United States Environmental Protection Agency | U.S. Department Of Health and Human Services | U.S. Public Health Service

Indoor Air And Radiation (6609J) | 402-K-02-006 | Revised May 2002

http://www.epa.gov/iaq/radon/pubs/citguide.html

A Citizen's Guide To Radon (Fourth Edition)

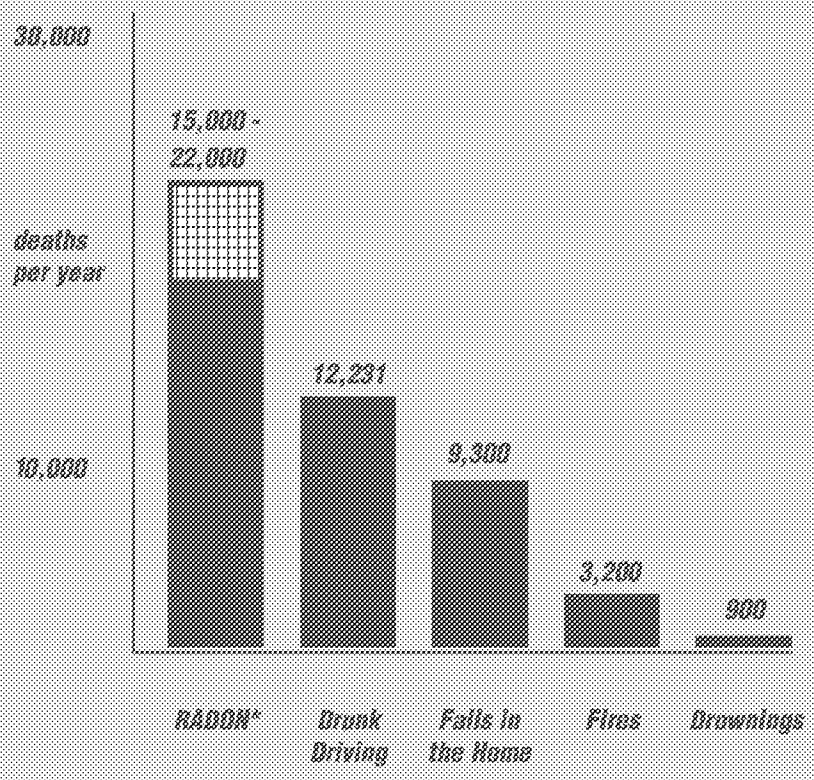
The Guide To Protecting Yourself And Your Family From Radon

Printed on Recycled Paper

EPA Recommends:

- ***Test your home for radon–it's easy and inexpensive.***
- ***Fix your home if your radon level is 4 picocuries per liter (pCi/L) or higher.***
- ***Radon levels less than 4 pCi/L still pose a risk, and in many cases may be reduced.***

Radon is estimated to cause thousands of cancer deaths in the U.S. each year.



* Radon is estimated to cause between 15,000 and 22,000 lung cancer deaths per year, according to the National Academy of Sciences 1998 data. The numbers of deaths from other causes are taken from 2001 National Safety Council reports.

Radon is a cancer-causing, radioactive gas.

You can't see radon. And you can't smell it or taste it. But it may be a problem in your home.

Radon is estimated to cause many thousands of deaths each year. That's because when you breathe air containing radon, you can get lung cancer. In fact, the Surgeon General has warned that radon is the second leading cause of lung cancer in the United States today. Only smoking causes more lung cancer deaths. **If you smoke and your home has high radon levels, your risk of lung cancer is especially high.**

Radon can be found all over the U.S.

Radon comes from the natural (radioactive) breakdown of uranium in soil, rock and water and gets into the air you breathe. Radon can be found all over the U.S. It can get into any type of building – homes, offices, and schools – and result in a high indoor radon level. But you and your family are most likely to get your greatest exposure at home. That's where you spend most of your time.

You should test for radon.

Testing is the only way to know if you and your family are at risk from radon. EPA and the Surgeon General recommend testing all homes below the third floor for radon. EPA also recommends testing in schools.

Testing is inexpensive and easy – it should only take a few minutes of your time. Millions of Americans have already tested their homes for radon (see page 5).

You can fix a radon problem.

There are simple ways to fix a radon problem that aren't too costly. Even very high levels can be reduced to acceptable levels.

New homes can be built with radon-resistant features.

Radon-resistant construction techniques can be effective in preventing radon entry. When installed properly and completely, these simple and inexpensive techniques can help reduce indoor radon levels in homes. In addition, installing them at the time of construction makes it easier and less expensive to reduce radon levels further if these passive techniques don't reduce radon levels to below 4pCi/L. Every new home should be tested after occupancy, even if it was built radon-resistant.

HOW DOES RADON GET INTO YOUR HOME?

