

Windsor Charter Academy

Radon Mitigation for Windsor Colorado

Science Fair - Health and Medicine Sciences

Jenna Brethauer
12/8/2010
6th Grade

Table of Contents

| | |
|---|----|
| Abstract | 3 |
| Investigative Question, Purpose, Hypothesis | 4 |
| Introduction | 5 |
| Experiment | 6 |
| Purpose | 6 |
| Materials | 6 |
| Procedure | 6 |
| Sketches..... | 8 |
| Graphs & Tables..... | 10 |
| Conclusions | 13 |
| Acknowledgements | 14 |
| Bibliography | 15 |

Abstract

Radon Mitigation for Windsor Colorado

The purpose of this project is to determine if Windsor Colorado residents are at high risk of Radon exposure and additionally understand the value to Windsor of creating building ordinance, similar to Fort Collins, requiring radon mitigation be included on all new residential homes. My hypothesis is that Windsor needs a building ordinance for new homes because looking at the regional data Windsor and Fort Collins appear to be in the same radon exposure zone. It is generally accepted that radon mitigation is required for any structure that exceeds the government recommended maximum of Pico curies/liter (4.0 pCi/l). However, other government and environmental agencies are now recommending mitigation for any structure which tests above 2.0 pCi/l. I am going to analyze and compare Windsor and Fort Collins Radon test data to show that Windsor does have enough exposure that it would be a good idea to pass a similar ordinance for Windsor. I will also show that new home mitigation is also necessary because a onetime test result under 4pCi/l may be misleading by proving that large fluctuations over time due to seasonal and home use variables exist. I will also show that the cost of mitigation during new construction is more cost effective than doing it later and is also a better investment in the long run than other building code requirements.

Investigative Question, Purpose, Hypothesis

Based on the data and other research studies, what is the potential impact of Radon to the future health of Windsor residents?

The purpose of this project is to see if Windsor has enough similarity to Fort Collins' unsafe level of radon in homes to pass an ordinance saying that in new homes Windsor should require the installation of radon mitigation.

My hypothesis is that Windsor Colorado should have a new home Radon Mitigation ordinance similar to the one in Fort Collins.

Introduction

I decided to do this project because I am curious to know if the people I know in Windsor are being negatively affected by Radon. Long term exposure to radon kills people by giving them lung cancer and if Windsor had a building code ordinance not so many people would be negatively affected by the long term effects of Radon. When our neighbors across the street did a radon test their house had an unsafe level of radon in it however, when we did a test in our house it tested at a relatively safe level. This really made me curious. What is Radon and how does it get into our homes? Why had our neighbors had an unsafe level in their home while we had a safe level in ours? How much do the tests vary from house to house? Do environmental conditions have an impact on these tests? What are the chances of getting lung cancer if you have long term exposure to Radon? What can be done to prevent or limit this exposure?

With that I decided that I wanted to do a project having something to do with Radon, so my Dad and I started calling people and asking them for advice on how to find out more about Radon and where to get radon testing data for our community. We also asked them if they had any advice regarding ideas for Radon specific science fair projects that I could do. We initially called a couple of Local Radon testing companies as well as someone at the Federal Environmental Protection Agency (EPA). They referred us to a person at the Colorado Department of Environment and Health Services (Chris Kelley). She was very helpful by offering to send us any data that we needed, sending us a box full of Radon Specific Documentation and by recommending that we also speak with a person who works for the city of Fort Collins (Bryan Woodruff) who was responsible for getting an ordinance passed that required all new homes in Fort Collins to have radon mitigation completed during initial construction. After doing this I decided that I wanted to do a project to see if Radon was negatively affecting Windsor enough that we needed a similar ordinance. Once we received the data and other materials, we researched some ways to analyze and present it.

After completing the analysis I do think that Windsor needs a new construction Radon mitigation ordinance because after analyzing the data it was clear that more than half of Windsor residents are exposed to unsafe levels of radon. Not only should Windsor create and adopt a new construction Radon mitigation ordinance, they should also work with state and federal agencies to develop a local Radon

awareness and testing program. This program would highlight the risk factors of radon and promote home testing and mitigation to help those who are being exposed to Radon in existing homes.

Experiment

Purpose

The purpose of this project was to see if the people in Windsor are being negatively affected by long term radon exposure and if so, how do the levels compare to Ft Collins where they have created a new home Radon mitigation ordinance.

