PRESENTING INFORMATION ON RADIOISOTOPES: THE *CHART OF THE NUCLIDES*

The activities in the *Radioactive Decay Series* require students to use “stairstep” charts to plot the atomic transitions occurring in the natural radioactive decay series and in spent fuel. These charts introduce students to a device they may not be familiar with that presents information on radioisotopes and radioactive decay. They are adapted from sections of a more general presentation called the *Chart of the Nuclides*. The *Chart of the Nuclides* presents the most pertinent information on all known radioactive and non-radioactive isotopes in a way that makes it relatively easy to follow the atomic transitions resulting from radioactive decay. It also gives the half-lives of the radioisotopes and the energies associated with the decay.

The *Chart of the Nuclides* is similar to the *Periodic Table of the Elements* in that it organizes and arranges information to give scientists both a quick overview and important detailed information. The periodic table was developed before radioactivity was discovered and before the isotopic nature of the chemical elements had become known. The periodic table presents in convenient form the periodicity or repetition of chemical behavior with increasing atomic number. For example, lithium, sodium and potassium with atomic numbers 3, 11 and 19, respectively, are similar in their chemical properties. Likewise fluorine, chlorine, and bromine with atomic numbers 9, 17 and 35, respectively, have common characteristics, differing mainly in degree of reactivity. The periodic table aided in the search for chemical elements then unknown by predicting their properties and encouraged research in the structure of atoms and how electrons are arranged around nuclei in a manner that makes the chemical behavior of the elements understandable and predictable. Although there have been many refinements to Mendeleev’s original 1869 formulation, the fundamental principles leading to the tabulation remain the same today. The periodic table is of primary interest to chemists, both practical and theoretical.

The *Chart of the Nuclides* is a product of the atomic age. The necessity for such a tabulation arose from the production and isolation of large numbers of radioisotopes following the development of the atomic bomb and a concurrent large increase in our knowledge of radioactivity. The need for an ordered formulation of isotopic information was further enhanced by the initiation of nuclear power development, the increased interest in isotopes (both radioactive and non-radioactive), and the realization of the enormous benefits that could be realized in all areas of human endeavor from the use of isotopes. The *Chart of the Nuclides* has a more universal appeal than the *Periodic Table of the Elements* and is of practical use in nearly all technical disciplines.

The chart was developed in the latter forties at the Knolls Atomic Power Laboratory operated by the General Electric Company under the direction of what was then the U.S. Atomic Energy Commission and is now the U.S. Department of Energy. The chart has gone through many revisions since it was first developed. The present arrangement is similar to that suggested in the beginning by Emilio Segre. The current chart reflects isotopic data up to the middle of 1983.

The chart is called the *Chart of the Nuclides* rather than the “Chart of the Isotopes” because *nuclide* is a more general term than *isotope*. *Nuclide* is a term applicable to *all* atomic forms of *all* the chemical elements. *Isotope* is a more restrictive term and refers to the various atomic forms of a single chemical element. The isotopes of a single chemical element may be thought of as a “family” of nuclides.

The *Chart of the Nuclides* can be purchased as a 55" x 32" wall chart and booklet for $10.00 (price includes shipment). A 60-page soft-cover book entitled *Chart of the Nuclides* is also available for $10.00 (price includes shipment). The book includes fold-outs of the chart. These items can be obtained from:

General Electric Company
Production Resources
1080 North Seventh Street
San Jose, California 95112

INTRODUCTION

Radiation

Radiation is perhaps easiest to understand when you remember that it is energy moving through space in the form of waves and particles. Radiation is everywhere — in, around, and above the world we live in. We could think of it as a natural energy force that surrounds us. We are generally not very aware of it until we are reminded of it by someone or something, like a reflector on a bicycle, a full moon, or listening to a favorite radio program.

Types of Radiation

Depending on how much energy it has, radiation can be described as either *non-ionizing* (low energy) or *ionizing* (high energy).

Non-Ionizing Radiation

All our lives, perhaps without knowing it, we have reaped the benefits associated with non-ionizing radiation. For example, radio and television waves provide news and entertainment in the home, microwaves ease some cooking tasks, the light from electric light bulbs takes away the night, and the ultraviolet light from grow lights brings an artificial sun indoors for our flowering plants. These are some forms of non-ionizing radiation.

Ionizing Radiation

High-energy ionizing radiation is called ionizing because it can knock electrons out of atoms and molecules, creating electrically charged particles called *ions*. Material that ionizing radiation passes through absorbs energy from the radiation mainly through this process of *ionization*.

Ionizing radiation can be used for many beneficial purposes, but it also can cause serious, negative health effects. That is why it is one of the most thoroughly studied subjects in modern science. Most of our attention in this section will be focused on ionizing radiation — what is it, where it comes from, and some of its properties.