UNDERSTANDING RADON . . .

AN INTRODUCTION

Presented by Matt Loehr, Nebraska Radon Program
What is Radon?
Radon is a radioactive, “Noble” gas. It does not react with other elements. It’s dangerous when it degenerates into its natural “daughter products”. 
The “Noble Gases” are a group of chemical elements with similar properties; under standard temperature and pressure (STP) are all odorless, colorless, **monatomic** gases with very low chemical reactivity.
Radon, and the other Noble Gases, are shown in Orange.

Nebraska Radon Program
Characteristics of Radon

- Odorless
- Colorless
- Tasteless
Characteristics of Radon

- Naturally-occurring
- Radioactive
- Chemically Inert (Monatomic)
The Radioactive Decay of **Radon**

- Occurs spontaneously.
- Radon has a “half-life” of 3.8 days.
- An atom changes identity and releases energy.
- Radiation is released in the process.

\[
\text{Rn-222} \rightarrow \text{Po-218} + \text{alpha radiation} + \text{gamma radiation}
\]
As time passes, ionizing radiation is emitted from the natural decay of Radon.
UNDERSTANDING RADON . . .

*Alpha Particles* are created as the radon atoms decay. These particles strike the cells lining the lung, causing damage to the DNA.

Nebraska Radon Program
Understand Radon ... Radon Decay

Ionizing Radiation

\[ \alpha \rightarrow \text{fast-moving helium nucleus, stopped by skin or paper} \]

\[ \beta \rightarrow \text{high energy electron, stopped by aluminium plate} \]

\[ \gamma \rightarrow \text{high energy photons, stopped by dense material} \]
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SURGEON GENERAL’S WARNING: Radon causes lung cancer.

U.S. Surgeon General Richard H. Carmona

January 13, 2005

Nebraska Radon Program
UNDERSTANDING RADON . . .

Radon is recognized as a serious national health problem by the following organizations:

- U.S. Surgeon General
- World Health Organization
- American Lung Association
- American Medical Association
- National Academy of Sciences
  - [http://www.nationalacademies.org/](http://www.nationalacademies.org/)
- Environmental Protection Agency
  - [http://www.epa.gov/iaq/radon/healthrisks.html](http://www.epa.gov/iaq/radon/healthrisks.html)
- Centers for Disease Control & Prevention
UNDERSTANDING RADON . . .

Lung Cancer Survivor Story

DENNIE EDWARDS, ELYRIA, OHIO (WWW.CANSAR.ORG)

“In 2004, I had a very bad cold, so my doctor performed a chest x-ray to check for pneumonia. I’ve never smoked, so you can imagine how shocked I was that he found a 4.5 centimeter mass in my left lung.

Even though I’ve been a real estate agent for thirty-one years. I had never bothered to test my house for radon. I always informed my clients that radon testing prior to purchase was an option (to protect my liability, but truthfully, I really didn’t care if they tested or not.

Now I had to wonder whether my lung cancer had been caused by radon exposure. While the doctor scheduled my surgery, I scheduled a radon test. The result was 10 pCi/L. I had lived in the home for twelve years. Needless to say, I called a contractor to have a mitigation system installed.

Two days later I had surgery. I thought I was surely going to die. When I woke up choking with tubes in my throat, panic set in. They had removed my entire left lung. I’m getting better. I can walk up to a mile; but I can no longer dance, lift things, or exert myself.

“My clients now get a very personal testimonial about the importance of testing for radon.”

Nebraska Radon Program
Radon is inhaled with each breath.

Radon is then exhaled, leaves the body, but . . .

If the Radon decays in your lungs, energy is released and “daughter products” are created.
The Health Effects of Radon

- Classified scientifically as a (Class A) “known human carcinogen”.
- Second leading cause of lung cancer after tobacco smoke.
- 21,000 lung cancer deaths are attributed to radon annually.
## Environmental Risk Comparisons

### Exposure Risks
- Pesticide Application
- Hazardous Waste Sites
- Toxic Outdoor Pollutants
- Pesticide Residue on Food
- Asbestos
- Radon

### Annual Cancer Deaths
- 100
- 1,100
- 2,000
- 6,000
- 12,000
- 21,000
Radon is the leading cause of lung cancer among non-smokers.
UNDERSTANDING RADON . . .

