

A RADON STUDY

FOR THE TOWN OF SHUTESBURY

Prepared By the
Shutesbury Elementary School
Sixth Grade - Mr. Berger's Class

Based on Research Done By
The Sixth Grade

And By
John Reid's N.S. 191 Class
At Hampshire College

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What is Radon?

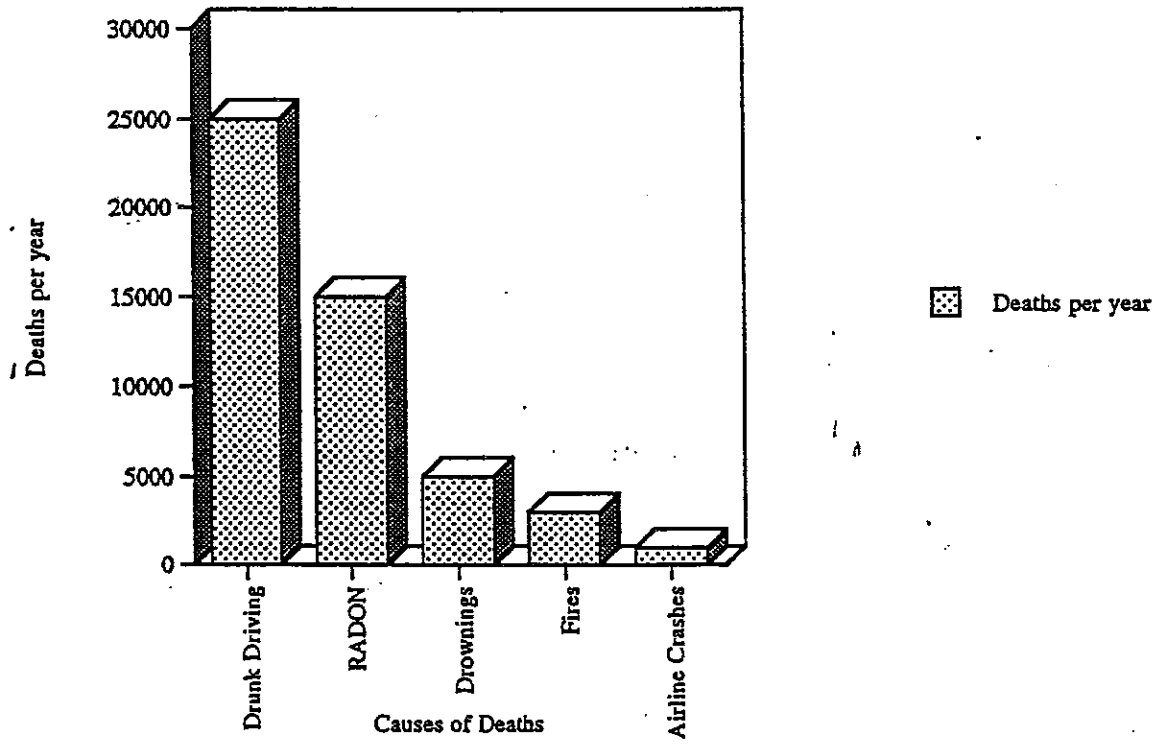
Radon is a colorless, odorless gas that occurs naturally in the ground. It is formed by radioactive uranium particles in the ground, which decay into radon. Radon seeps up through the ground, and enters the air, and over most of the earth, and spreads through the air harmlessly. However, if the radon gas rises up into a house it can create a health hazard in the house. The primary health hazard of radon is that it can cause lung cancer. It's the second leading cause of cancer, after smoking. Like smoking, you don't automatically get cancer, but it increases your chances.

The government has decided that four picaCuries of radon per liter of air is the safe cutoff level for homes and all buildings. Any building, new or old, in any part of the country, can be infiltrated by radon. The only way to know if a building has radon is to test.

Radon is treatable in all homes. To treat the houses, it means installing a pump system to suck out the infiltrating air. To install a treatment system for a home usually costs about five hundred to twenty-five hundred dollars.

The government wants to make sure that all houses or buildings that have over the safe limit of radon get a treatment system.

Estimated Deaths per Year due to Radon
U.S. E.P.A Figures



Radon Tests

There are different ways to measure radioactivity. One measurement is called Curies. In a house it is necessary to measure radon by Curies per liter of air (Ci/L.) Curies are however too big to measure radon by so picaCuries per liter (pCi/L) are used. A pCi/L is equal to a trillionth of a Ci/L. The presently accepted safe level of radon is four pCi/L or less.

There are long term radon tests (3-9 months) and then there are short term tests (2-90 days.) In Shutesbury Elementary School every family took home one short-term (the two day kind) charcoal canister and put it on the lowest living level, above knee level in the room. To make sure that the results were accurate the 6th grade East all took home two canisters each for a comparison check. Some took home a third one from a private company. The results were all very similar, which showed us that the tests were accurate.

Averages: Mean or Median?

In this report there is so much data to present that we needed to use averages. There are two types of averages, mean and median. They are calculated differently. It depends on the data that you are calculating, which is more significant. In this report we used both averages, so that we could present a full picture.

The difference between the two is that in the mean, you add up all the data and divide by the number of data items you added. A problem with this is that one high number can throw your answer off. For example, in the data series, 3,2,6,9,1,3,4,900, the mean would be 116. It doesn't show you that there a lot of small numbers.

In the median, you stack all the data, smallest to largest and find the mid point. Sometimes this is a better picture of the data. For the above data series, the median would be 3.5, this would clearly present a better sense of the data. The problem with this method may be, for example, if you had the numbers, 0,0,0,5,23 the mid point is 0, which gives you a deceiving picture of the data.

For some of our data mean would be more significant, and median others. For the results of the whole town, we used both averages, but the median was more signifigant because a few high values throw off the mean.

The Shutesbury School/Hampshire College Radon Project

John Reid, a professor at Hampshire College thought it would be a good project for his students to do free radon tests for the town of Shutesbury (usually a radon test costs 30 to 50 dollars). He then approached Ron Berger and asked if his sixth grade would help conduct the tests. The tests would be available to all the teachers and students living in Shutesbury. State radon specialist William Bell advised John Reid and Ron Berger's class on carrying out the study.

Students from John Reids class N.S. 191 weighed the amounts of charcoal, for the test and set up the canisters. They also prepared a survey sheet of questions about the condition of the house. and also a map of the town and divided it in to different sections. They handed out the materials to the Shutesbury sixth grade. The sixth graders learned about radon from John Reid and from materials that William Bell gave us. Then the sixth graders briefly educated the school (particularly the younger children) on radon, gave a school assembly on it too.

The sixth grade then put together radon kits for each family, and then handed them out. Most of the kits were brought back on the scheduled date, two days later. John Reid and the students from Hampshire College then analyzed the tests and wrote a confidential letters saying how much radon each family had. Then they gave the letters to the sixth grade who distributed them to the families. Family with levels higher than four were encouraged to call William Bell to see about treatment.

