Figure 2.7 The age of remains that contain carbon and are less than about 50,000 years old, such as this pygmy mammoth, can be determined using carbon dating. (credit: Bill Faulkner/NPS/Biology 2E OpenStax)

CAREER CONNECTION - Interventional Radiologist

The controlled use of radioisotopes has advanced medical diagnosis and treatment of disease. Interventional radiologists are physicians who treat disease by using minimally invasive techniques involving radiation. Many conditions that could once only be treated with a lengthy and traumatic operation can now be treated non-surgically, reducing the cost, pain, length of hospital stay, and recovery time for patients. For example, in the past, the only options for a patient with one or more tumors in the liver were surgery and chemotherapy. Some liver tumors, however, are difficult to access surgically, and others could require the surgeon to remove too much of the liver. Chemotherapy is also highly toxic to the liver, and certain tumors do not respond well. In some cases, an interventional radiologist can treat the tumors by disrupting the patient's blood supply. In this procedure, called radioembolization, the radiologist accesses the liver with a fine needle, threaded through one of the patient's blood vessels. The radiologist then inserts tiny radioactive "seeds" into the blood vessels that supply the tumors. In the days and weeks following the procedure, the radiation emitted from the seeds destroys the vessels and directly kills the tumor cells in the vicinity of the treatment.

Radioisotopes emit subatomic particles that can be detected and tracked by imaging technologies. One of the most advanced uses of radioisotopes in medicine is the positron emission tomography (PET) scanner. The procedure begins with administering a very small dose of radioactive glucose, the simple sugar that cells use for energy. The PET camera shows the medical team, which of the patient's tissues are taking up the most glucose. Thus, the most metabolically active tissues show up as bright "hot spots" on the images (Figure 2.8). PET can reveal some cancerous masses because cancer cells consume glucose at a high rate to fuel their rapid reproduction.

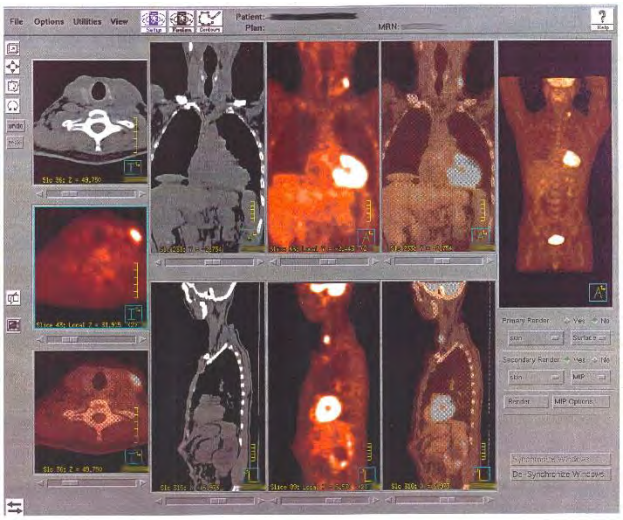

Figure 2.8 PET Scan PET highlights areas in the body where there is relatively high glucose use, which is characteristic of cancerous tissue. This PET scan shows sites of the spread of a large primary tumor to other sites. (credit: Betts et al./Anatomy and Physiology OpenStax)[/caption]

CONCEPTS IN ACTION- To learn more about atoms and isotopes, and how you can tell one isotope from another, visit this site and run the simulation.

The Periodic Table

The **periodic table** organizes and displays different elements. Created by a Russian chemist, Dmitri Mendeleev (1834–1907), in 1869, the table groups elements that, although unique, share certain chemical properties with each other. The properties of elements are responsible for their physical state at room temperature; they may be gases, solids, or liquids. Elements also have specific chemical reactivity. **Reactivity** is the ability of elements to combine and chemically bond with each other.

In the periodic table in Figure 2.9, the elements are organized and displayed according to their atomic number and are arranged in a series of rows and columns based on shared chemical and physical properties. In addition to providing the atomic number for each element, the periodic table also displays the element's atomic mass. Looking at carbon, for example, its symbol (C) and name appear. Its atomic number of six is shown in the upper left-hand corner and its atomic mass of 12.11.

