Beta particle: ☐ Radioactivity:
     - ☐ Nucleus: ☐ Quark: ☐ Gamma ray: ☐ Radioisotope:
     - ☐ Proton: ☐ Isotope: ☐ X-ray:
     - ☐ Neutron: ☐ Alpha particle: ☐ Ionization:
   - ☐ 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 quark structure of a neutron and a proton.

3. Do ONE of the following; then discuss modern particle physics with your counselor:
   - ☐ a. Visit an accelerator (research lab) or university where people study the properties of the nucleus or nucleons.
   - ☐ b. Name three particle accelerators and describe several experiments that each accelerator performs, then discuss modern particle physics with your counselor.
     - ☐ 1. ☐ 2. ☐ 3.
     - ☐ Discuss modern particle physics:

4. Do TWO of the following;
   - ☐ a. Build an electroscope.
     - ☐ Show how it works.
       - ☐ Place a radiation source inside and explain the effect it causes.
   - ☐ b. Make a cloud chamber.
     - ☐ Show how it can be used to see the tracks caused by radiation.
       - ☐ Explain what is happening.
   - ☐ c. Obtain a sample of irradiated and non-irradiated foods.
     - ☐ Prepare the two foods and compare their taste and texture.
     - ☐ 1. Taste_____ Texture_____
     - ☐ 2. Taste_____ 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.
       - ☐ 5 Days: ☐ 10Days: ☐ 14 Days:
   - ☐ d. Visit a place where radioisotopes are being used. Using a drawing, explain how and why they are used

Location: Drawing:

5. Do ONE of the following; then discuss with your counselor the principles of radiation safety.
   - ☐ 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 3 different materials between the source and the detector, explain differences in the measurements per minute.
     - ☐ 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 concern 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.
     Location: _____
     - ☐ Draw floor plan of this room. Show where the unit, unit operator, and patient would be when the X-ray unit is operated.
     - ☐ Explain the precautions taken and the importance of those precautions.
   - ☐ Discuss with your counselor the principles of radiation safety:

6. Do ONE of the following, then discuss with your counselor how nuclear energy is used to produce electricity:
   - ☐ 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."
   - ☐ 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.
   - ☐ 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.
     - ☐ Nuclear power plants ☐ Coal ☐ Gas
   - ☐ Discuss with your counselor how nuclear energy is used to produce electricity:

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.
   - ☐ Nuclear medicine
   - ☐ Environmental applications
   - ☐ Industrial applications
   - ☐ Space exploration
   - ☐ Radiation therapy

   For each example, explain the application and its significance to nuclear science
   - ☐ Nuclear medicine
   - ☐ Environmental applications
   - ☐ Industrial applications
   - ☐ Space exploration
   - ☐ Radiation therapy
8. Find out about three career opportunities in nuclear science that interest you.
   - ☐ 1. ☐ 2. ☐ 3.

   Pick one and find out the education, training, and experience required for this profession.
   - ☐ Career:

   Education Training Experience
   - ☐ Discuss this with your counselor, and explain why this profession might interest.

_____	_____	_____
Scout Name	Address	Troop Number
_____	_____	_____
Counselor Signature	Unit Leader Signature	Date Completed

Counselor: Initial next to the box located to the left of the requirement completed in class. Sign the space that states Counselor Signature.
Scout: Complete the spaces above for Scout Name, Address and Troop Number. Complete all highlighted areas outside of class.

This form replaces the traditional "Blue Card".