For the next three weeks, the sixth graders analyzed the data from the radon tests and the survey. They used calculators and computer data base and graphing programs. They looked for correlations between radon levels and the geography of town and the features of the homes. This was put together as this report.

General Results for the Town

The general results for the town of Shutesbury were fairly good. We tested 160 houses, and we found that 22 of them were above the safe level of 4 pCi/L. This represents 14% of the homes that we tested. Of these 22 high readings, 16 were below 8 pCi/L and only one was above 12 pCi/L. The minimum of the houses was .05 pCi/L and the highest was 21.50 pCi/l.

On the graphs we made there is a big clump around .5 - 2.5. The mean radon level is 2.33 and the median level is 1.54.

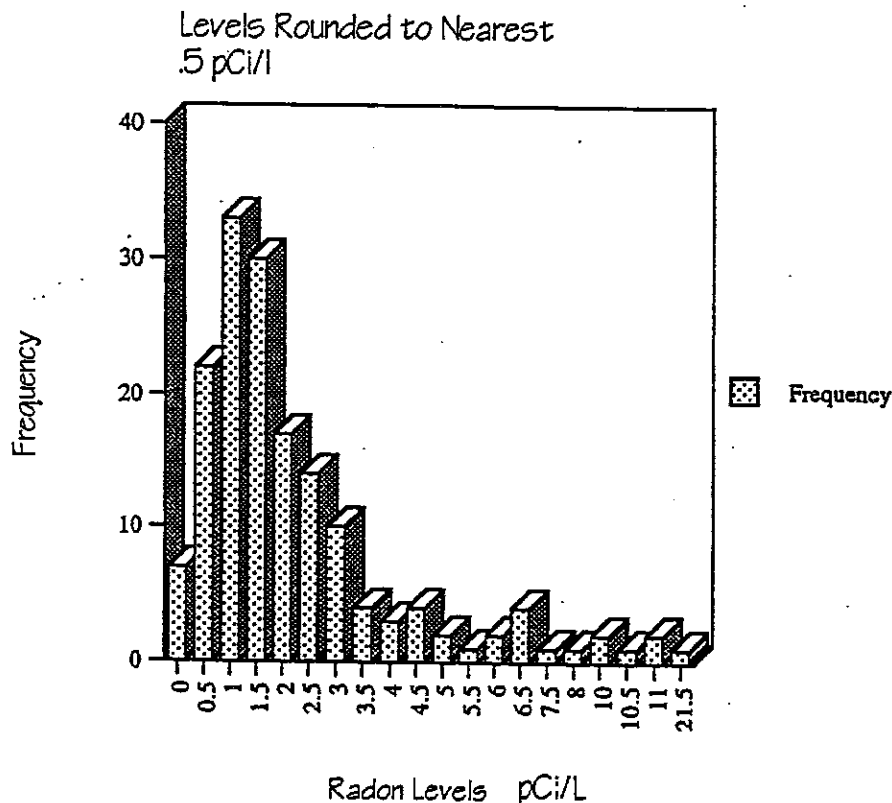
There were 46 houses with radon levels from 0-1, 55 from 1-2, 26 from 2-3, 11 from 3-4, 3 from 5-6, 5 from 6-7, 2 from 7-8, 0 from 8-9, 1 from 9-10, 3 from 10-11, 1 from 11-12, and one from 21-22.

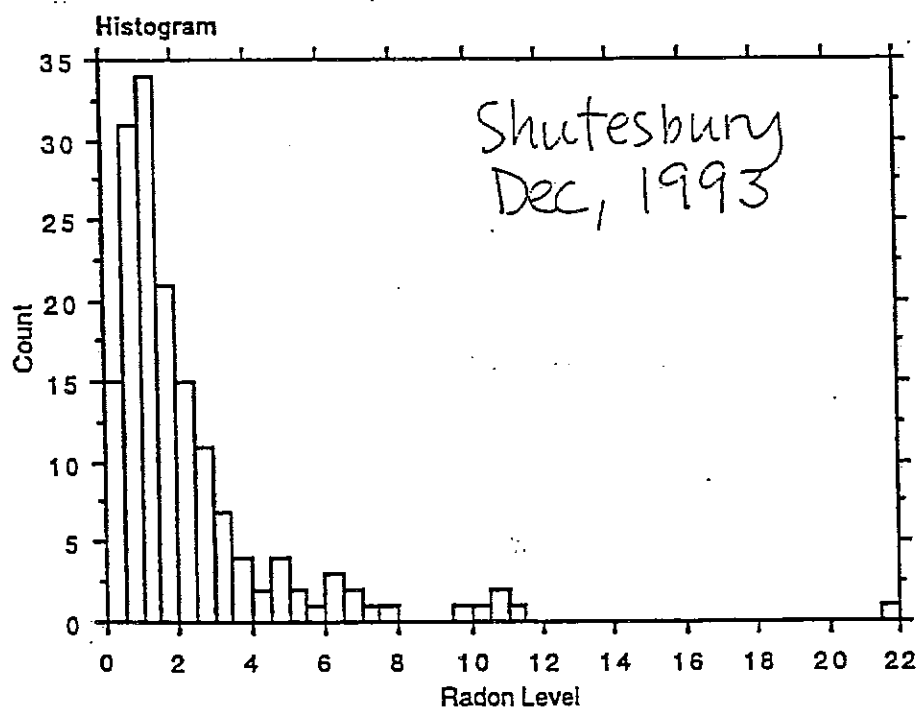
We tested the elementary school, the town hall basement, and the school in South Deerfield where we are this year. All of these places had values below 3 pCi/L.

John Reid gave us some data from a study of about 500 houses in rural Maine. The results were almost identical to our results! The mean was 2.30 and the median was 1.58, while our mean was 2.33 and our median was 1.54. The graphs were almost the same, too!

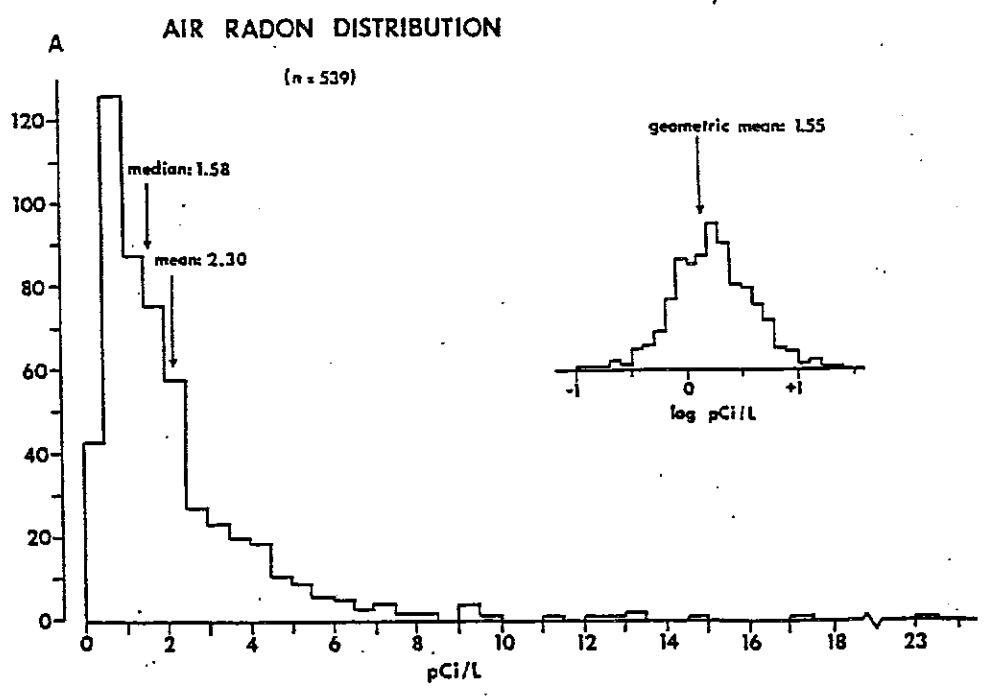
Following are two graphs for the same Shutesbury data (done on different graphing programs) and the graph of the Maine study.