Materials

- Computer
- Microsoft Access & Microsoft Excel
- Fort Collins Radon test results data
- Windsor Radon test results data
- Fort Collins ordinance and supporting data
- Radon test kit
- Physicians guide to radon
- A citizens guide to radon
- A consumer's guide to radon reduction
- Building radon out step by step guide

Procedure

First, my Dad and I made phone calls to many different groups requesting information and test result data for Windsor and Fort Collins. Next, I received large amount of printed Radon materials and guides through the mail.

After that, I collected and analyzed lots of test result data for both Windsor and Fort Collins on spreadsheet then I calculated the number of tests in each month and the average of the test results. Then, I created graphs for the average of the test results and the number of tests in each month. These graphs were made to compare Fort Collins's test result data to Windsor's and to also understand what the average test results for Windsor were lower than Fort Collins. I then read through four of the manuals o

learn as much out radon and Radon Mitigation as possible. This also helped me to identify the variables and my control. My control is the Fort Collins test data that was used to support the Radon ordinance. My variables are the Windsor and Fort Collins Radon Test data, Monthly variations in test data, Population growth for Windsor and Smokers vs. non-smokers. Finally I came to some conclusions about my project.

After analyzing Windsor's test result data I came to the conclusion that too many homes (over half) are being negatively affected by Radon (Graph 1). Looking further at the data, the proportion of Radon Test results by band are almost identical (Graph 2). However, when looking at the overall averages for Fort Collins and Windsor, the Windsor average is lower than the Fort Collins average (Graph 3). I needed to understand if this difference was significant and also if it was real or caused by other variables. My theory was that different tests taken during different seasons might be the cause of this difference. The data supported this theory. When I looked at the Radon Test Data by month it was clear that Fort Collins had conducted more tests during the winter while Winsor conducted more during the summer (Graph 4). Also looking at the monthly Radon test results is was clear that tests taken during the summer are generally lower than tests taken during the winter (Graph 5) So Windsor residents would benefit from a radon Mitigation ordinance as well. Because we fall into the same place as Fort Collins on the radon map (Illustration 1), Windsor also has about the same percent of homes with basements as Fort Collins