Radon is the leading cancer killer in both men and women in the United States.

The lung cancer five-year survival rate (16.6%) is lower than many other leading cancers.

Over half of people with lung cancer die within one year of being diagnosed.

Nebraska Radon Program
Lung cancer causes more deaths than the next three most common cancers combined (colon, breast, and pancreatic).
An effort is being made to investigate a possible correlation between radon and other diseases such as Alzheimer’s, Parkinson’s, leukemia, and breast cancer.
UNDERSTANDING RADON . . .

SURGEON GENERAL’S WARNING

Radon Causes Lung Cancer. You Should Test Your Home.

Nebraska Radon Program
Radon Measurement

Radon is measured in picocuries per liter (pCi/L).
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Measuring Radon

“P” Pico = Trillionth
“Ci” Curie = A Measurement of Energy
“L” Per Liter of Air
UNDERSTANDING RADON . . .
The Occurrence of Radon in Nebraska

- **Nationally**, one in every fifteen *(1 in 15)* homes exceeds the 4.0 pCi/L action level for indoor radon.

- **In Nebraska**, one in every two *(1 in 2)* homes exceeds the 4.0 pCi/L action level for indoor radon.

*Nebraska Radon Program*
The Occurrence of Radon in Nebraska

- The average indoor radon concentration in US homes is 1.3 pCi/L.
- The average indoor radon concentration in Nebraska homes is 6.0 pCi/L.

Nebraska Radon Program
The Occurrence of Radon in Nebraska

- **Nationally**, one in every one thousand (1 in 1,000) homes has greater than 20.0 pCi/L of indoor radon.

- **In Nebraska**, nearly three in every one hundred (3 in 100) homes has greater than 20.0 pCi/L of indoor radon.
Uranium is commercially extracted at the Crow Butte mine three miles east of Crawford in northwest Nebraska.
UNDERSTANDING RADON . . .

Radon Measurement Devices

- Multiple Devices Available
  - Activated charcoal devices, charcoal liquid scintillation devices, electret ion chambers, grab radon devices, and continuous radon monitors.

- Two most commonly used in Nebraska
  1. Activated Charcoal Devices
  2. Continuous Radon Monitor

Nebraska Radon Program
Activated Charcoal Devices

Pros

• Easy to use, and used by professionals and homeowners.
• Requires no power to operate.
• Very economical choice.

Cons

• Limited to short term sampling.
• Doesn’t track hourly variations of measurements.
• Results are not instant, must be sent to a lab for analysis.
Placement of Your Testing Device

Does Your Home Have:
- A Basement
- No Basement
- A Crawlspace?

Never Test in a Crawl Space

- Choose occupied room
- Keep away from drafts and moisture

Lowest lived in

Lowest lived in
Test Placement Within A Room

- 3 feet from windows or exterior doors
- At least 20 inches above floor
- 4 inches from other objects
- Where it won’t be disturbed
A.C. Device Results

Protocol for Test Results
• If your results are between 4 and 7 pCi/L, conduct a long term measurement (3 months to 1 year).
• If your results are 8 pCi/L or higher, conduct another short term measurement.
Continuous Radon Monitors

Pros

• Can track hourly variations of measurements.
• Provides instant results.

Cons

• Expensive, usually only cost effective during real estate transactions.
• Requires power.
Test reports provided to buyer’s may come in different forms.
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Where does Radon come from?
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The Uranium Decay Sequence . . .
The Origin of the Element Radon (Rn)
Radon Entry Into Your Home

Radon gas enters buildings as part of the soil air that is pulled into structures as they “breathe”.