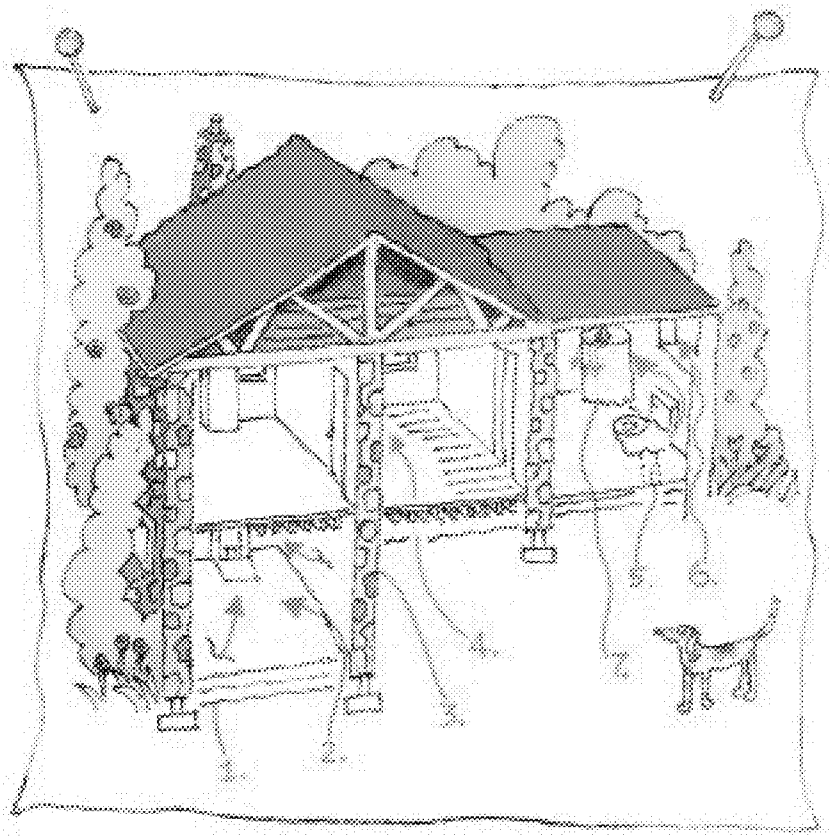
Any home may have a radon problem.

Radon is a radioactive gas. It comes from the natural decay of uranium that is found in nearly all soils. It typically moves up through the ground to the air above and into your home through cracks and other holes in the foundation. Your home traps radon inside, where it can build up. Any home may have a radon problem. This means new and old homes, well-sealed and drafty homes, and homes with or without basements.

Radon from soil gas is the main cause of radon problems. Sometimes radon enters the home through well water (see page 8). In a small number of homes, the building materials can give off radon, too. However, building materials rarely cause radon problems by themselves.

RADON GETS IN THROUGH:

1. *Cracks in solid floors.*
2. *Construction joints.*
3. *Cracks in walls.*
4. *Gaps in suspended floors.*
5. *Gaps around service pipes.*
6. *Cavities inside walls.*
7. *The water supply.*



Nearly 1 out of every 15 homes in the U.S. is estimated to have elevated radon levels. Elevated levels of radon gas have been found in homes in your state. Contact your state radon office (see back cover) for general information about radon in your area. While radon problems may be more common in some areas, any home may have a problem. The only way to know about your home is to test.

Radon can also be a problem in schools and workplaces. Ask your state radon office (see back cover) about radon problems in schools, daycare and childcare facilities, and workplaces in your area.

HOW TO TEST YOUR HOME

You can't see radon, but it's not hard to find out if you have a radon problem in your home. All you need to do is test for radon. Testing is easy and should only take a few minutes of your time.

The amount of radon in the air is measured in "picocuries per liter of air," or "pCi/L." Sometimes test results are expressed in Working Levels (WL) rather than picocuries per liter (pCi/L) (see page 6). There are many kinds of low-cost "do it yourself" radon test kits you can get through the mail and in some hardware stores and other retail outlets. If you prefer, or if you are buying or selling a home, you can hire a qualified tester to do the testing for you. You should first contact your state radon office about obtaining a list of qualified testers. You can also contact a private radon proficiency program for lists of privately certified radon professionals serving your area. For links and more information, visit *http://www.epa.gov/iaq/radon/proficiency.html.*

There are Two General Ways to Test for Radon:

Testing is easy and should only take a few minutes of your time.

SHORT-TERM TESTING:

The quickest way to test is with short-term tests. Short-term tests remain in your home for two days to 90 days, depending on the device. "Charcoal canisters," "alpha track," "electret ion chamber," "continuous monitors," and "charcoal liquid scintillation" detectors are most commonly used for short-term testing. Because radon levels tend to vary from day to day and season to season, a short-term test is less likely than a long-term test to tell you your year-round average radon level. If you need results quickly, however, a short-term test followed by a second short-term test may be used to decide whether to fix your home. (see also page 7 under Home Sales)

LONG-TERM TESTING:

Long-term tests remain in your home for more than 90 days. "Alpha track" and "electret" detectors are commonly used for this type of testing. A long-term test will give you a reading that is more likely to tell you your home's year-round average radon level than a short-term test.