Shutesbury Radon Levels





Airborne levels of radon in Maine homes



Results by Geographic Grid Location

We split up the town of Shutesbury into a grid of 25 sections. Out of the 25 sections there were 17 sections reporting.

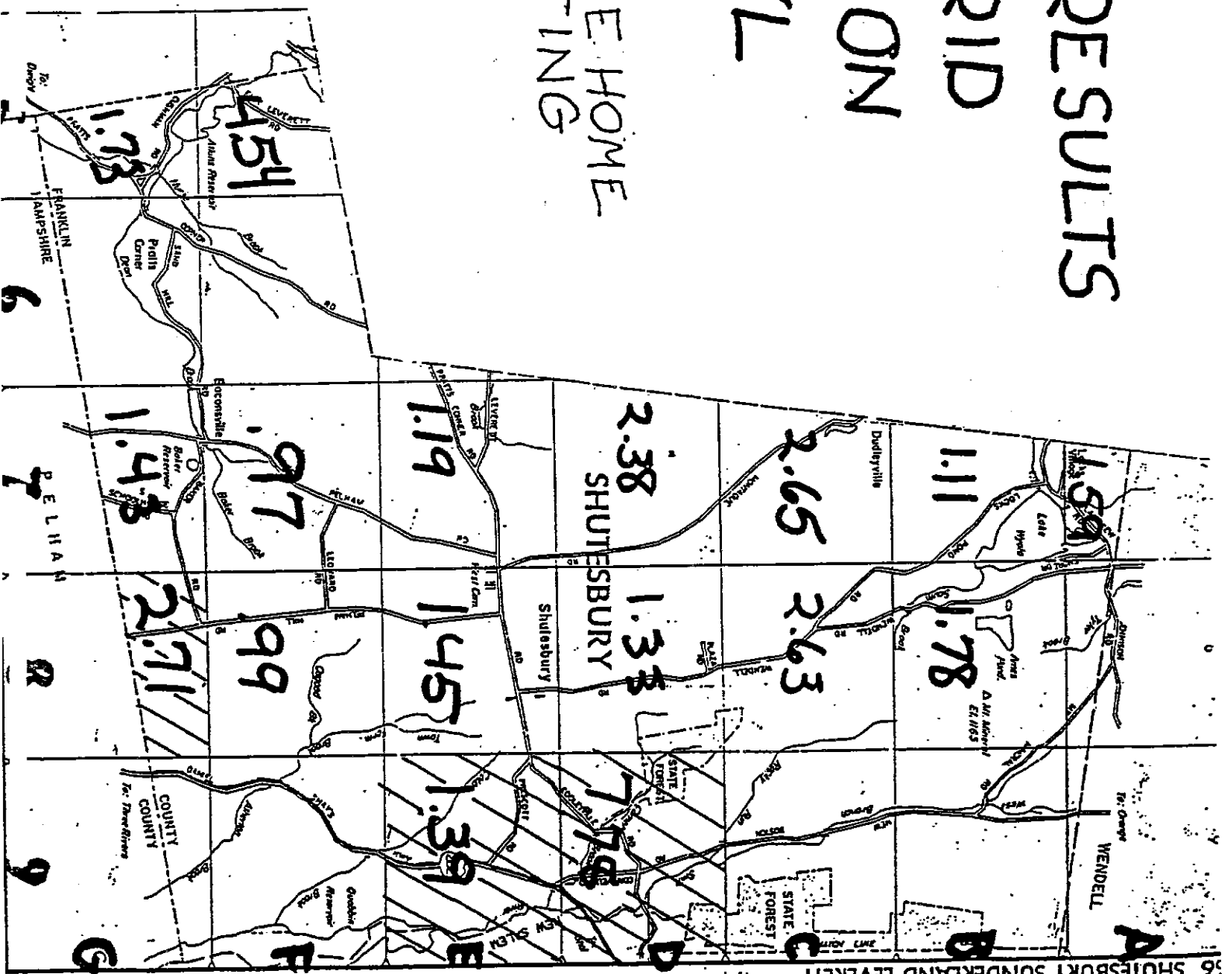
Out of the 17 sections, 3 sections only had 1 home reporting, so the data from those sections are not significant.

Out of the sections with more than one home reporting, only two sections looked like a worry. B8 looked like a concern with the mean, but the median was so low that there is not a concern. On the other hand, F5, near Atkins Reservoir, had a high mean and median because five out of ten of the homes had high levels. The high levels were...11.13, 10.14, 10.06, 5.76, and 7.34.

Grid Coordinate	Homes Reporting	Mean Level	Median Level
A7	6	2.21	1.59
B7	4	1.12	1.11
B8	7	4.25	1.78
C7	5	2.74	2.65
C8	6	2.79	2.63
D7	6	3.56	2.38
D8	9	1.41	1.33
D9	1	7.78	7.78
E7	18	1.79	1.19
E8	20	1.73	1.45
E9	1	1.35	1.35
F5	10	5.45	4.54
F7	11	2.37	0.97
F8	3	0.99	0.9
G5	6	2.1	1.73
G7	10	1.53	1.43
G8	1	2.71	2.71