It enters through any available openings.
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Radon Entry Into Your Home

How radon enters a house

Nebraska Radon Program
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EPA Map of Radon Zones Nebraska

EPA Radon Zones

- Red: Zone 1 - High (>4 pCi/L)
- Orange: Zone 2 - Moderate (2 - 4 pCi/L)
- Yellow: Zone 3 - Low (<2 pCi/L)

This map is not intended to be used to determine if a home in a given zone should be tested for radon. Homes with elevated levels of radon have been found in all three zones. All homes should be tested regardless of geographic location.
Contributing factors for the concentration of radon

2. Transport of radon, which includes pathways and driving forces.
3. Ventilation rate of the building.
Five things to minimize radon entry into your home . . .

1. Open air supply registers in the basement.
2. Ensure return air ducts in the basement are completely sealed.
3. Fill any cracks, joints, and other openings in your basement floor.
4. Fill any openings around pipe penetrations through the first floor.
5. If you have a sump pit, take steps to make it air-tight to prevent intrusion of soil air.
Radon measurement still high?

It’s time to mitigate if you want your home below the action level of 4.0 pCi/L.

- Homeowners can install their own radon mitigation system.
- Only licensed radon mitigation companies should be used to install a radon mitigation system.
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Radon Mitigation Systems
The Department of Health & Human Services administers the Nebraska Radon Program pursuant to Article 35 of the Radiation Control Act (71-3501).
Nebraska Radon Program Homepage

Nebraska Department of Health & Human Services
Helping People Live Better Lives

Nebraska Radon Program Homepage

Subscribe to this page

Radon is a cancer-causing natural radioactive gas that you can't see, smell or taste. Its presence in your home can pose a danger to your family's health. Radon is the leading cause of lung cancer among non-smokers and claims about 20,000 lives annually.

Nebraska has a very high prevalence of radon in homes. One out of every two radon tests conducted in the state is elevated. Homes with an annual average radon level at or above 4 picocuries per liter (pCi/L) should be mitigated to reduce radon levels.

DHHS Radon Program
PO Box 95026, Lincoln, NE 68509-5026
402-471-1005
Fax 402-471-8833

Documents in PDF format require the use of Adobe Acrobat Reader which can be downloaded for free from Adobe Systems, Inc.

Indoor Air Quality Program
Environmental Health Page

Last Updated: 1/5/2016 8:30 AM
Site Best Viewed at 1024x768 Screen Resolution
© 2011 Nebraska Department of Health & Human Services
301 Centennial Mall South, Lincoln, Nebraska 68509 (402) 471-3121
Home | Contact Us | Security, Privacy & Accessibility Policy | General Disclaimer
Nebraska Radon Program Activities

1. License measurement/mitigation businesses and individuals.
2. Educate the public.
3. Fund programs to support testing.
4. Conduct free radon mitigation system inspections.
As of January 2016, there are 95 licensed Radon Measurement Businesses in Nebraska.

These businesses employ 181 Radon Measurement Specialists, licensed by the Department of Health and Human Services.
UNDERSTANDING RADON . . .
As of January 2016, there are 44 licensed Radon Mitigation Businesses in Nebraska.

These businesses employ 79 Radon Mitigation Specialists, licensed by the Department of Health and Human Services.
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Licensed Radon Mitigation Businesses In Nebraska

South Dakota

Legend

- Licensed Business

0 50 100 Miles
Free or Low Cost Test Kits

Nebraska Radon Program
Test Kits

The DHHS Radon Program no longer sells radon test kits from the office in Lincoln. However, existing partnerships allow Nebraskans to obtain a free or low-cost test kit when they want to test radon levels in a home. Nebraska law allows individuals to test the home where they reside for radon without a license. Testing any other property requires a license issued by DHHS. Ownership of the property does not provide an exemption from the licensure requirement.

DHHS recommends that homes involved in a real estate transaction have radon measurements performed by a licensed Radon Measurement Professional.

