INVESTIGATION 8

HOW DOES RADON GET INTO YOUR HOME?

INTRODUCTION

There are three principal sources of radon found in indoor air: 1) rocks and soils under the building, 2) building materials used in construction, and 3) radon dissolved in the water supply. Of these, the rocks and soils under the building are by far the most important. Some kinds of rocks, and the soils that form from their breakdown, are more prone to giving off radon than others. This is because some rocks naturally contain more uranium and radium than others.

Radon is a gas, and moves through cracks and fissures in rocks, and through the air spaces in soil. The major factors that influence the movement of radon into a home include the uranium and radium concentrations of the rock and soil materials beneath the home, pathways through the rocks and soil to the base of the home, openings from the soil directly into the inside of the home, and the amount of suction created by air flows within the home (Figure 1). This suction is caused by differences in pressure between the inside and outside of the house. Once radon gets into a home, its concentration in the indoor air is influenced by the amount of household ventilation. Opening windows and doors, operating bathroom and kitchen fans, and operating clothes dryers all tend to change the radon concentrations by increasing ventilation and/or by pulling more radon in from the soil through the lower parts of the home. In this activity, you will conduct a radon audit of your home to determine possible areas for radon entry and estimate the extent of household ventilation (possible routes for radon to leave the home). Because radon enters the home from the underlying soil, it seldom reaches high concentrations above the second floor of a building. If you live on a higher floor, for example in an apartment building, you should carry out this exercise with a classmate who lives closer to the ground floor.

OBJECTIVES

To identify sources of radon entry into homes and factors that influence radon concentrations in indoor air.

Ventilation - the amount of air movement into and out of the home. Ventilation is governed by openings in the exterior, including doors, windows, chimneys, fan ducts, cracks, and crevices.

PROCEDURE

1. Draw a diagram of your home, illustrating the major potential routes of radon entry from beneath the home.

2. Using a tape measure and calculator, estimate the total size, in square centimeters, of all cracks, openings, and holes in your home that increase the ventilation inside the home even when all windows and doors are kept closed. Add three square centimeters to your total for each fan that is vented to the outside and six square centimeters for each fire-place or woodstove. Divide the total size of all openings to the outside that you have estimated by the total area (also in square centimeters) of the *outside* walls and ceilings in the home. Do not include the area of inside walls, floors, or ceilings between floors. This calculation will give you the estimate of the ratio of air leaks to surface area of your house.

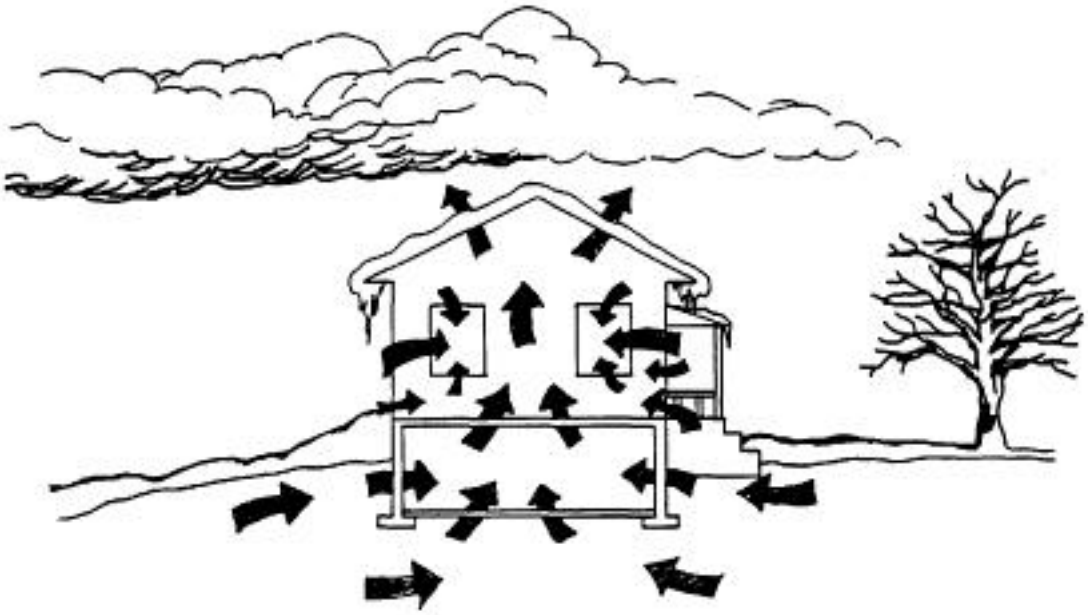
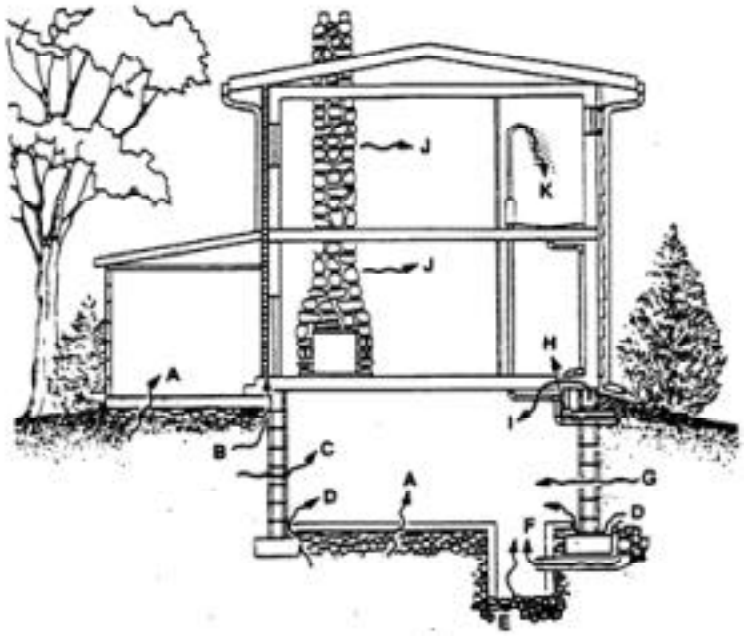