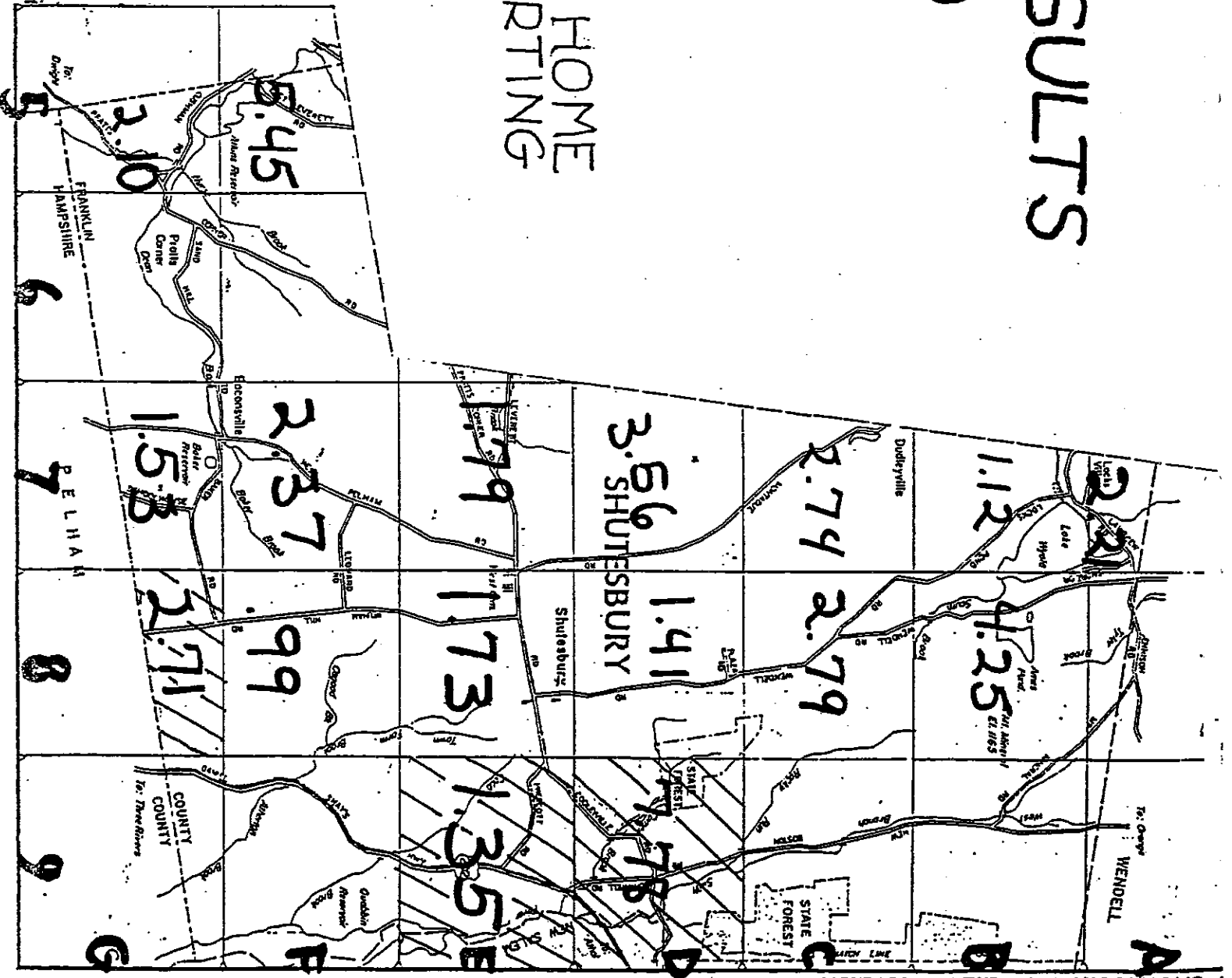
MEDIAN RESULTS BY GRID SECTION DCI/L

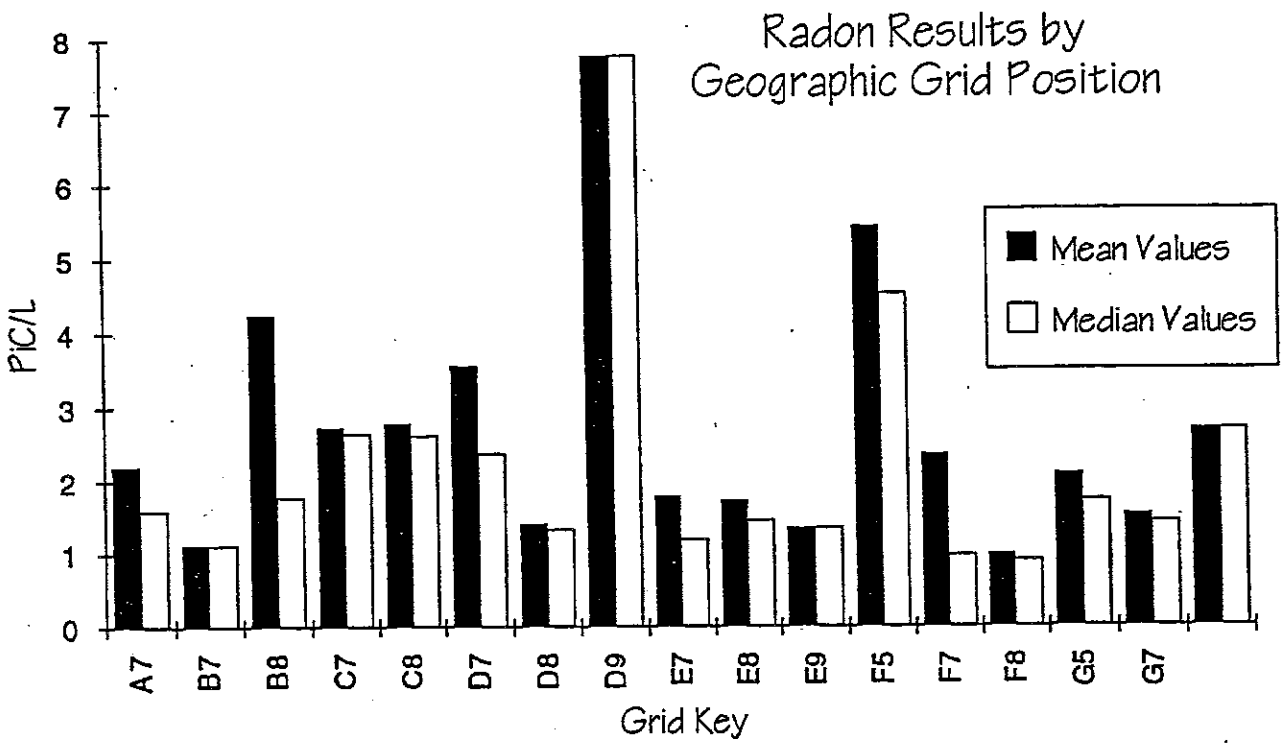
ONLY HOME
REPORTING



MEAN RESULTS BY GRID SECTION PC:1/L

 ONLY ONE HOME
REPORTING





Survey Results

Hampshire College students made a survey for the people who took the radon tests.

The survey asked questions about conditions of the houses such as: When was your house built? What are your foundation walls made of? What kind of heating system do you have? Do you have a fireplace in use? Do you have a coal or wood stove that you use?

With the answers we looked for connections between the level of radon and the different features of the houses. We used two computer programs to look at the data. With Microsoft Excel we sorted and analyzed the data and with Cricket Graph, we graphed the data.

RADON SURVEY QUESTIONNAIRE

TOWN SHUTESBURY

ZIP CODE 01072

The map on the reverse side is divided into squares. In what square is your home?

Please answer the following questions about your home to the best of your knowledge. The survey is strictly anonymous and confidential. Questionnaires will be used only for the compilation of radon distribution statistics.