Free Test Kits
Some organizations have local programs to distribute radon test kits for free. To see if an organization in your area is participating, visit: http://dhhs.ne.gov/publichealth/Pages/radon_projects.aspx

Purchasing Test Kits
Some manufacturers offer special pricing for Nebraska residents when purchasing a radon test kit (see below). The DHHS Radon Program provides this list as a service to the citizens of Nebraska, but we do not endorse one manufacturer/laboratory over another. We have tried to ensure that all the information is accurate, however you should confirm the pricing prior to purchase.

Accustar
To order a discounted long-term test kit from AccuStar, call 800-523-4964 and mention NEBRASKA. More information about Accustar products can be found at: http://www.accustarlabs.com/Default.aspx

Air Chek, Inc.
To order a discounted short- or long-term test kit from Air Chek, Inc. visit: www.radon.com/nebraska

Alpha Energy Laboratories
To order a discounted short- or long-term test kit from Alpha Energy, visit: http://dirhomeair.com/nebraska

Radon test kits can often be found at local hardware stores or home centers, as well.
UNDERSTANDING RADON . . .

Free Test Kit Availability

2015-2016 Local Radon Projects in Nebraska

Legend
- Not Participating LHDs

Source: Nebraska Department of Health and Human Services

Nebraska Radon Program
2015 Free Test Kit Statistics

- 3,831 Test Kits Purchased
- 3,671 Distributed (96%)
- 1,773 Tested and Sent to the Lab (48%)
- 848 Tests were above 4.0 pCi/L
Free Radon Mitigation System Inspections

UNDERSTANDING RADON . . .

Divison of Public Health
Radon Mitigation System Inspection Record

<table>
<thead>
<tr>
<th>Property Inspected</th>
<th>City/Zip Code</th>
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<tbody>
<tr>
<td>1234 A St</td>
<td>Lincoln</td>
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<table>
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<tr>
<th>Mitigation Business (installer):</th>
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<tbody>
<tr>
<td>Clean Air Tec</td>
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<table>
<thead>
<tr>
<th>Date of Inspection</th>
<th>Start time:</th>
<th>End time:</th>
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<tbody>
<tr>
<td>01/06/16</td>
<td>11:00 am</td>
<td>11:20 am</td>
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<tr>
<th>Inspector:</th>
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<tr>
<td>Lacy</td>
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<table>
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<tr>
<th>Occupants' Telephone Number:</th>
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<tr>
<td>(402) 123-4567</td>
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Is this the individual who gave permission?

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Critical Elements Inspected

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1. Ventilation piping was installed to ensure drainage back to the suction point.

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2. Ventilation piping was adequately supported (Horizontal & Vertical supports).

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3. Ventilation piping is properly sealed at all joints.

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4. The ventilation pipe is properly sealed within the suction point enclosure.

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5. The ventilation piping does not block windows or doors.

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6. The discharge outlet is ten feet above ground.

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7. The discharge outlet is ten feet from a neighboring building.

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8. The discharge outlet is above the eave of the roof.

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9. The discharge outlet is two feet above any window or door within ten feet.

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10. The fan is located outside the house or in an exterior unoccupied area.

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11. The system has an easily readable "performance indicator".

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12. The system contains a Mitigator identification label with telephone number.

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13. The all ventilation pipe sections (on all floors) are properly Inseated.

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14. The circuit breaker in the electrical panel box is labeled "Radon System".

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15. Is the ventilation piping attached to the structure of the building?

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If a Firewall was penetrated, was a UL listed fire collar or acceptable material used.

Notes regarding items marked "No" above:

Other deficiencies noted:

<table>
<thead>
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Inspector's Signature: [Signature]

Nebraska Radon Program
1 (888) 334-9491
www.dhhs.ne.gov/radon
UNDERSTANDING RADON . . .

Radon Mitigation System Bloopers

Nebraska Radon Program
UNDERSTANDING RADON . . .

Radon Mitigation System Bloopers
UNDERSTANDING RADON . . .

Radon Mitigation System Bloopers
UNDERSTANDING RADON . . .

Presentation developed by:

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