How To Use a Test Kit:

Follow the instructions that come with your test kit. If you are doing a short-term test, close your windows and outside doors and keep them closed as much as possible during the test. Heating and air conditioning system fans that re-circulate air may be operated. Do not operate fans or other machines which bring in air from outside. Fans that are part of a radon-reduction system or small exhaust fans operating only for short periods of time may run during the test. If you are doing a short-term test lasting just 2 or 3 days, be sure to close your windows and outside doors at least 12 hours **before** beginning the test, too. You should not conduct

short-term tests lasting just 2 or 3 days during unusually severe storms or periods of unusually high winds. The test kit should be placed in the lowest lived-in level of the home (for example, the basement if it is frequently used, otherwise the first floor). It should be put in a room that is used regularly (like a living room, playroom, den, or bedroom) but **not** your kitchen or bathroom. Place the kit at least 20 inches above the floor in a location where it won't be disturbed—away from drafts, high heat, high humidity, and exterior walls. Leave the kit in place for as long as the package says. Once you've finished the test, reseal the package and send it to the lab specified on the package right away for analysis. You should receive your test results within a few weeks.

EPA Recommends the Following Testing Steps:

Step 1. ***Take a short-term test. If your result is 4 pCi/L or higher*, take a follow-up test (Step 2) to be sure.***

Step 2. ***Follow up with either a long-term test or a second short-term test:***

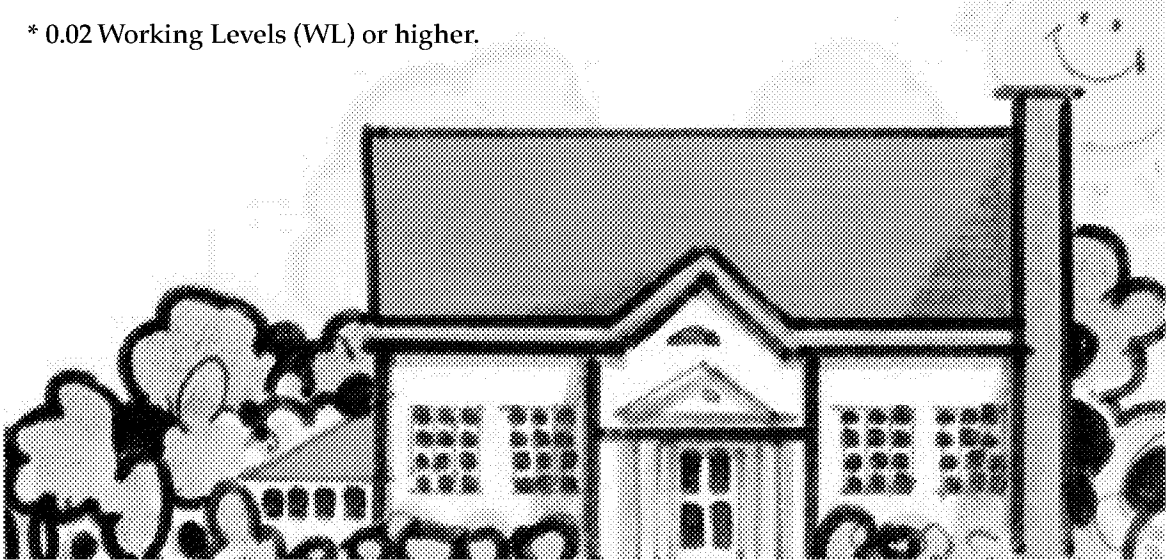
- ***For a better understanding of your year-round average radon level, take a long-term test.***
- ***If you need results quickly, take a second short-term test.***

The higher your initial short-term test result, the more certain you can be that you should take a short-term rather than a long-term follow up test. If your first short-term test result is more than twice EPA's 4pCi/L action level, you should take a second short-term test immediately.

Step 3.

- ***If you followed up with a long-term test: Fix your home if your long-term test result is 4 pCi/L or more*.***
- ***If you followed up with a second short-term test: The higher your short-term results, the more certain you can be that you should fix your home. Consider fixing your home if the average of your first and second test is 4 pCi/L or higher*. (see also page 7 under Home Sales)***

* 0.02 Working Levels (WL) or higher.



WHAT YOUR TEST RESULTS MEAN

The average indoor radon level is estimated to be about 1.3 pCi/L, and about 0.4 pCi/L of radon is normally found in the outside air. The U.S. Congress has set a long-term goal that indoor radon levels be no more than outdoor levels. While this goal is not yet technologically achievable in all cases, most homes today *can* be reduced to 2 pCi/L or below.

Sometimes short-term tests are less definitive about whether or not your home is above 4 pCi/L. This can happen when your results are close to 4 pCi/L. For example, if the average of your two short-term test results is 4.1 pCi/L, there is about a 50% chance that your year-round average is somewhat below 4 pCi/L. However, EPA believes that any radon exposure carries some risk—no level of radon is safe. Even radon levels below 4 pCi/L pose some risk, and you can reduce your risk of lung cancer by lowering your radon level.

If your living patterns change and you begin occupying a lower level of your home (such as a basement) you should retest your home on that level.

Even if your test result is below 4 pCi/L, you may want to test again sometime in the future.

Test your home now and save your results. If you find high radon levels, fix your home before you decide to sell it.

RADON AND HOME SALES

More and more, home buyers and renters are asking about radon levels before they buy or rent a home. Because real estate sales happen quickly, there is often little time to deal with radon and other issues. The best thing to do is to test for radon NOW and save the results in case the buyer is interested in them. Fix a problem if it exists so it won't complicate your home sale. If you are planning to move, call your state radon office (see back page) for EPA's pamphlet "Home Buyer's and Seller's Guide to Radon," which addresses some common questions (http://www.epa.gov/iaq/radon/pubs/realestate.html). You can also use the results of two short-term tests done side-by-side (four inches apart) to decide whether to fix your home.

