

# Radon Frequent Questions

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See also, Frequent Questions on other Indoor Air topics - [Asthma](#), [Indoor Air Quality](#), [Mold](#), [IAQ Tools for Schools Program](#), and [Smoke-free Homes/Environmental Tobacco Smoke](#).

## Definitions

### **Radon**

Radon is a gaseous radioactive element having the symbol Rn, the atomic number 86, an atomic weight of 222, a melting point of -71°C, a boiling point of -62°C, and (depending on the source, there are between 20 and 25 isotopes of radon - 20 cited in the chemical summary, 25 listed in the table of isotopes); it is an extremely toxic, colorless gas; it can be condensed to a transparent liquid and to an opaque, glowing solid; it is derived from the radioactive decay of radium and is used in cancer treatment, as a tracer in leak detection, and in radiography. (From the word *radium*, the substance from which it is derived.) Sources: *Condensed Chemical Dictionary*, and *Handbook of Chemistry and Physics*, 69th ed., CRC Press, Boca Raton, FL, 1988.

EPA's Integrated Risk Information System profile on Radon 222 [CASRN 14859-67-7] is located at: [epa.gov/iris/subst/0275.htm](http://epa.gov/iris/subst/0275.htm)

Conversion Factors for Radon Units ([PDF](#), 1 page, 346KB [About PDF](#))

Radon Decay Series Chart ([PDF](#), 1 page, 244KB [About PDF](#))

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## Sources of Radon

Earth and rock beneath home; well water; building materials.

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## What are the Health Effects From Exposure to Radon

No immediate symptoms. Based on an [updated Assessment of Risk for Radon in Homes](#), radon in indoor air is estimated to cause about 21,000 lung cancer deaths each year in the United States. Smokers are at higher risk of developing Radon-induced lung cancer. Lung cancer is the only health effect which has been definitively linked with radon exposure. Lung cancer would usually occur years (5-25) after exposure. There is no evidence that other respiratory diseases, such as asthma, are caused by radon exposure and there is no evidence that children are at any greater risk of radon induced lung cancer than adults.

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## What is the Average Level of Radon Found in a Home?

Based on a national residential radon survey completed in 1991, the average indoor radon level is about 1.3 picocuries per liter (pCi/L) in the United States. The average outdoor level is about 0.4 pCi/L.

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## What's the Debate on Radon?

There is no debate about radon being a lung carcinogen in humans. All major national and international organizations that have examined the health risks of radon agree that it is a lung carcinogen. The scientific community continues to conduct research to refine our understanding of the precise number of deaths attributable to radon. The [National Academy of Sciences BEIR VI Report](#) has estimated that radon causes about 15,000 to 22,000 lung cancer deaths annually based on their two-preferred models. Major scientific organizations continue to believe that approximately 12% of lung cancers annually in the United States are attributable to radon.

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## How do we know radon is a carcinogen?

The World Health Organization (WHO), the National Academy of Sciences, the US Department of Health and Human Services, as well as EPA, have classified radon as a known human carcinogen, because of the wealth of biological and epidemiological evidence and data showing the connection between exposure to radon and lung cancer in humans.

There have been many studies conducted by many different organizations in many nations around the world to examine the relationship of radon exposure and human lung cancer. The largest and most recent of these was an international study, led by the National Cancer Institute (NCI), which examined the data on 68,000 underground miners who were exposed to a wide range of radon levels. The studies of miners are very useful because the subjects are humans,

not rats, as in many cancer research studies. These miners are dying of lung cancer at 5 times the rate expected for the general population. Over many years scientists around the world have conducted exhaustive research to verify the cause-effect relationship between radon exposure and the observed increased lung cancer deaths in these miners and to eliminate other possible causes.

In addition, there is an overlap between radon exposures received by miners who got lung cancer and the exposures people would receive over their lifetime in a home at EPA's action level of 4 pCi/L, i.e., the lung cancer risk in miners has been documented at exposure levels comparable to those which occur in homes/residences.

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## **How many cases does it take to make residential radon epidemiology studies meaningful?**

To have a reasonable certainty in the conclusions, many thousands of cases are required to detect the increased risk of lung cancer due to radon. This is because the more things that cause a disease the harder it is to separate one cause from another, thus it takes many cases to pinpoint the risk from each separate cause. The U.S. Public Health Service radon experts estimate that 10,000 to 30,000 cases, and twice as many controls would be needed to conduct a definitive epidemiologic study of residential radon lung cancer risk. The residential studies conducted to date have all included between 50 and 1500 cases and thus have been too small to provide conclusive information.

Some years ago this same process was used to detect an increased risk of lung cancer due to cigarette smoking. It took many years of study to make the positive link between the cause and effect of smoking and lung cancer. Most of the increased lung cancer risk is attributable to smoking through mathematical modeling. The research process for smoking was very laborious. However, radon's process is even more challenging because radon's contribution to increased lung cancer risk (12%) is difficult to see against the large background of lung cancer due to other causes, which include smoking, asbestos, some heavy metals and other types of radiation; i.e., detecting radon-related lung cancer is like trying to detect a 12% increase of sand on a beach already full of sand.

Finally, it is difficult to accurately determine radon exposures in residential settings since we are estimating past exposures from current measurements. The number of required study participants increases with the difficulty in determining the exposure.

