Radioisotopes

The widespread use of radioactive isotopes in biology began just after World War II. Wartime research in nuclear physics had generated a stockpile of radioactive materials, and these materials were soon made available to scientists.

Biologists quickly began using radioisotopes to construct tracers. Tracers are molecules that can be tracked while they are being used by living cells. Molecules containing radioisotopes make very effective tracers because they constantly send out bursts of radiation. Biologists can track these bursts and follow the paths of the tracers as they move within the cell. The paths taken by the tracers can give biologists valuable information about the nature of the chemical reactions taking place in the cell.

Tracers are prepared by combining a radioisotope (such as phosphorus-32, carbon-14, or sulfur-35) with other nonradioactive atoms to form molecules that will be taken into cells. Because cells are unable to distinguish between radioactive and nonradioactive isotopes, they treat tracer molecules the same as nonradioactive molecules.

Once the tracers have entered the cell, scientists must have a way to monitor their movements. Biologists generally use two methods to do this. The first method is autoradiography. In autoradiography, tracers take pictures of themselves! Cells are exposed to tracer molecules and given time to incorporate the tracers into their chemical processes. Then, the labeled cells are covered by a type of photographic paper that is sensitive to radiation. The radioisotopes emit radiation that forms an image on the photographic paper. Biologists can then study these photographic images to determine the location of the radioisotopes.

The second common method of detecting radioactive tracers is called quantitative assay. An assay is an analysis of a substance to determine the nature of its components. In a quantitative assay, scientists allow cells to take in and use tracer molecules. Scientists then separate the cells into their component parts and test each group of components to determine where the tracer molecules are concentrated. This was the method Hershey and Chase used to determine whether the material transferred from bacteriophages to bacteria was DNA or protein.

Evaluation *Answer the following questions on a separate sheet of paper.*

1. What problems might result from using a tracer that contained a radioisotope that was either too strongly or too weakly radioactive?
2. A scientist has been inserting a tracer molecule containing phosphorus-32 into a population of bacteria to see where they store phosphorus. Which method might the scientist use to monitor the movement of the tracers within the bacteria? Explain your answer.