Sketches

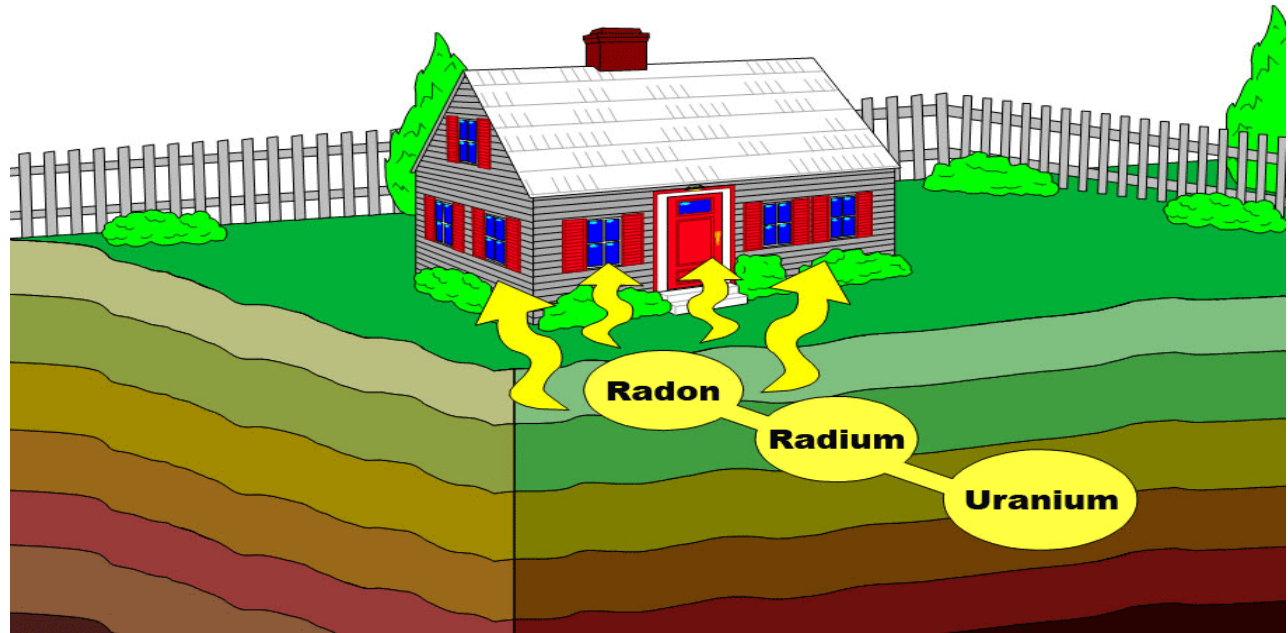


Illustration 1

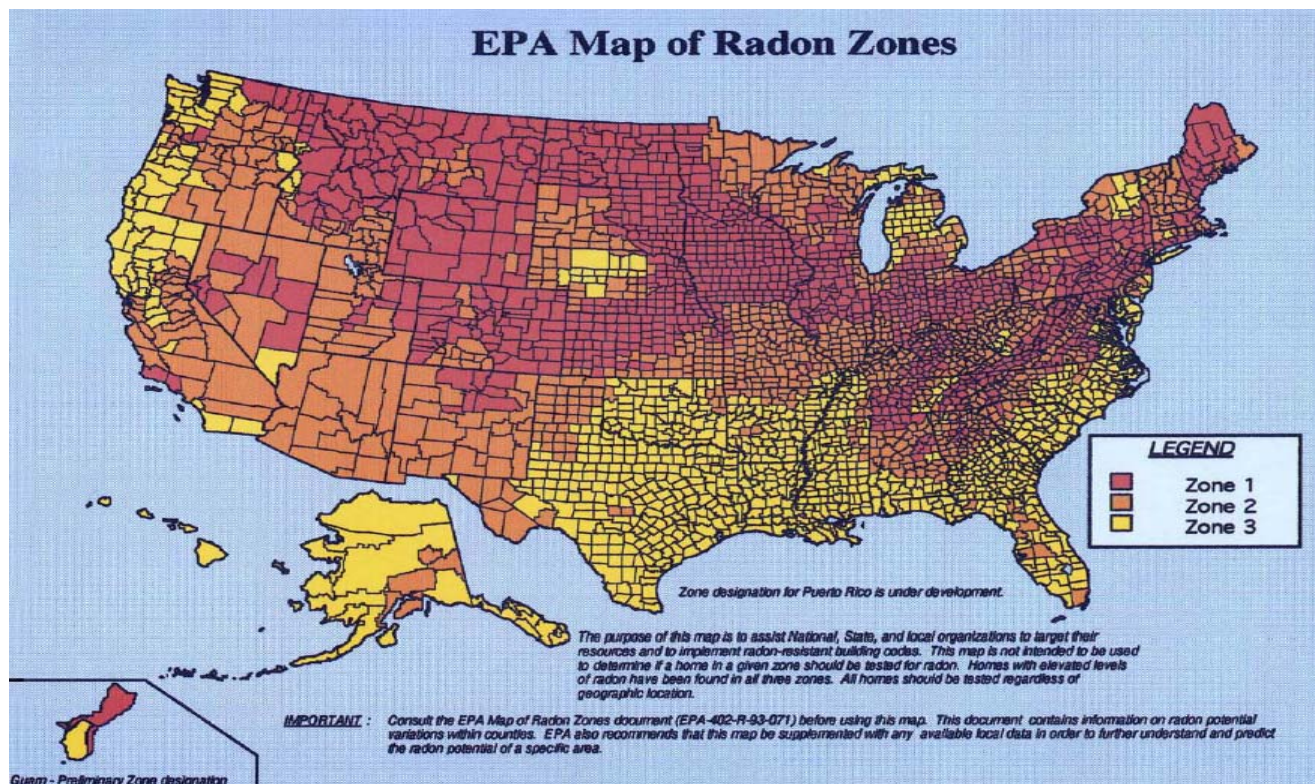


Illustration 2

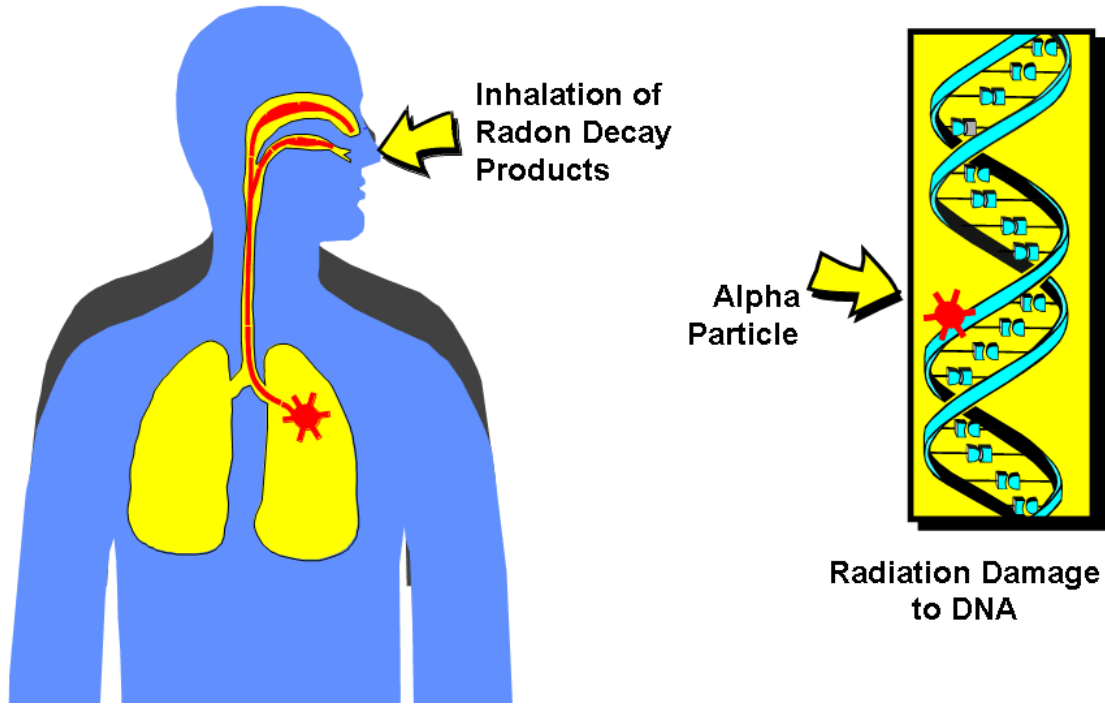


Illustration 3

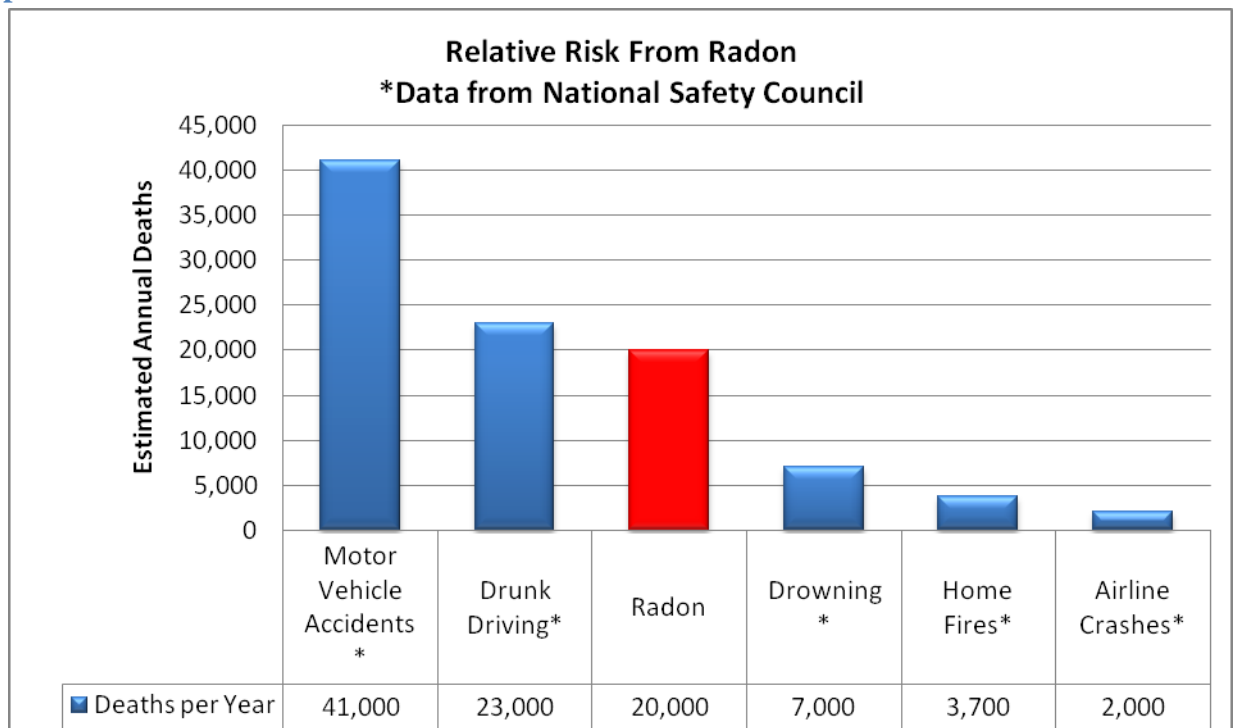
| Radon Level ^a | Lifetime Risk of Lung Cancer Death (per person) from Radon Exposure in Homes ^b | | | |
|--------------------------|---|-------------------|------------------------------|-------------------------|
| | pCi/L | Never Smokers | Current Smokers ^c | General Population |
| 20 | | 36 out of 1,000 | 26 out of 100 | 11 out of 100 |
| 10 | | 18 out of 1,000 | 15 out of 100 | 56 out of 1,000 |
| 8 | | 15 out of 1,000 | 12 out of 100 | 45 out of 1,000 |
| 4 | | 73 out of 10,000 | 62 out of 1,000 | 23 out of 1,000 |
| 2 | | 37 out of 10,000 | 32 out of 1,000 | 12 out of 1,000 |
| 1.25 | | 23 out of 10,000 | 20 out of 1,000 | 73 out of 10,000 |
| 0.4 | | 73 out of 100,000 | 64 out of 10,000 | 23 out of 10,000 |

