Appendix B Classroom Topics

Topics for discussion or for written reports

1. Describe the three modes of radioactivity decay; explain the changes in atomic number and mass number for each; and diagram an example of each.
2. Describe how radioactive decay is related to energy states in the nucleus.
3. Describe nuclear stability in terms of the neutron to proton ratio.
4. Explain the shape of the chart of the nuclides.
5. Describe the distinction between fission and fusion reactions.
6. Describe the role of neutrons in causing and sustaining nuclear fission.
7. Give several examples of radioactive isotopes; predict how much will remain at the end of their third half-life.
8. Give examples of reactions producing transuranic elements.
9. Define the purpose of accelerators; compare and contrast linear accelerator, cyclotron and synchrotron.
10. List and define the four basic interactions between particles.
11. Demonstrate parity symmetry using a plane mirror as a prop.
12. Describe the nuclear evolution of the Universe in terms of time and temperature.
13. Use the World Wide Web to find a nuclear laboratory and learn about the research being done there. Report your findings to your class.

Topics about Nuclear Science related to societal issues

1. How does the application of radioactivity benefit and hurt us?
2. Is radioactivity unnatural?
3. In the future, what role should nuclear power plants act in supplying power for the world? How will new technologies such as solar effect this?
4. Compare and contrast the effects that nuclear, coal, hydroelectric and solar power have on the environment. How do they effect the Earth's $C0_2$ level? Do they contribute to global warming? What are the economic advantages and disadvantages of each?
5. Should we pursue the development of fusion power?
6. What should be done about the radioactive waste from medical applications? From nuclear power.
7. Do we have no more need for nuclear weapons? What can be done with dismantled nuclear weapons?

Possible Misconceptions

1. *Radioactivity first appeared during World War II*. Radioactivity has been around since the Big Bang. Humans have known about radioactivity and used it since the end of the 19th century.
2. *Atoms cannot be changed from one element to another*. Atoms can be changed to from one element to another with the addition or subtraction of protons. We see elements change in alpha decay, beta decay, fission, and fusion reactions.
3. *Fission and fusion are the same; fission is more powerful than fusion*. Fission is the splitting of heavier nuclei into lighter ones and fusion is the combining of lighter nuclei to form heavier ones.
4. *Neutrons and protons have no internal structure*. Neutrons and protons are composed of quarks and gluons.
5. Nuclear power plants produce harmful radioactive waste while other forms of electrical generation do not. Mining for coal brings uranium to the surface of earth and the uranium is distributed into the atmosphere when the coal is burned.
6. *Radiation causes cancer. Thus, it cannot be used to cure cancer*. Excessive radiation can cause cancer. The destructive power of radiation on cancerous cells can cure cancer.
7. *Once a material is radioactive it is radioactive forever*. One can physically or chemically remove the radioactive particles from the material or wait for it to decay. Some radioactive nuclei decay in a short time while other nuclei might last longer 10,000 years or even longer.