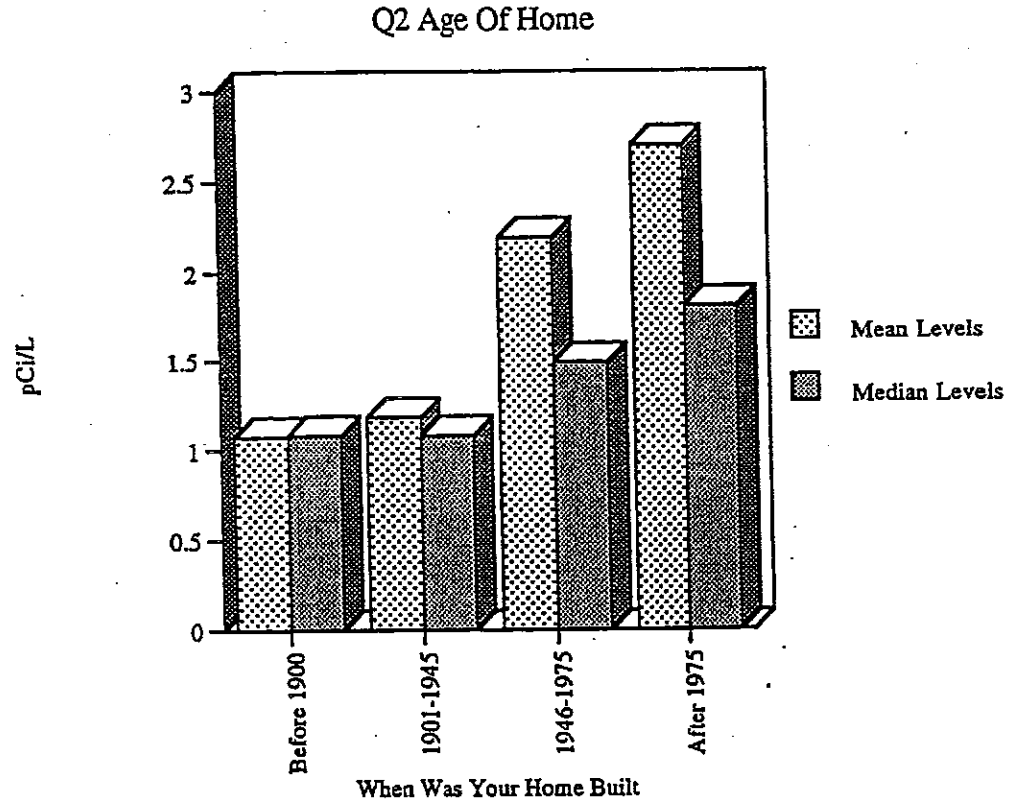
PLEASE MARK THE APPROPRIATE ANSWER.

Example:

- | | 1. | 2. | 3. | 4. |
|---|---|--|---|------------------------------------|
| 1. In what season did you start the test? | 1. Fall | 2. Winter | 3. Spring | 4. Summer |
| 2. Approximately when was your home built? | 1. Before 1900 | 2. 1901-1945 | 3. 1946-1975 | 4. After 1975 |
| 3. Which of the following descriptions best characterizes your home's foundation? | 1. Tightly sealed, no cracks, gaps | 2. Cracks, but no gaps to ground | 3. Areas exposed to ground | |
| 4. The foundation floor is made out of: | 1. Poured concrete | 2. Stone | 3. Dirt | 4. Other _____ |
| 5. The foundation walls are made out of: | 1. Poured concrete | 2. Stone | 3. Cinder block | 4. Other _____ |
| 6. What is the main heating system? | 1. Electric baseboard | 2. Hot water or steam | 3. Forced hot air | 4. Other _____ |
| 7. Is there a dry well or sump, wet sump or other hole in the basement floor? | 1. Yes | 2. No | | |
| 8. Do you have a fireplace that you use? | 1. Yes | 2. No | | |
| 9. Do you have a coal stove or wood stove that you use? | 1. Yes | 2. No | | |
| 10. How tightly insulated is your home? | 1. Very tight: Super-insulated throughout, thermal pane windows | 2. Not drafty: well insulated attic and walls, storm windows | 3. Some drafts: incomplete or old insulation, storm windows | 4. Drafty: little or no insulation |

Q2 Age Of Home?

This data clearly suggests that on average, the older the house, the lower the radon level. This could be coincidence, but the graph looks very convincing. If this relationship is true, we guess that is because older houses are more drafty, and the radon can get out.



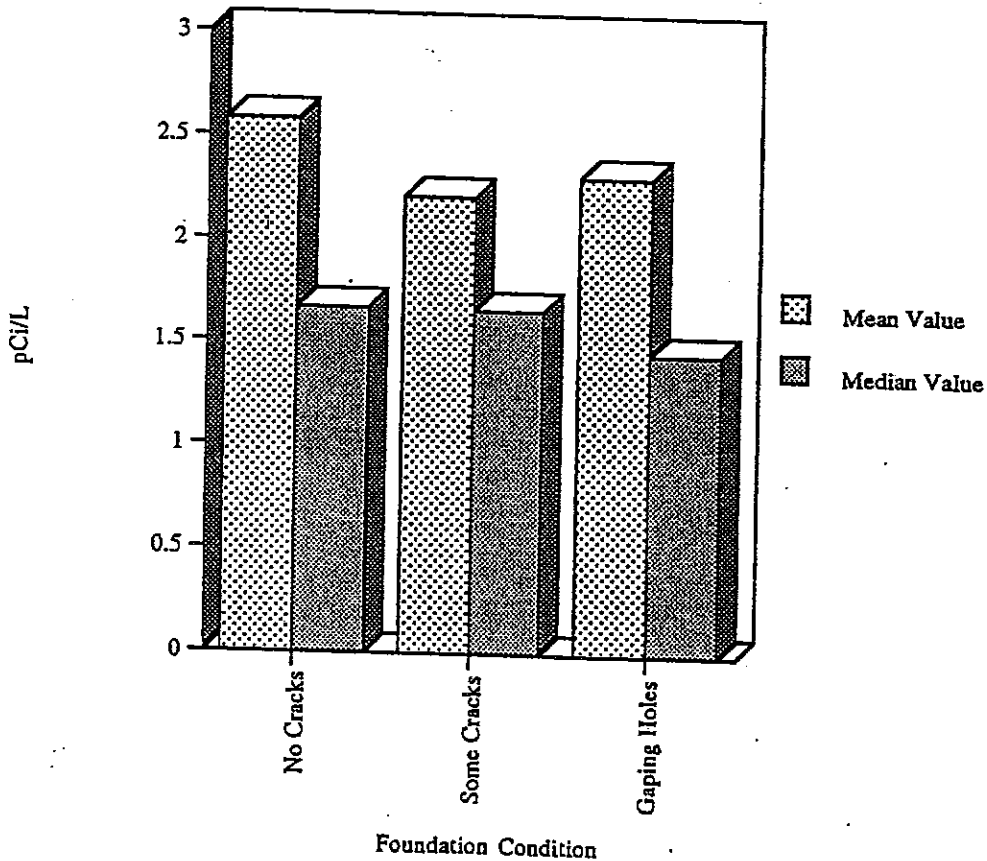
Q2 Age Of Home

	1	2	3
	When Was Your Home Built	Mean Levels	Median Levels
1	Before 1900	1.07	1.08
2	1901-1945	1.18	1.08
3	1946-1975	2.19	1.49
4	After 1975	2.7	1.81

Q3 Foundation Condition

This graph is a graph of foundation conditions. All of the results are relatively the same, although the houses with less cracks on average have more radon. You would guess that the houses with tight foundations would have less radon. This wasn't the case. Why? Perhaps the levels depend more on the level in the ground rather than the foundation condition. Another explanation would be that the older houses are more drafty, therefore the radon may get out easier, and in the newer houses, it would be harder for radon to get out.