^a Assumes constant lifetime exposure in homes at these levels.
^b Estimates are subject to uncertainties as discussed in Chapter VIII of the risk assessment.
^c Note: BEIR VI did not specify excess relative risks for current smokers.

Illustration 4

Data

Graphs & Tables

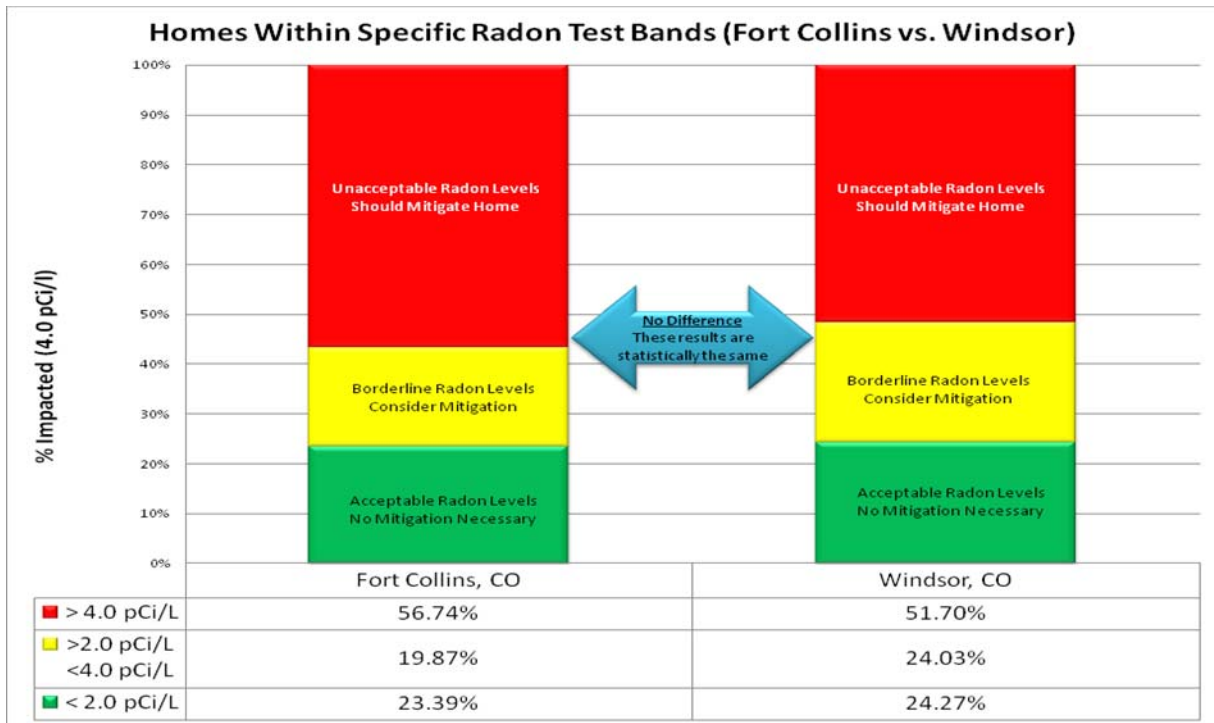


Graph 1

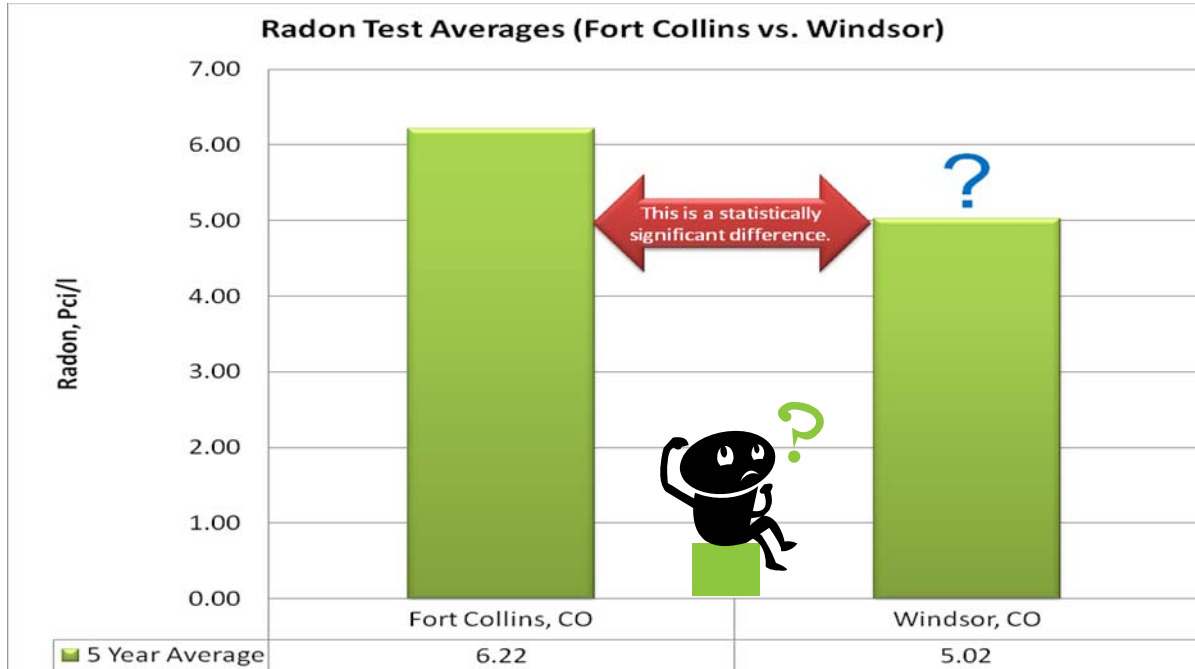
| | Fort Collins | Windsor 2010 | Windsor 2030 |
|-------------------|--------------|--------------|--------------|
| Population | 57000 | 18000 | 37000 |

| Radon Level | Probability of Cancer | Radon Fort Collins % | Radon Windsor % | Fort Collins | Windsor |
|--|-----------------------|----------------------|-----------------|--------------|------------|
| >20 pCi/l | 11.00% | 2.99% | 0.49% | 187.2009 | 9.6350 |
| 10-20 pCi/l | 5.60% | 14.71% | 9.98% | 469.6146 | 100.5547 |
| 8-10 pCi/l | 4.50% | 8.33% | 7.79% | 213.6240 | 63.0657 |
| 4-8 pCi/l | 2.30% | 30.72% | 33.58% | 402.7507 | 139.0073 |
| 2-4 pCi/l | 1.20% | 19.88% | 24.09% | 135.9670 | 52.0292 |
| 1.3-2 pCi/l | 0.73% | 8.45% | 9.25% | 35.1450 | 12.1489 |
| 0.4-1.3 pCi/l | 0.23% | 11.29% | 12.17% | 14.8070 | 5.0365 |
| < 0.4 pCi/l | 0.10% | 3.63% | 2.68% | 2.0713 | 0.4818 |
| Potential Total Lung Cancer Cases | | | | 1461 | 382 |