Figure 1. Patterns of airflow in a home. Hot air rises, and therefore most of the inside air escapes to the outside in the upper portions of the home. This is especially pronounced during very cold or very warm weather, when the temperatures inside are very different than the temperatures outside.



A. Cracks in concrete slabs
B. Spaces behind brick veneer walls that rest on hollow-block foundation
C. Pores and cracks in concrete blocks
D. Floor-wall joints
E. Exposed soil, as in a sump
F. Weeping (drain) tile, if drained to open sump
G. Mortar joints
H. Loose fitting pipe penetrations
I. Open tops of block walls
J. Building materials such as some rock
K. Water (from some wells)

Figure 2.Possible routes of radon entry from soil into a typical home.

DATA GENERATION

A. Total area of openings (in square centimeters) _____

B. Number of fans (Add three square centimeters for each) _____

C. Number of fireplaces and woodstoves (Add six square centimeters for each) _____

D. Sum of A + B + C _____

E. Total area of all *outside* surfaces (walls and ceilings) _____

F. Divide C by D to get ratio of air leaks to outside surface area _____

ANALYSIS

3. List what you believe to be the three most important routes of radon entry into your home.

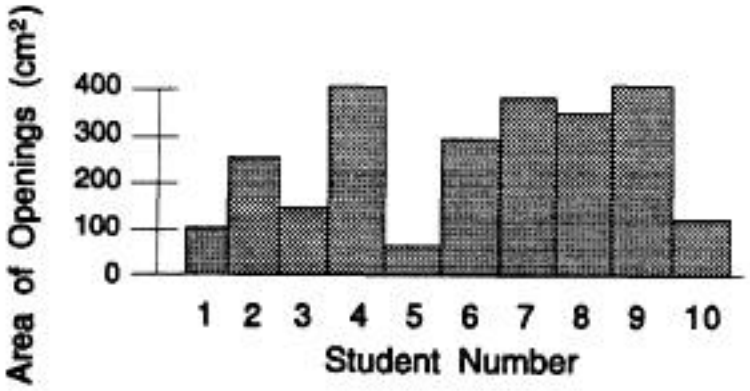
_____

_____

_____

4. Record the total amount of ventilation for each home in your class on a separate sheet o paper. Display the data using a bar chart, plotting the area in square centimeters of the tot household openings on the vertical (y) axis and each student's home along the horizont (x) axis.

Example bar chart:



Bar Chart

A bar chart provides a simple graphing technique to aid in the interpretation of data. The height of each bar above or below the zero-line (origin) of the vertical (y) axis corresponds to the magnitude of the variable of interest.

5. Assuming that radon concentrations in the air inside your home show the following pattern, determine the person in your family who is most likely exposed to the greatest amount of radon at home.

   ·Basement (or crawl space if there is no basement) - highest concentration
   ·First floor - 1/2 the concentration in the basement or crawl space
   ·Second floor (if present) - 1/2 the concentration on the first floor
   ·All higher floors 1/10 the concentration in the basement or crawl space

Hint: You will need to estimate the average number of hours per day each family member spends on each floor of the home.

6. How do the routes of radon entry into your home compare with the homes of your classmates? How about the total amount of ventilation under closed-door conditions?

Hint: You will need to calculate the mean value for total amount of ventilation of all student homes.

CONCLUSIONS

7. List three actions that you could take if you wanted to reduce the radon concentrations that *you* are exposed to inside your house?

8. Given the information that you have collected in this activity, do you think that radon is a problem in your home? What information are you lacking that you would need to make a reasonable evaluation? How could you obtain the needed additional information?

9. Could you use the ventilation data that you and your classmates collected to predict which student is exposed to the greatest amount of radon? Why or why not?