Q3 Graph Table

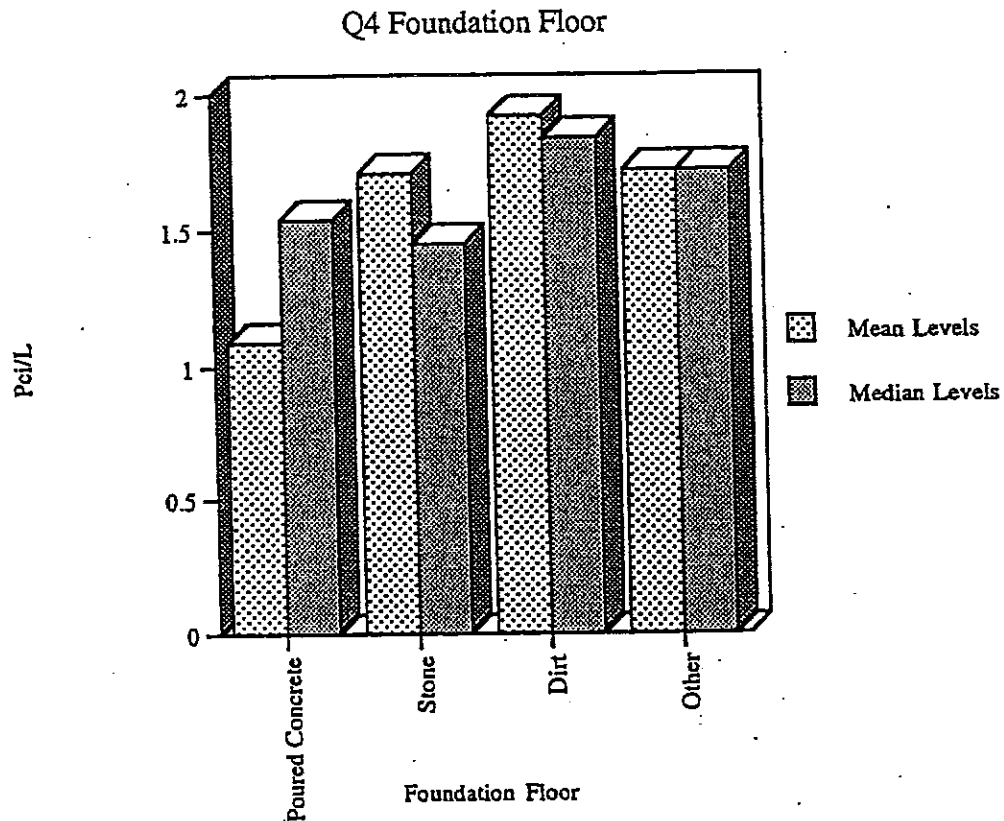


Q3 Graph Table

	1	2	3
	Foundation Condition	Mean Value	Median Value
1	No Cracks	2.58	1.67
2	Some Cracks	2.21	1.66
3	Gaping Holes	2.31	1.45

Q4 Foundation Floor

This data doesn't seem to show any significant difference in radon levels for the different types of floors. The mean is low for concrete, but the median levels, which are more significant, are fairly close.

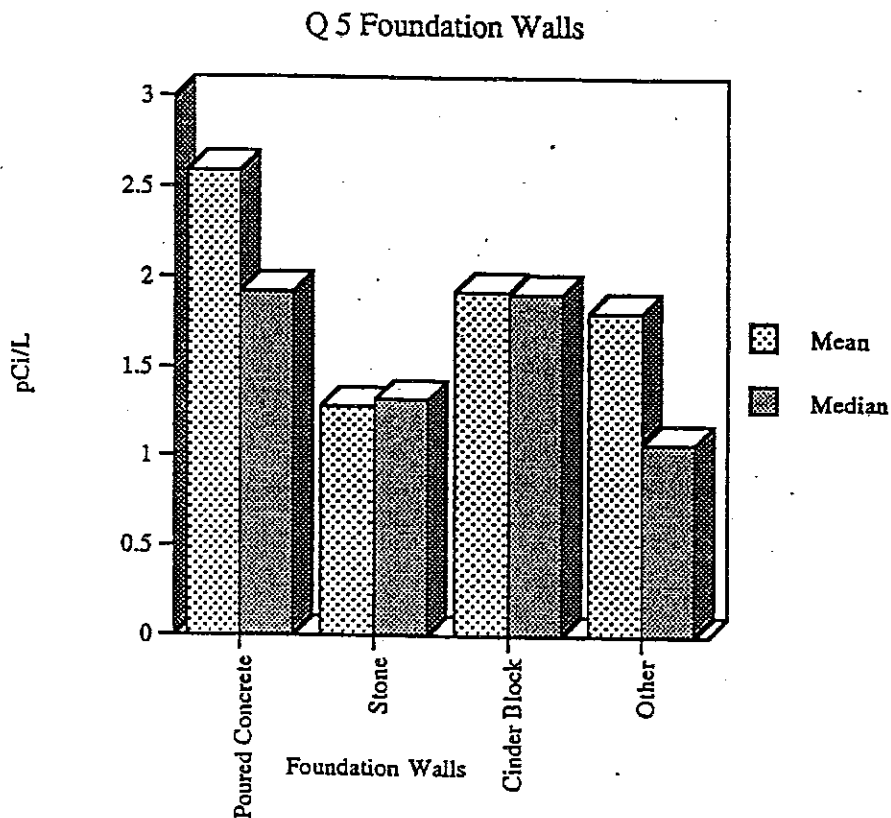


Q4 Foundation Floor

	1	2	3
	Foundation Floor	Mean Levels	Median Levels
1	Poured Concrete	1.09	1.54
2	Stone	1.71	1.45
3	Dirt	1.92	1.84
4	Other	1.72	1.72

Q5 Foundation Walls

Our guess would have been that poured concrete would keep more radon out of the house. This data shows that stone wall houses on average have less radon. Our guess now is that the stone wall houses are older and draftier than the new tighter houses with poured concrete.