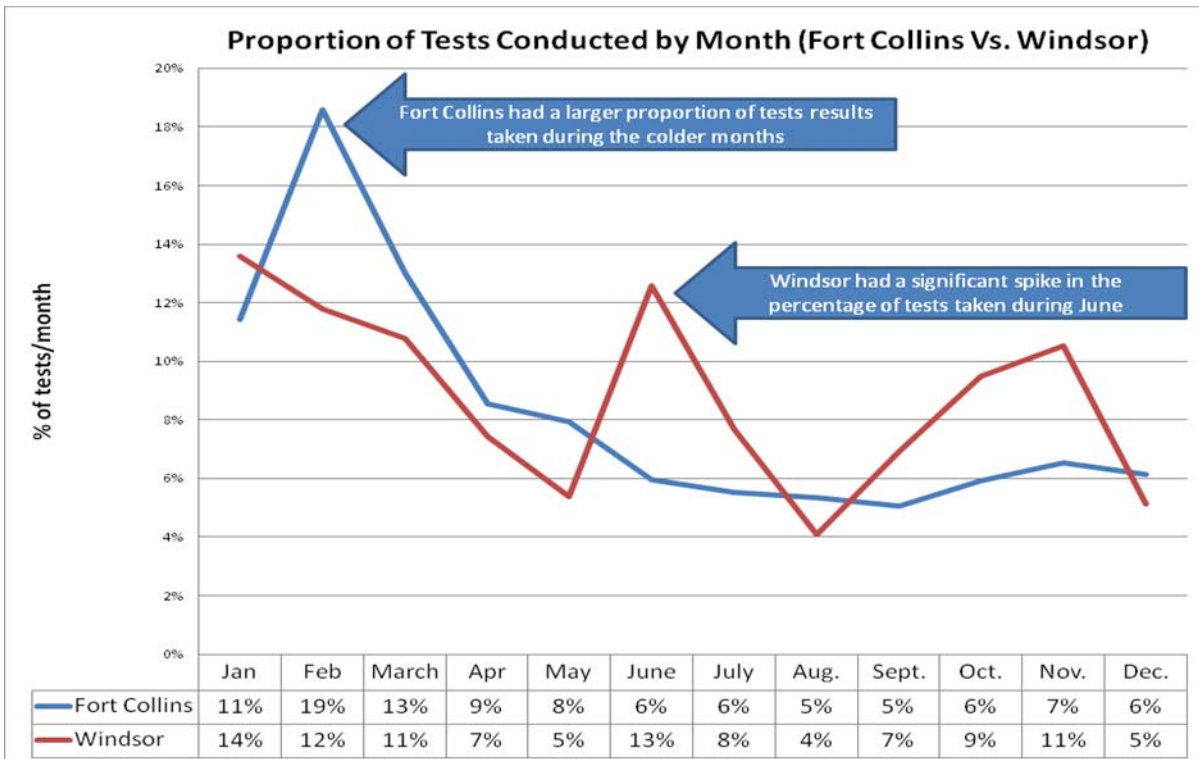
| | |
|----------------------------|-------------|
| Total cancer cases | 382 |
| Avoided Cancer | 180 |
| new homes | 19000 |
| cost per home | \$522 |
| Total cost | \$9,918,000 |
| Cost per life saved | \$55,247.08 |



