Name _____ Class _____ Date _____

Radon

It was a typical day for Stanley Watras, an engineer reporting to work at a nuclear power plant near Pottstown, Pennsylvania—until he entered the plant and set off a radiation alarm. Oddly enough, the alarm meant that he was bringing radiation *into* the nuclear power plant, not out of it.

Watras suspected that he might have absorbed the radiation in his home, into which he and his family had moved only a year before. He asked the Philadelphia Electric Company, the owners of the power plant, to test his house. The tests revealed a startling, and frightening, situation: The house was contaminated by radioactivity. It had a radiation level 165 times higher than that permitted in uranium mines—more than scientists had ever recorded in a dwelling.

It was found that the air in Watras's house was polluted by radon, a radioactive gas that is one of the decay products of the uranium in the rocks of the earth's crust. This discovery was alarming because the gas is associated with lung cancer in humans after long-term exposure. Experts have calculated that the effect of living in that house for 20 years would be equivalent to the effect of smoking 50 to 100 packs of cigarettes per day or being subjected to three chest X rays per minute for life. In other words, for a person exposed to the levels of radiation recorded in Watras's house over a lifetime, the chances of developing lung cancer would be 100 percent.

Radon by itself is not dangerous. If breathed in, it is breathed out again. However, radon decays into polonium as shown by the equation for the alpha decay of the isotope of radon having the longest half-life ($T_{1/2}$ = 3.823 days), radon-222:

$$\underset{\text{radon}}{^{222}_{86}\text{Rn}} \rightarrow \underset{\text{polonium}}{^{218}_{84}\text{Po}} + \underset{\text{alpha particle}}{^{4}_{2}\text{He}}$$

Polonium, the decay product, is itself radioactive and, in turn, decays into radioactive isotopes of bismuth and lead. These solid elements are called "radon daughters." When particles of these elements are breathed in, they tend to accumulate in the lung tissues. Over a period of time, these particles can induce lung cancer. Some experts believe that most lung cancer occurring in nonsmokers is caused by radon.

When radon seeps up from uranium deposits into the open air, the gas simply disperses and is not harmful. However, when radon seeps into buildings through, for example, cracks in the foundation, it tends to accumulate there. Persons living in the building breathe in the gas, and the radon daughters eventually become lodged in their lungs.

Radon is a natural environmental hazard. It is an unusual hazard in two ways: First, it is not produced by human activities or as the result of careless dumping of wastes; rather, it is released naturally from uranium-containing rock formations in the earth. Second, the air-pollution problem created by radon occurs only indoors. As a result, the Environmental Protection Agency (EPA) has no authority over radon pollution; under the Clean Air Act, its jurisdiction extends only to outdoor air.

Radon has always been, and continues to be, released from the earth. It posed little risk, however, in regions that were mostly rural and sparsely settled. But as areas over uranium deposits have become more densely populated, and people have spent more time in buildings instead of outdoors, the potential health hazard of radon has steadily increased. The radon problem has become especially more severe since the energy crisis of the 1970s. In an effort to save energy and money, homeowners have tried to make their houses airtight by caulking window and door openings, installing insulation, and so on. When radon seeps into a well-insulated, airtight house, it cannot escape. Then it becomes dangerous for the residents.

State and federal agencies are conducting extensive investigations into the radon problem, trying to pinpoint geologic formations where it might occur. One such area, called the Reading Prong, stretches across three states, from Reading, a city in eastern Pennsylvania, through northwestern New Jersey and into New York State. The Watras's home is situated on the Reading Prong. However, scientists consider radon to be a problem in some areas of every state.

The presence of uranium deposits in a region does not necessarily mean that residents there will experience the effects of radon pollution. A set of complicated factors, which scientists are just beginning to recognize, determine whether radon will contaminate buildings situ-

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Radon (*Continued*)

ated over such deposits. One such factor is the permeability of the soil. For instance, scientists are investigating the New England region for radon pollution, as the terrain there is quite hilly and the soil loose and rocky. Another factor is the way buildings are constructed—the type and condition of the foundation, the number of stories, and the system of ventilation are all parts of a total situation that either increases or reduces the risk of radon pollution. Scientists have learned that without specific testing it is not possible to say for certain that all houses on a particular block or hillside probably have a radon problem. Every building must be tested individually.

A common approach to a pollution problem is to eliminate its cause. In this case, this is not a practical solution. The rocks on which a house is built cannot very well be removed. Future development of land areas could include testing the ground for radon danger before construction begins. But the solution to the radon problem for existing buildings must take some other form.

The Philadelphia Electric Company offered to reconstruct the Watras's house as a demonstration of how a building with a radon problem can be well insulated and yet still have a low radon level. However, not all buildings with radon leakage must be totally remodeled, obviously a very expensive procedure. Individuals with problems of less severity than that of the Watras's have a variety of lower-cost options available to them; for example, installing a different type of ventilation system or carefully patching the basement walls and foundation. Still, these people do face an unexpected expense as well as a possibly serious reduction in the value of their property—all through no fault of their own or of anyone else.

The large-scale scientific investigation of radon gas pollution is just beginning. Some of the important factors being studied include the location of uranium deposits in the earth, the testing of buildings suspected of having radon pollution, the health risks posed by this gas, and feasible methods to prevent these risks.

QUESTIONS

1. a) What is the major health concern with regard to radon pollution?
   b) Radon has always been emitted from rocks in the ground that contain uranium. Why has its potential health hazard been discovered only recently?
2. a) What would you consider to be the most urgent issue in cases where radon pollution has been detected?
   b) What do you consider to be the most urgent issue with regard to new construction in areas with a high probability of radon pollution?
3. Which factors of the radon pollution problem are partially or completely under human control? Which are not?
4. Do you think that people who face financial loss as a result of radon pollution of their homes should be compensated? If so, by whom or in what way?
5. Do you think that the radon problem requires new laws to prevent its future occurrence? If so, what should these laws provide? Should the laws be federal, state, or local?
6. Indoor air pollution has become a new field of scientific investigation. Do some research on this topic in the library. You might want to present your findings to your class.

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