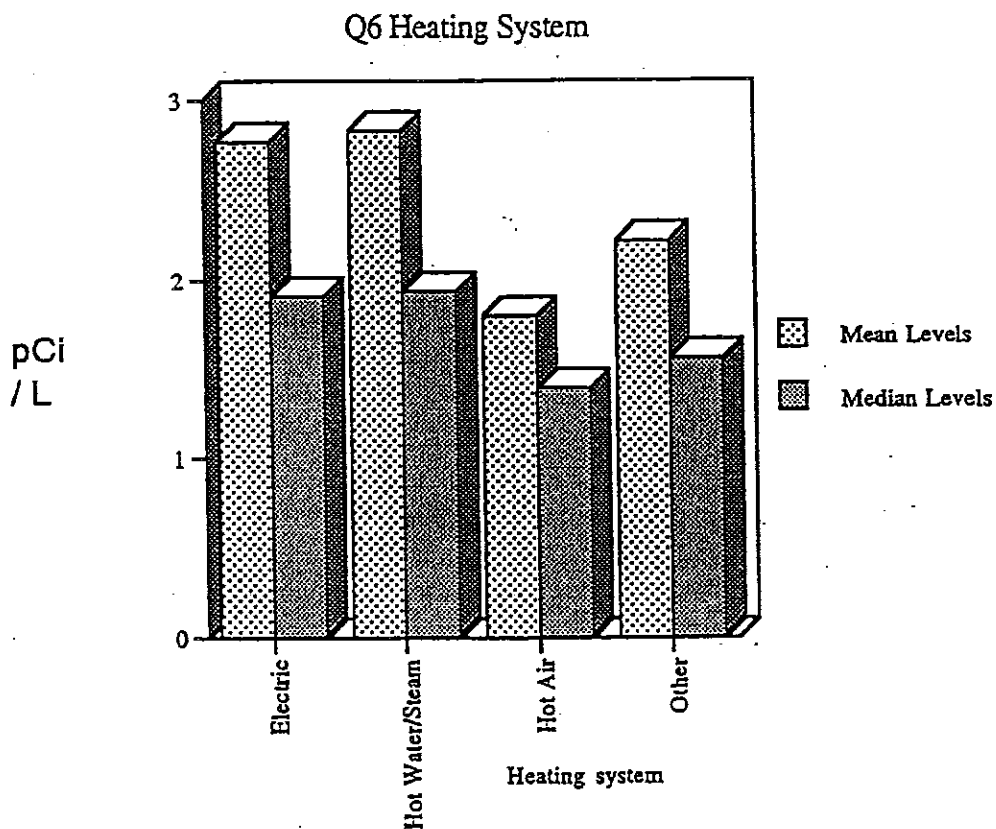


Q 5 Foundation Walls

	1	2	3
	Foundation Walls	Mean	Median
1	Poured Concrete	2.59	1.92
2	Stone	1.28	1.32
3	Cinder Block	1.92	1.91
4	Other	1.81	1.07

Q6 Heating System

This data did not suggest to us any big difference in whether a heating system affects radon levels. Hot air was a little lower than the others, so that might mean that the air blowing is causing more drafts.

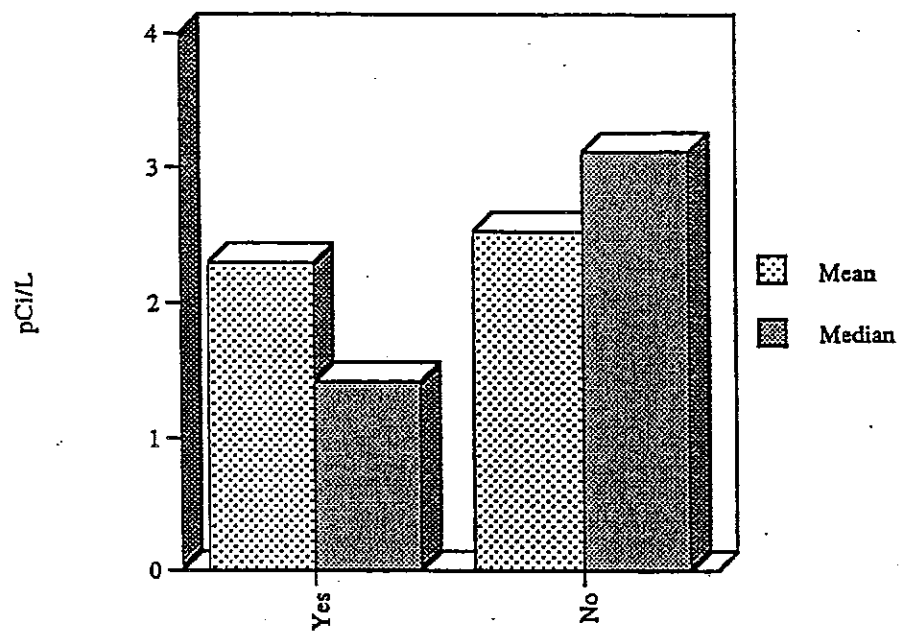


Q6 Heating System

	1	2	3
	Heating system	Mean Levels	Median Levels
1	Electric	2.77	1.91
2	Hot Water/Steam	2.83	1.94
3	Hot Air	1.8	1.39
4	Other	2.22	1.56

Q7 Holes in Basement Floor

You would think that no holes would mean lower radon levels. But surprisingly it was the other way around. We think maybe that people who live in old homes might have more basement floor holes and have lower radon levels because they have more drafts.



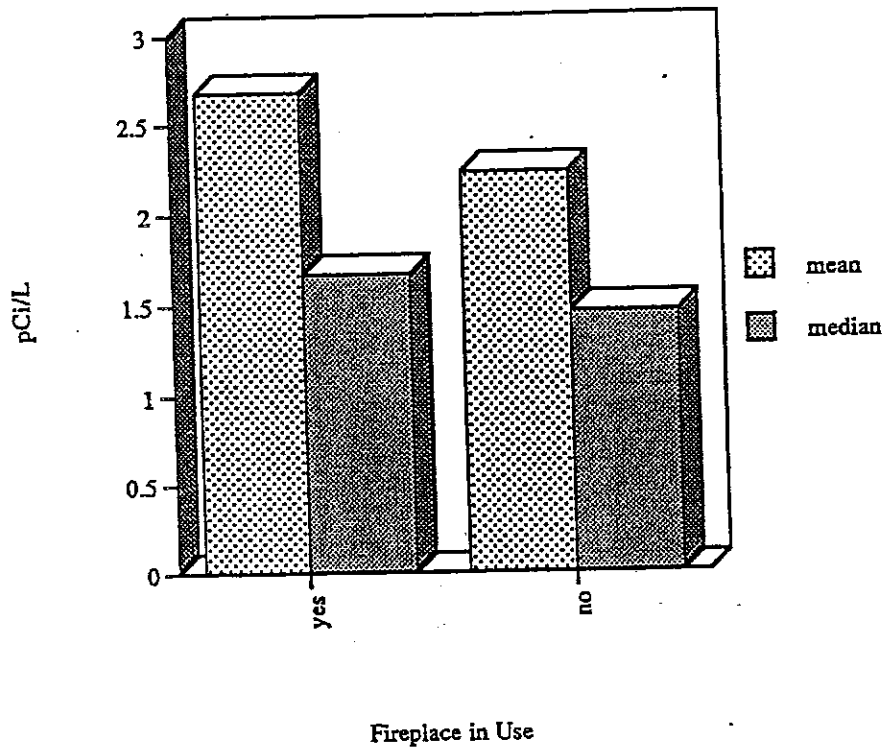
Holes in the basement floor.