During home sales:

- *Buyers often ask if a home has been tested, and if elevated levels were reduced.*
- *Buyers frequently want tests made by someone who is not involved in the home sale. Your state radon office (see back cover) can assist you in identifying a qualified tester.*
- *Buyers might want to know the radon levels in areas of the home (like a basement they plan to finish) that the seller might not otherwise test.*

Today many homes are built to help prevent radon from coming in. Your state or local area may require these radon-resistant construction features. Radon-resistant construction features usually keep radon levels in new homes below 2 pCi/L. If you are buying or renting a new home, ask the owner or builder if it has radon-resistant features. The EPA recommends building new homes with radon-resistant features in high radon potential (Zone 1) areas. For more information, refer to the EPA's Map of Radon Zones and other useful EPA documents on radon-resistant new construction (see back cover), or visit http://www.epa.gov/iaq/radon. Even if built radon-resistant, every new home should be tested for radon after occupancy. If you have a test result of 4pCi/L or more, you can have a qualified mitigator easily add a vent fan to an existing passive system for about $300 and further reduce the radon level in your home.

RADON IN WATER

The radon in your home's indoor air can come from two sources, the soil or your water supply. Compared to radon entering the home through water, radon entering your home through the soil is usually a much larger risk.

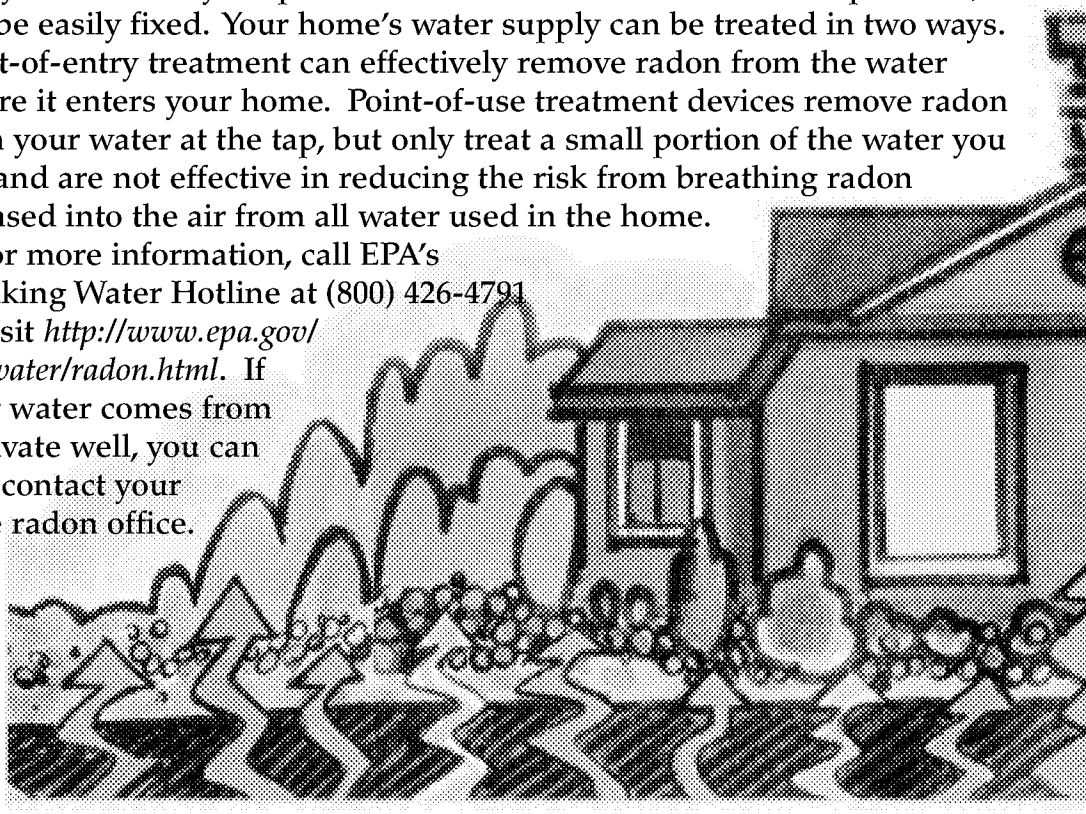
The radon in your water supply poses an inhalation risk and an ingestion risk. Research has shown that your risk of lung cancer from breathing radon in air is much larger than your risk of stomach cancer from swallowing water with radon in it. Most of your risk from radon in water comes from radon released into the air when water is used for showering and other household purposes.

If you've tested the air in your home and found a radon problem, and your water comes from a well, have your water tested.

Radon in your home's water is not usually a problem when its source is surface water. A radon in water problem is more likely when its source is ground water, e.g. a private well or a public water supply system that uses ground water. Some public water systems treat their water to reduce radon levels before it is delivered to your home. If you are concerned that radon may be entering your home through the water and your water comes from a public water supply, contact your water supplier.