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## **Why are residential epidemiology studies of radon so complicated?**

There are many factors that must be considered when designing a residential radon epidemiology study. It is very expensive and often impossible to design a study that takes all the pertinent factors into consideration. These factors include:

- **Mobility:** people move a lot over their lifetime; it is virtually impossible to go back

and test every home where an individual has lived;

- **Housing Stock Changes:** over time, older homes are often destroyed or remodeled, thus radon measurements will be non-existent or highly varied; a home's radon level may change, higher or lower, over time if new ventilation systems are installed, the occupancy patterns are substantially different, or the home's foundation shifts or cracks appear.
- **Inaccurate Histories:** often a majority of the lung cancer cases (individuals) being studied are deceased or too sick to be interviewed by researchers. This requires reliance on second-hand information which may not be as accurate. These inaccuracies primarily affect:
  - **Residence History:** a child or other relative may not be aware of all residences occupied by the patient - particularly if the occupancy is distant in time or of relatively short duration. Even if the surrogate respondent is aware of a residence they may not have enough additional information to allow researchers to locate the home.
  - **Smoking History:** smoking history historically has reliability problems. Individuals may under-estimate the amount they smoke. Conversely, relatives or friends may over-estimate smoking history.
- **Other:** complicating factors other than variations in smoking habits include an individual's: genetics, lifestyle, exposure to other carcinogens, and home heating, venting and air conditioning preferences.

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## Are there any residential epidemiology studies finding increased risk of lung cancer due to radon?

Yes, several residential epidemiology studies have found an increased risk of lung cancer due to residential exposures (i.e. Sweden, New Jersey ) These studies are also just pieces of a much bigger puzzle that is being put together. The [National Academy of Sciences' BEIR VI Report](#) examines in detail the available studies of radon and lung cancer in homes, as well as the studies of underground miners.

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## Why can we be sure about radon's health risk?

We already have a wealth of scientific data on the relationship between radon exposure and the development of lung cancer. The scientific experts agree that the occupational miner data is a very solid base from which to estimate risk of lung cancer deaths annually. While residential radon epidemiology studies will improve what we know about radon, they will not supersede the occupational data. Health authorities like the Centers for Disease Control (CDC), [the Surgeon General](#) [\[EXIT Disclaimer\]](#), the American Lung Association, the American Medical Association, and others agree that we know enough now to recommend radon testing and to encourage public

action when levels are above 4 pCi/L. The most comprehensive of these efforts has been the National Academy of Science's [Biological Effects of Ionizing Radiation \(BEIR VI\) Report](#). This report reinforces that radon is the second-leading cause of lung cancer and is a serious public health problem. As in the case of cigarette smoking, it would probably take many years and rigorous scientific research to produce the composite data needed to make an even more definitive conclusion.

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## What did the National Academy of Sciences (NAS) published a report on radon and lung cancer say?

The NAS published its latest analysis of health research on radon, the [Biological Effects of Ionizing Radiation \(BEIR VI\) Report](#) in 1999. This is the most comprehensive review effort to date. The Committee was charged with:

- reviewing all current miner and residential data, as well as all existing cellular-biological data,
- comparing the dose per unit exposure effects of radon in mines and homes, and
- examining:
  - interactions between radon exposure and smoking, and
  - any exposure-rate effect (alteration of effect by intensity of exposure).

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## How can you find a qualified radon service professional in your area?

If you are interested in finding a qualified radon service professional to test or mitigate your home, or you need to purchase a radon measurement device, you should:

1. Contact your [State Radon Contact](#) to determine what are, or whether there are, requirements associated with providing radon measurement and or radon mitigations/reductions in your State. Some States maintain lists of contractors available in their state or they have proficiency programs or requirements of their own.
2. Contact one or both of the two privately-run Radon Proficiency Program (listed here alphabetically) who are offering proficiency listing/accreditation/certification in radon testing and mitigation.

<p><b>The National Environmental Health Association (NEHA)</b> <b>National Radon Proficiency Program</b> Website: <a href="http://www.neha-nrpp.org/">www.neha-nrpp.org/</a> <small>EXIT Disclaimer</small> Toll Free: (800) 269-4174 or (828) 890-4117 Fax: (828) 890-4161 E-Mail Address: <a href="mailto:angel@neha-nrpp.org">angel@neha-nrpp.org</a></p>	<p><b>The National Radon Safety Board (NRSB)</b> Toll Free: (866) 329-3474 Fax: (914) 345-1169 WebSite: <a href="http://www.nrsb.org">www.nrsb.org</a> <small>EXIT Disclaimer</small> E-mail Address: <a href="mailto:info@NRSB.org">info@NRSB.org</a> <b>Administrative Office Address:</b></p>
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<p><b>Mailing Address:</b> NEHA-NRPP Administrative Office P.O. Box 2109 Fletcher, NC 28732</p> <p><b>Delivery Address:</b> 313 Banner Farm Road, Suite 1-B Horse Shoe, NC 28742</p>	<p>14 Hayes Street Elmsford, NY 10523</p>
<p>(Reference herein to any specific commercial products, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government.)</p>	

If you have further questions about Radon, please call your [State Radon Contact](#) or the National Radon Information Line at:

**1-800-SOS-RADON**  
**[1 (800) 767-7236]**

To get a [discounted Radon Test Kit](#) EXIT Disclaimer, go to the National Safety Council's [Environmental Health Center](#) EXIT Disclaimer

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## How to Order Publications from EPA

### IAQ INFO

P.O. Box 37133, Washington, DC 20013-7133  
**1-800-438-4318/703-356-4020**  
 (fax) 703-356-5386  
[iaqinfo@aol.com](mailto:iaqinfo@aol.com)

or, you can order these publications directly via EPA's **National Service Center for Environmental Publications (NSCEP)** (<http://www.epa.gov/ncepihom/>). web site. Your publication requests can also be mailed, called or faxed directly to:

U.S. Environmental Protection Agency  
 National Center for Environmental Publications (NSCEP)  
 P.O. Box 42419  
 Cincinnati, OH 42419  
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