Q7

	1	2	3
	Holes in the basement floor	Mean	Median
1	Yes	2.3	1.42
2	No	2.53	3.12

Q8 Fireplace in Use?

This data didn't suggest to us any big difference in whether a fireplace affects radon levels.

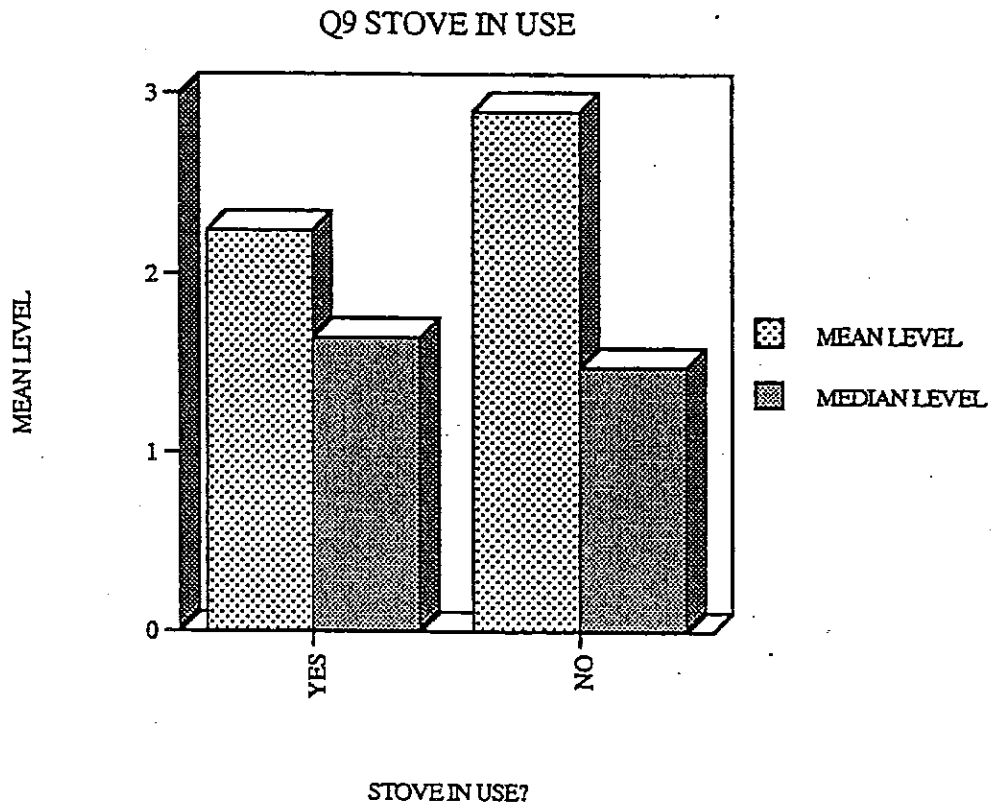


Q8 fireplace

	1	2	3
	Fireplace in Use	mean	median
1	yes	2.68	1.67
2	no	2.23	1.46

Q9 Stove in Use ?

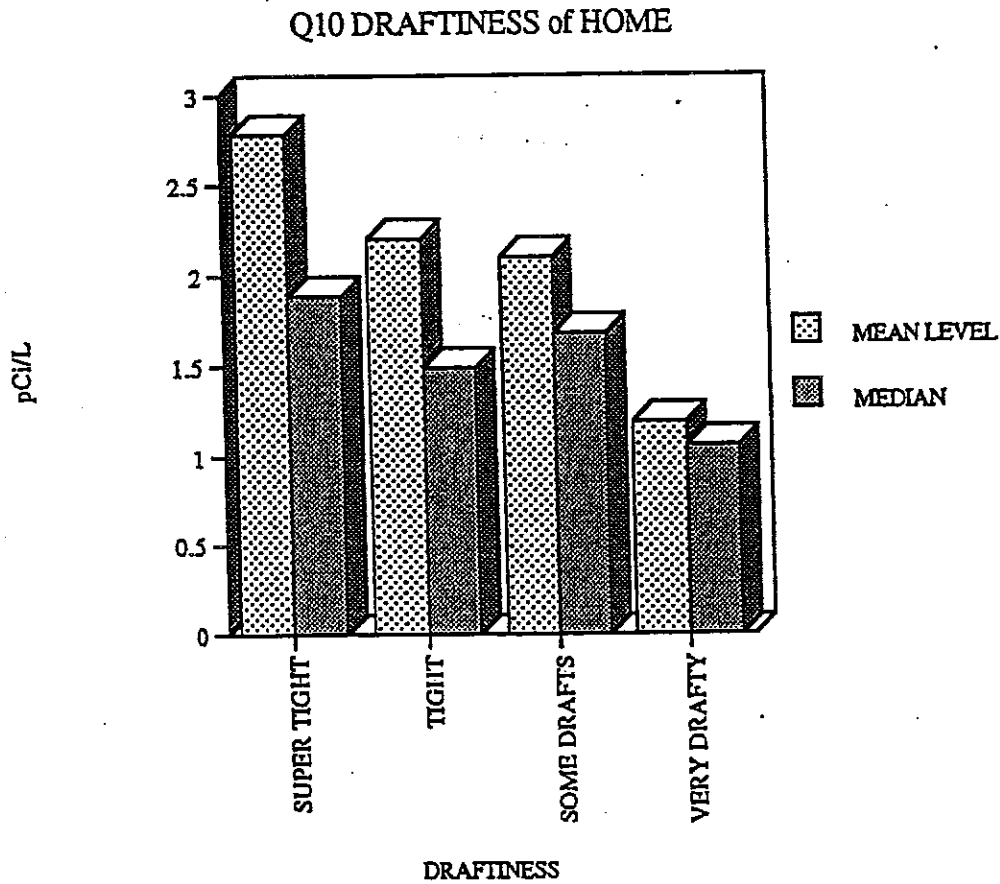
This data didn't suggest to us any significant connections between radon and a wood or coal store in use.



	1	2	3
	STOVE IN USE?	MEAN LEVEL	MEDIAN LEVEL
1	YES	2.24	1.65
2	NO	2.9	1.49

Q10 Draftiness of the House

This data suggests that houses that were the most drafty had lower averages than houses that were not as drafty. In fact, this graph suggests a clear relationship, the draftier the home, the less radon.



Q10 DRAFTINESS of HOME

	1	2	3
	DRAFTINESS	MEAN LEVEL	MEDIAN
1	SUPER TIGHT	2.78	1.89
2	TIGHT	2.2	1.49
3	SOME DRAFTS	2.1	1.68
4	VERY DRAFTY	1.19	1.06