If you've tested your private well and have a radon in water problem, it can be easily fixed. Your home's water supply can be treated in two ways. Point-of-entry treatment can effectively remove radon from the water before it enters your home. Point-of-use treatment devices remove radon from your water at the tap, but only treat a small portion of the water you use and are not effective in reducing the risk from breathing radon released into the air from all water used in the home.

For more information, call EPA's Drinking Water Hotline at (800) 426-4791 or visit *http://www.epa.gov/safewater/radon.html*. If your water comes from a private well, you can also contact your state radon office.



HOW TO LOWER THE RADON LEVEL IN YOUR HOME

Since there is no known safe level of radon, there can always be some risk. But the risk can be reduced by lowering the radon level in your home.

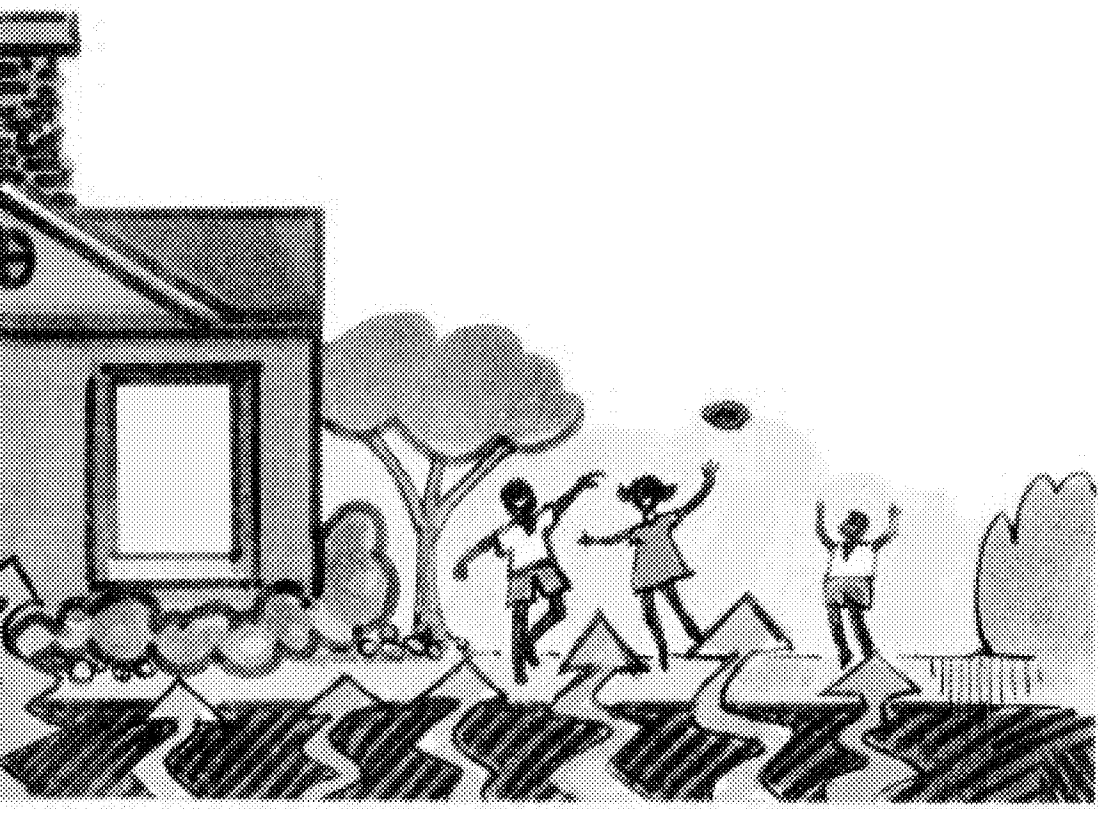
A variety of methods are used to reduce radon in your home. In some cases, sealing cracks in floors and walls may help to reduce radon. In other cases, simple systems using pipes and fans may be used to reduce radon. Such systems, known as soil suction, do not require major changes to your home. These systems remove radon gas from below the concrete floor and the foundation before it can enter the home. Similar systems can also be installed in houses with crawl spaces. Radon contractors use other methods that may also work in your home. The right system depends on the design of your home and other factors.

Ways to reduce radon in your home are discussed in EPA's "Consumer's Guide to Radon Reduction." You can get a copy from your state radon office, or view it online at *www.epa.gov/iaq/radon/pubs/index.html.*

The cost of making repairs to reduce radon depends on how your home was built and the extent of the radon problem. Most homes can be fixed for about the same cost as other common home repairs like painting or having a new hot water heater installed. The average house costs about $1,200 for a contractor to fix, although this can range from about $800 to about $2,500. The cost is much less if a passive system was installed during construction.

RADON AND HOME RENOVATIONS

If you are planning any major structural renovation, such as converting an unfinished basement area into living space, it is especially important to test the area for radon before you begin the renovation. If your test results indicate a radon problem, radon-resistant techniques can be inexpensively included as part of the renovation. Because major renovations can change the level of radon in any home, always test again after work is completed.