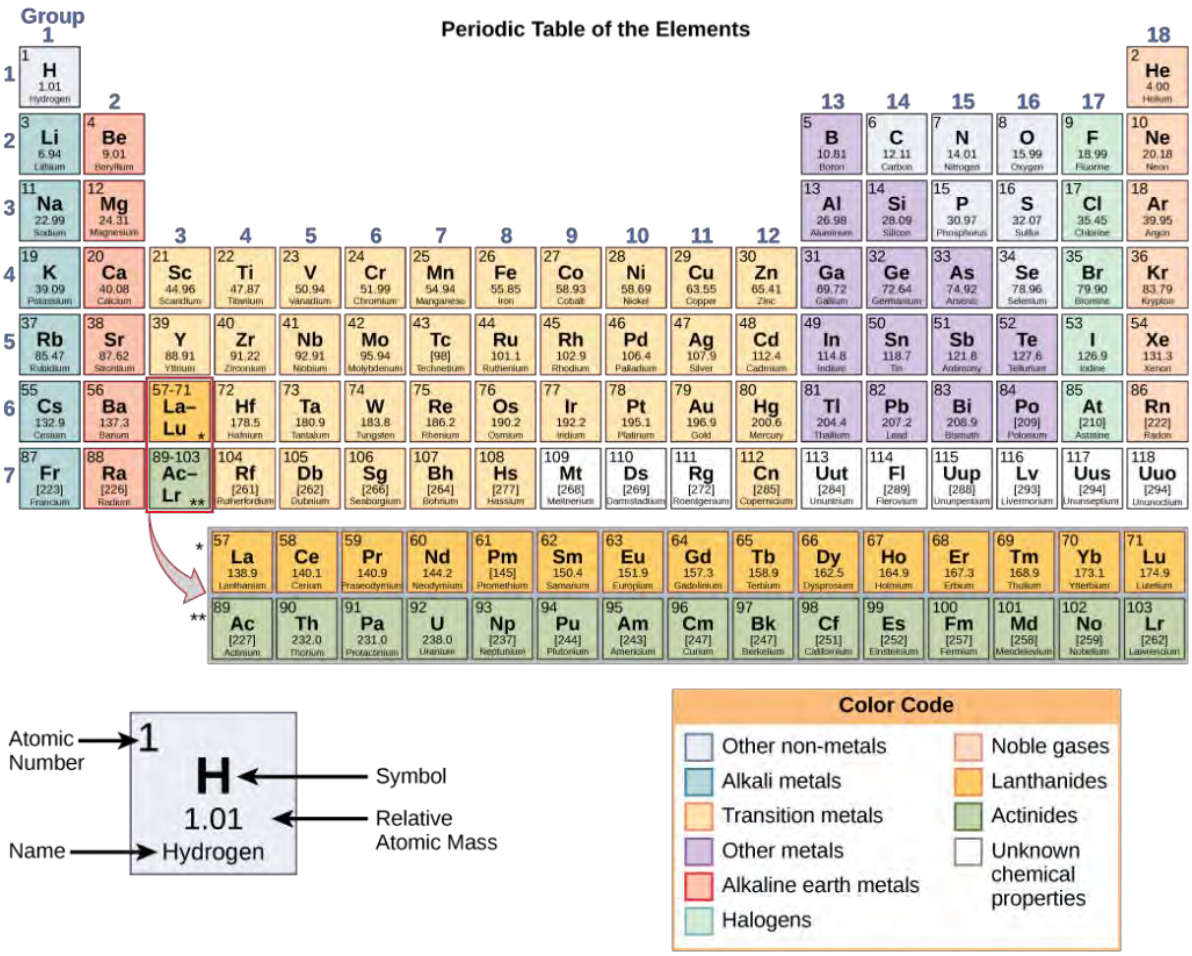

Figure 2.9 Arranged in columns and rows based on the characteristics of the elements; the periodic table provides key information about the elements and how they might interact with each other to form molecules. (credit: Concepts of Biology 1st Canadian Edition)

Check your knowledge

How many neutrons do potassium (K) and oxygen (O) have, respectively?

Answer: potassium - (20 neutrons) and oxygen - (8 neutrons)

The periodic table groups elements according to chemical properties. Scientists base the differences in chemical reactivity between the elements on the number and spatial distribution of an atom's electrons. Atoms that chemically react and bond with each other form molecules. **Molecules** are simply two or more neutral atoms chemically bonded together. The atoms that chemically bond may be identical, or they may be different from one another. Chemical **compounds** differ from molecules in that they are always made up of different types of atoms held together by chemical bonds. Logically, when two atoms chemically bond to form a molecule or compound, their electrons, which form the outermost region of each atom come together first.