Atomic Energy Merit

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1. Define *atomic* or *nuclear energy.*

2. Define these terms:
   a. Atom
   b. Proton
   c. Neutron
   d. Nucleus
   e. Nucleon
   f. Electron
   g. Alpha particle
   h. Beta particle
   i. Cosmic rays
   j. Gamma rays
   k. Isotope
   l. Ionization
   m. Fission
   n. Fusion
   o. Nuclear reactor
   p. Particle accelerator
   q. Linear acceleration
   r. Synchrotron
   s. Radiation
   t. Roentgen
   u. X ray
   v. Half-life
   w. Quanta

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3. Complete the following:
   a. Construct a Bohr model of the hydrogen atom.
   b. Define the terms *ground state* and *excited state.*
   c. Build models of two hydrogen isotopes. Use these models to demonstrate the difference between atomic weight and number. Name the scientists who contributed to the discoveries of these isotopes.

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4. Explain at least four useful ways nuclear energy is being used today.

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5. Build a model of ONE of the devices listed below. Give a presentation to your group or to a school class. Explain how your model works and its use in the study of atomic energy. (Additional instructions and requirements follow below for each device.)
   a. Reactor
   b. Synchrotron
   c. Simplified Geiger counter
   d. Cloud chamber

a. Reactor: Include movable control rods in your model. List the two types of fuel used to fuel the reactor. Describe the cooling methods, the moderator material, how the rods control the fission process, the use of safety rods and the material they are made of, the thermal shield, and the biological shield. List at least three types of reactors and their uses.

b. Synchrotron: Show in your model the special magnets that are inserted into straight sections of the vacuum ultraviolet (VUV) ring and the five straight sections in the X-ray ring. Point out where the electron beam "wiggles" and, therefore, emits even more intense synchrotron radiation.

1. Describe the history of the synchrotron research device.
2. Describe some of the current uses of the synchrotron.
3. Define *synchrotron light*.
4. Describe the National Synchrotron Light Source, its purpose, how it is funded, and what discoveries, accomplishments, and uses were made from discoveries there.

c. A simplified Geiger counter: Define what it is and how it works. Use Gatorade or a banana to obtain a radioactive signal. Explain why Gatorade or a banana can generate a radioactive signal.

d. Cloud chamber: Build a cloud chamber. Demonstrate how it can be used to bring the subatomic world into visibility. Explain the phenomenon that is being observed and what is happening.

1. How can the cloud chamber be used to help understand phenomena in the atmosphere or outer space?

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6. Explain why it is best to shield people from radiation. Include the danger level of exposure to ionizing radiation. List the measurements of radiation levels and how each level can affect the human body.

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7. Define *ionization radiation* and list the different types. Explain how these types should be shielded.

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8. List ways in which we are exposed to radiation in everyday life. Include steps we can take to limit radiation's effects on our bodies.

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9. Define *critical mass.* Explain what a chain reaction is and how it would be controlled and stopped in a nuclear reactor plant.

10. Complete the following regarding irradiation:

a. Explain what irradiated seeds are and how irradiation affects the seed.

b. Do an experiment to compare the growth of irradiated and nonirradiated seeds of the same kind. Plant both types of seeds, record the growth of both groups, and report in writing your discoveries and results.

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c. Explain how irradiation is used in the food industry. Describe benefits and its safety for humans.