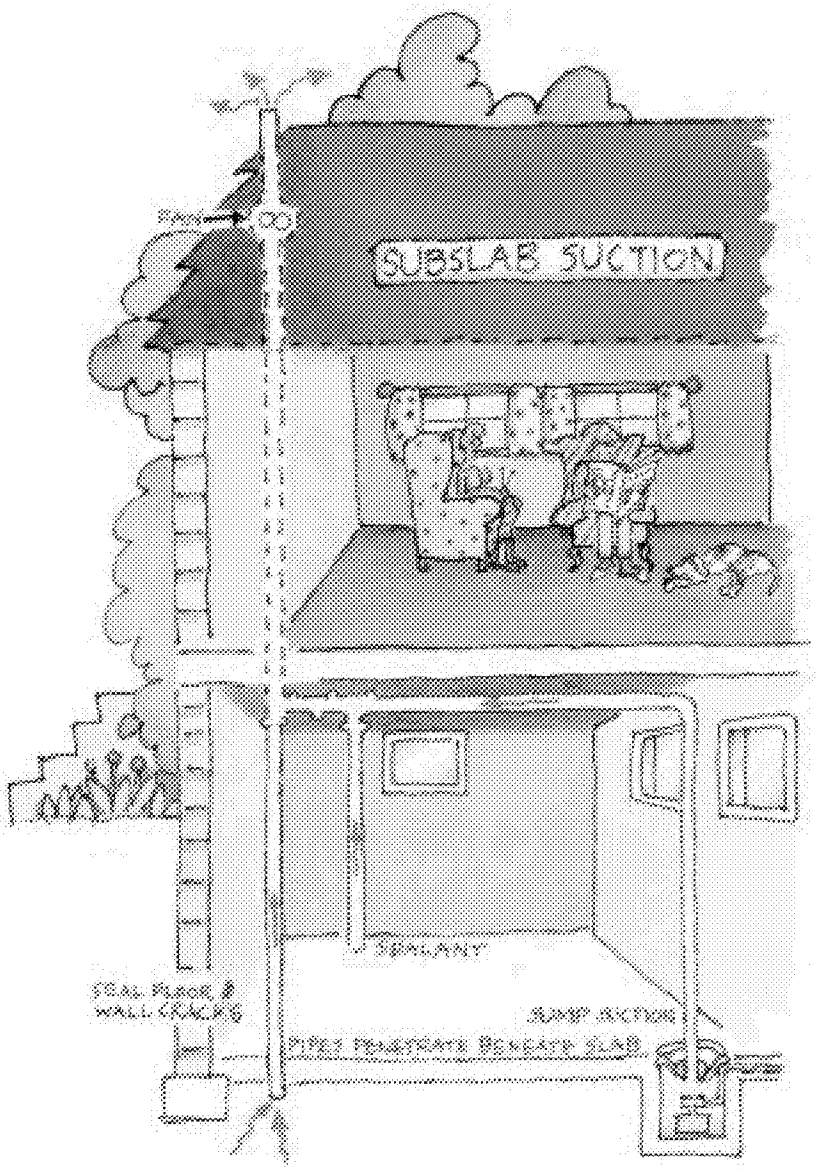
Lowering high radon levels requires technical knowledge and special skills. You should use a contractor who is trained to fix radon problems. A qualified contractor can study the radon problem in your home and help you pick the right treatment method.

Check with your state radon office for names of qualified or state certified radon contractors in your area. You can also contact private radon proficiency programs for lists of privately certified radon professionals in your area. For more information on private radon proficiency programs, visit *http://www.epa.gov/iaq/radon/proficiency.html*. Picking someone to fix your radon problem is much like choosing a contractor for other home repairs – you may want to get references and more than one estimate.

Most homes can be fixed for about the same cost as other common home repairs.

If you are considering fixing your home's radon problem yourself, you should first contact your state radon office for guidance and assistance.

You should also test your home again after it is fixed to be sure that radon levels have been reduced. Most soil suction radon reduction systems include a monitor that will indicate whether the system is operating properly. In addition, it's a good idea to retest your home every two years to be sure radon levels remain low.



Note: This diagram is a composite view of several mitigation options. The typical mitigation system usually has only one pipe penetration through the basement floor; the pipe may also be installed on the outside of the house.

THE RISK OF LIVING WITH RADON

Radon gas decays into radioactive particles that can get trapped in your lungs when you breathe. As they break down further, these particles release small bursts of energy. This can damage lung tissue and lead to lung cancer over the course of your lifetime. Not everyone exposed to elevated levels of radon will develop lung cancer. And the amount of time between exposure and the onset of the disease may be many years.

Like other environmental pollutants, there is some uncertainty about the magnitude of radon health risks. However, we know more about radon risks than risks from most other cancer-causing substances. This is because estimates of radon risks are based on studies of cancer in humans (underground miners).