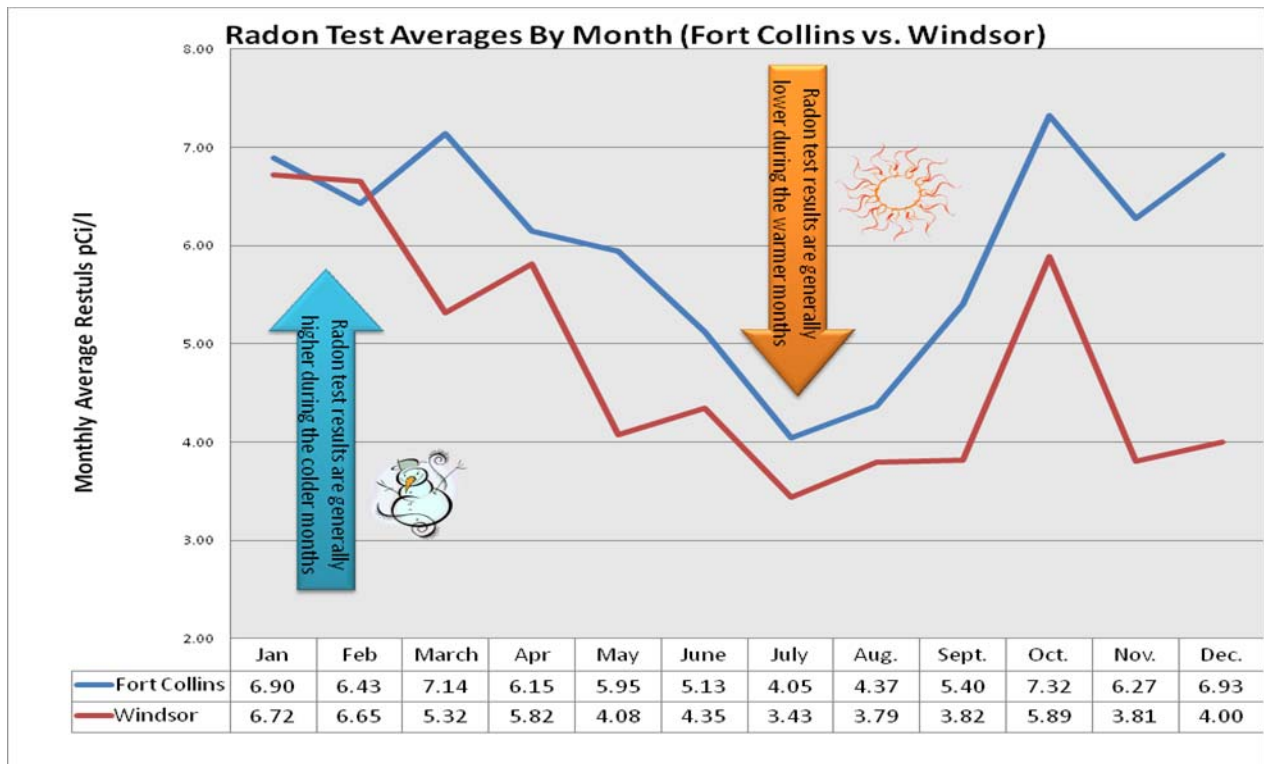
Graph 2



Graph 3



Graph 4



Graph 5

Conclusions

The impact of Radon over a life time is quite large so many people will die from lung cancer caused by Radon. Radon is third on the list of big killers after car accidents and drunk driving. An estimated number of people dead from radon in a life time would be around 382 people with the current population (Illustration 4).

According to my calculations if no mitigation is done at all, the impact over a lifetime of Radon exposure would be approximately 382 lives lost to lung cancer from Windsor. If mitigation equipment were installed in all new homes starting now I would estimate that it would save 180 lives. This is calculated using future population and new home estimates as well as the figure that estimates that new home Radon Mitigation would decrease lung cancer cases by up to 47%. There is also a cost to new home mitigation. The costs for installing Radon mitigation equipment in new homes would add approximately \$600 to new home construction (vs. up to \$2500 to do it after the house is built). This cost would add up to \$9,918,000.00 in additional construction costs over the next 20 years. That sounds like a lot but that translates to a cost of \$55,247.00 per life saved. In my opinion this is a good value. Therefore, I come to the conclusion that it would be highly beneficial to Windsor and its residents if an ordinance requiring new home Radon Mitigation was passed. My idea for the future is to go into more detail about the cost per life saved and compare that to other public dangers such as lead based paint, car accidents, drowning, etc.

Acknowledgements

I would like to thank my Dad. He was a wonderful help to me throughout the whole project, I would also like to thank Christen Kelly who sent tons of information and data for my project, Bryan Woodruff the Radon expert was of great help in my search to find Radon test data and Cheryl Judson who helped me understand how to analyze the data. Thank you all for your assistance.

Bibliography

Chen, Paulina. *Building Radon Out: a Step-by-step Guide on How to Build Radon-resistant Homes.* [Washington, D.C.]: U.S. Environmental Protection Agency, Indoor Environments Division, Office of Air and Radiation, 2001. Print

EPA. "A Citizen's Guide to Radon | Radon | US EPA." *US Environmental Protection Agency.* Web. 09 Dec. 2010. <<http://www.epa.gov/radon/pubs/citguide.html>>

EPA. "A Physician's Guide | Radon | US EPA." *US Environmental Protection Agency.* Web. 09 Dec. 2010. <<http://www.epa.gov/radon/pubs/physic.html>>.

National Environmental Health Association. *PowerPoint*

Christine Kelly. Colorado Department of Environment and Health

1555 N 17th Ave Greeley, CO 80631-9117

(303)692-3442

Bryan Woodruff. City of Fort Collins – Department of Natural Resources, Air quality

<http://www.fcgov.com/visitor/fcfacts.php>

<http://www.fcgov.com/airquality/radon.php>

215 N Mason St, Fort Collins, CO 80524

970224-5443

Extra information about Radon

Radon is a life threatening gas that comes up through people's basements (Illustration 1). Radon comes from uranium and radium in soils and well water it can be found all over the United States (Illustration 2). The uranium breaks down the radium therefore turning it into radon there is virtually no way to sense radon's presence it is colorless tasteless and no smell.

If your house is at a high enough level of radon you could get lung cancer, lung cancer is very harmful and many people die from it each year. (Illustration 3)

These high levels of radon can be prevented from happening with radon mitigation. With new technology there are many different ways to rid your home of radon. Such as, installing a sub slab in your basement, this is a vacuum that pipes radon to a safe location, you can use mechanical barriers, this is plastic sheeting and sealing to stop radon from entering your home, reducing the stack effect, this is sealing and caulking to remove negative pressure in your homes base, and installing air distribution systems, this is sealing air ducts in places like crawl spaces and basements. It is much less expensive to install Radon Mitigation equipment during house construction that it is to do it later.

Some people in Fort Collins decided that too many people are being affected by Radon, so they collected the data and statistics and passed an ordinance requiring Radon mitigation for all new homes. I want to know if Windsor needs the same type of ordinance.