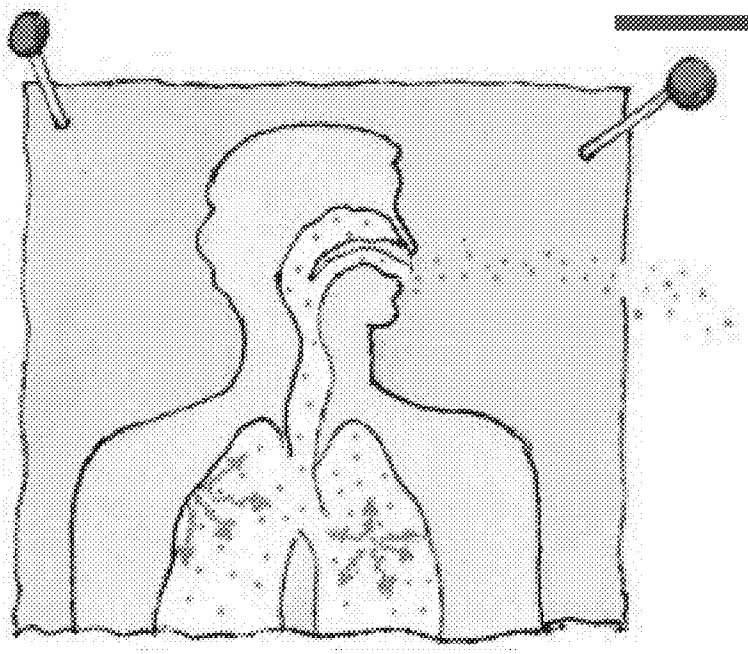
Smoking combined with radon is an especially serious health risk. Stop smoking and lower your radon level to reduce your lung cancer risk.

Children have been reported to have greater risk than adults of certain types of cancer from radiation, but there are currently no conclusive data on whether children are at greater risk than adults from radon.

Scientists are more certain about radon risks than risks from most other cancer-causing substances.

Your chances of getting lung cancer from radon depend mostly on:

- ***How much radon is in your home***
- ***The amount of time you spend in your home***
- ***Whether you are a smoker or have ever smoked***



It's never too late to reduce your risk of lung cancer. Don't wait to test and fix a radon problem. If you are a smoker, stop smoking.

RADON RISK IF YOU SMOKE

Radon Level	If 1,000 people who smoked were exposed to this level over a lifetime. . .	The risk of cancer from radon exposure compares to. . .	WHAT TO DO: Stop Smoking and. . .
20 pCi/L	About 135 people could get lung cancer	◂ 100 times the risk of drowning	Fix your home
10 pCi/L	About 71 people could get lung cancer	◂ 100 times the risk of dying in a home fire	Fix your home
8 pCi/L	About 57 people could get lung cancer		Fix your home
4 pCi/L	About 29 people could get lung cancer	◂ 100 times the risk of dying in an airplane crash	Fix your home
2 pCi/L	About 15 people could get lung cancer	◂ 2 times the risk of dying in a car crash	Consider fixing between 2 and 4 pCi/L
1.3 pCi/L	About 9 people could get lung cancer	(Average indoor radon level)	(Reducing radon levels below 2 pCi/L is difficult)
0.4 pCi/L	About 3 people could get lung cancer	(Average outdoor radon level)	

Note: If you are a former smoker, your risk may be lower.

RADON RISK IF YOU'VE NEVER SMOKED

Radon Level	If 1,000 people who never smoked were exposed to this level over a lifetime. . .	The risk of cancer from radon exposure compares to. . .	WHAT TO DO:
20 pCi/L	About 8 people could get lung cancer	◂ The risk of being killed in a violent crime	Fix your home
10 pCi/L	About 4 people could get lung cancer		Fix your home
8 pCi/L	About 3 people could get lung cancer	◂ 10 times the risk of dying in an airplane crash	Fix your home
4 pCi/L	About 2 people could get lung cancer	◂ The risk of drowning	Fix your home
2 pCi/L	About 1 people could get lung cancer	◂ The risk of dying in a home fire	Consider fixing between 2 and 4 pCi/L
1.3 pCi/L	Less than 1 person could get lung	(Average indoor radon level)	(Reducing radon levels below 2 pCi/L is difficult)
0.4 pCi/L		(Average outdoor radon level)	

Note: If you are a former smoker, your risk may be higher. Also, based on information from the National Academy of Sciences 1998 report, *The Health Effects of Exposure to Radon*, your radon risk may be higher than shown, even if you have never smoked.

RADON MYTHS

MYTH: Scientists aren't sure radon really is a problem.	***FACT: Although some scientists dispute the precise number of deaths due to radon, all major health organizations (like the Centers for Disease Control, the American Lung Association and the American Medical Association) agree with estimates that radon causes thousands of preventable lung cancer deaths every year. This is especially true among smokers, since the risk to smokers is much greater than to non-smokers.***
MYTH: Radon testing is difficult, time consuming and expensive.	***FACT: Radon testing is easy. You can test your home yourself or hire a qualified radon test company. Either approach takes only a small amount of time and effort.***
MYTH: Radon test kits are not reliable and are difficult to find.	***FACT: Reliable test kits are available from qualified radon testers and companies. Reliable testing devices are also available by phone or mail-order, and can be purchased in hardware stores and other retail outlets. Call your state radon office (see back cover) for help in identifying radon testing companies.***
MYTH: Homes with radon problems can't be fixed.	***FACT: There are simple solutions to radon problems in homes. Hundreds of thousands of homeowners have already fixed radon problems in their homes. Radon levels can be readily lowered for about $800 to $2,500. Call your state radon office (see back cover) for help in identifying qualified mitigation contractors.***
MYTH: Radon only affects certain kinds of homes.	***FACT: House construction can affect radon levels. However, radon can be a problem in homes of all types: old homes, new homes, drafty homes, insulated homes, homes with basements, homes without basements. Local geology, construction materials, and how the home was built are among the factors that can affect radon levels in homes.***

MYTH: Radon is only a problem in certain parts of the country.	***FACT: High radon levels have been found in every state. Radon problems do vary from area to area, but the only way to know your radon level is to test.***
MYTH: A neighbor's test result is a good indication of whether your home has a problem.	***FACT: It's not. Radon levels can vary greatly from home to home. The only way to know if your home has a radon problem is to test it.***
MYTH: Everyone should test their water for radon.	***FACT: Although radon gets into some homes through water, it is important to first test the air in the home for radon. If your water comes from a public water system that uses ground water, call your water supplier. If high radon levels are found and the home has a private well, call the Safe Drinking Water Hotline at (800) 426-4791 for information on testing your water.***
MYTH: It's difficult to sell homes where radon problems have been discovered.	***FACT: Where radon problems have been fixed, home sales have not been blocked or frustrated. The added protection is some times a good selling point.***
MYTH: I've lived in my home for so long, it doesn't make sense to take action now.	***FACT: You will reduce your risk of lung cancer when you reduce radon levels, even if you've lived with a radon problem for a long time.***
MYTH: Short-term tests can't be used for making a decision about whether to fix your home.	***FACT: A short-term test followed by a second short-term test* can be used to decide whether to fix your home. However, the closer the average of your two short-term tests is to 4 pCi/L, the less certain you can be about whether your year-round average is above or below that level. Keep in mind that radon levels below 4 pCi/L still pose some risk. Radon levels can be reduced in most homes to 2 pCi/L or below.*** **If the radon test is part of a real estate transaction, the result of two short-term tests can be used in deciding whether to mitigate. For more information, see EPA's Home Buyer's and Seller's Guide to Radon.*

FOR FURTHER INFORMATION

EPA Radon Website

http://www.epa.gov/iaq/radon/
EPA's main radon page. Includes links to publications, hotlines, private proficiency programs and more.

Hotlines

1-800-SOS-RADON (767-7236)
Operated by the National Safety Council in partnership with EPA. Order radon test kits by phone.

1-800-55RADON (557-2366)
Operated by the National Safety Council in partnership with EPA. For live help with your radon questions.

1-800-725-8312
Spanish language hotline, operated by the National Alliance for Hispanic Health in partnership with EPA. For general help with radon, testing, and mitigation questions, and free test kits.

1-800-438-4318
Indoor Air Quality Information Clearinghouse, operated by an EPA contractor. For general radon and indoor air quality information and copies of EPA publications.

1-800-426-4791
Safe Drinking Water Hotline, privately operated under contract to EPA. For general information on drinking water, radon in water, testing and treament, and radon drinking water standards.

1-800-644-6999
Radon Fix-It Hotline, privately operated by the Consumer Federation of America Foundation (CFAF) in partnership with EPA. For general information on how to mitigate your home.

EPA Regional Offices

http://www.epa.gov/iaq/regionia.html
Check the above website for a listing of your EPA regional office.

EPA Publications

Sample list of some of the publications available through the above sources:

Home Buyer's and Seller's Guide to Radon

Consumer's Guide to Radon Reduction

Radon Guide for Tenants

Application of Radon Reduction Techniques for Detached Houses

EPA Map of Radon Zones and Fact Sheet

Buying a New Home? How to Protect Your Family From Radon

Building a New Home, Have You Considered Radon?

Building Radon Out: A Step-By-Step Guide on How To Build Radon-Resistant Homes

[1]U.S. GOVERNMENT PRINTING OFFICE: 1995–620-596

National Academy of Sciences Report on Radon

In February 1998, the National Academy of Sciences (NAS) released its report on radon and lung cancer, *The Health Effects of Exposure to Indoor Radon* (the BEIR VI report). The NAS is an independent, non-governmental, scientific organization. The NAS estimates that radon causes between 15,000 and 22,000 lung cancer deaths each year in the United States and that 12 percent of all lung cancer deaths are linked to radon. The BEIR VI Committee (Biological Effects of Ionizing Radiation) concluded that after smoking, radon is the second leading cause of death due to lung cancer in the United States.

Surgeon General Health Advisory

"Indoor radon gas is a national health problem. Radon causes thousands of deaths each year. Millions of homes have elevated radon levels. Homes should be tested for radon. When elevated levels are confirmed, the problem should be corrected."

State Radon Offices (http://www.epa.gov/iaq/contacts.html)

Call your state radon office for additional help with any of your radon questions. Up-to-date information on how to contact your state radon office is also available on EPA's website at http://www.epa.gov/iaq/contacts.html, or call EPA's toll free Indoor Air Quality Information Clearinghouse (IAQ INFO) at (800) 438-4318 to obtain the current listing.

	Local-Toll	Toll-Free		Local-Toll	Toll-Free
Alabama	334-206-5391	800-582-1866	Montana	406-444-6768	800-546-0483
Alaska	907-474-7201	800-478-8324	Nebraska	402-471-0594	800-334-9491
Arizona	602-255-4845		Nevada	775-687-5394 x275	
Arkansas	501-661-2301	800-482-5400	New Hampshire	603-271-4674	800-852-3345 x4674
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