

**Florida Chapter of the Health Physics Society
Florida Local Section of the American Industrial Hygiene
Association
Spring 2022 Joint Meeting
April 8, 2022**

**Radon in Florida:
What you need to know!**



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Presented by the

Radon & Indoor Air Program

Public Health Toxicology Section

Bureau of Environmental Health

Division of Disease Control and Health Protection

Florida Department of Health (DOH)

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Presentation Topics

What is Radon?

Why Do We Care?

Some Florida Issues

Regulations

Entry and Behavior

Measurement /
Measurement Protocols

Radon Mitigation and
Building Investigations

What is Radon?



Radon (Rn)

Naturally Occurring
Noble Gas
Odorless
Colorless
Tasteless
Radioactive

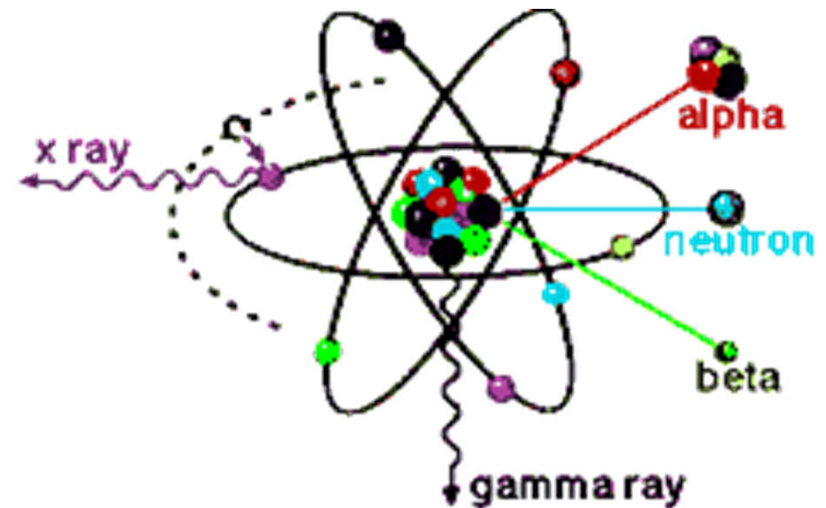


Definition:

Radioactivity - The transformation or decay of unstable atomic nuclei by the emission of radiation.

Unstable nuclei release invisible waves of energy or particles.

This is called **ionizing radiation**.

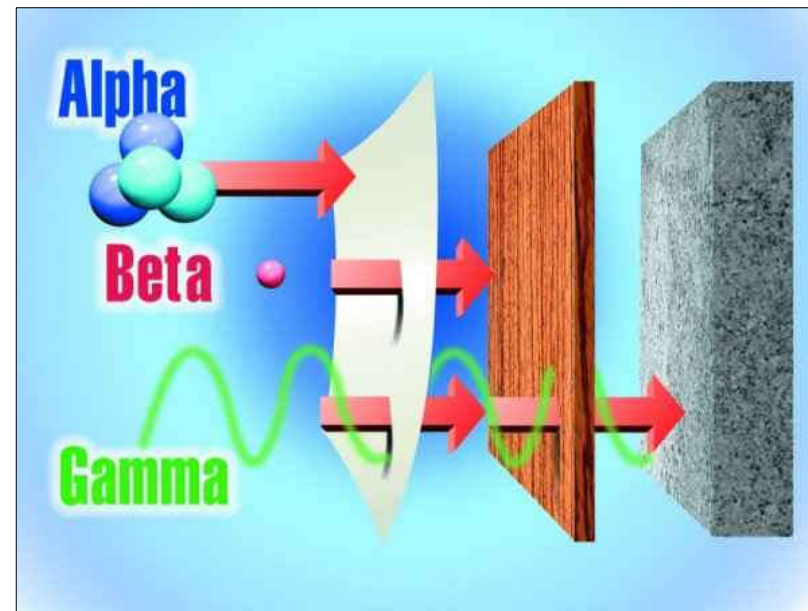


Alpha Particles

Least penetrating of all radiation

Most ionizing of all radiation

Ionizing radiation is energetic particles or waves that have the potential to ionize an atom or molecule through atomic interactions.



Radon Measurement Units

PicoCuries per Liter of air
- pCi/L

One trillionth (10^{-12}) of a Curie
1 pCi/L = 2.22 decays per
minute

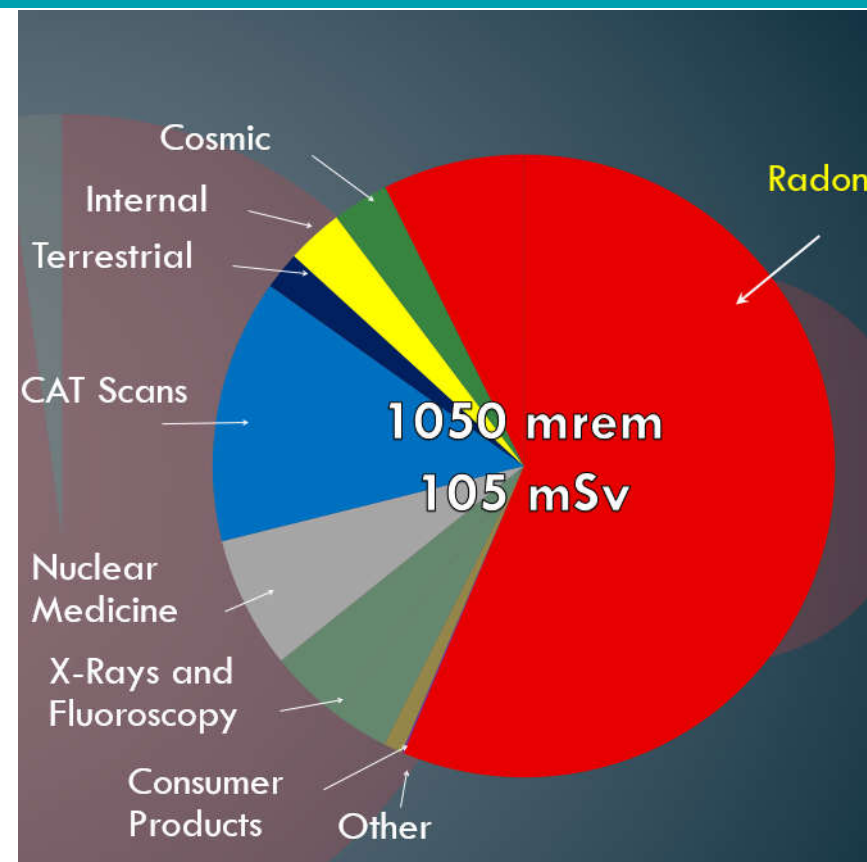
On average you have 2.6 liters
in air in your lungs:

More than 3.2 million
radioactive decays per year in
the lungs of someone living at
4 pCi/L



Source of Radiation and Radon Reduction

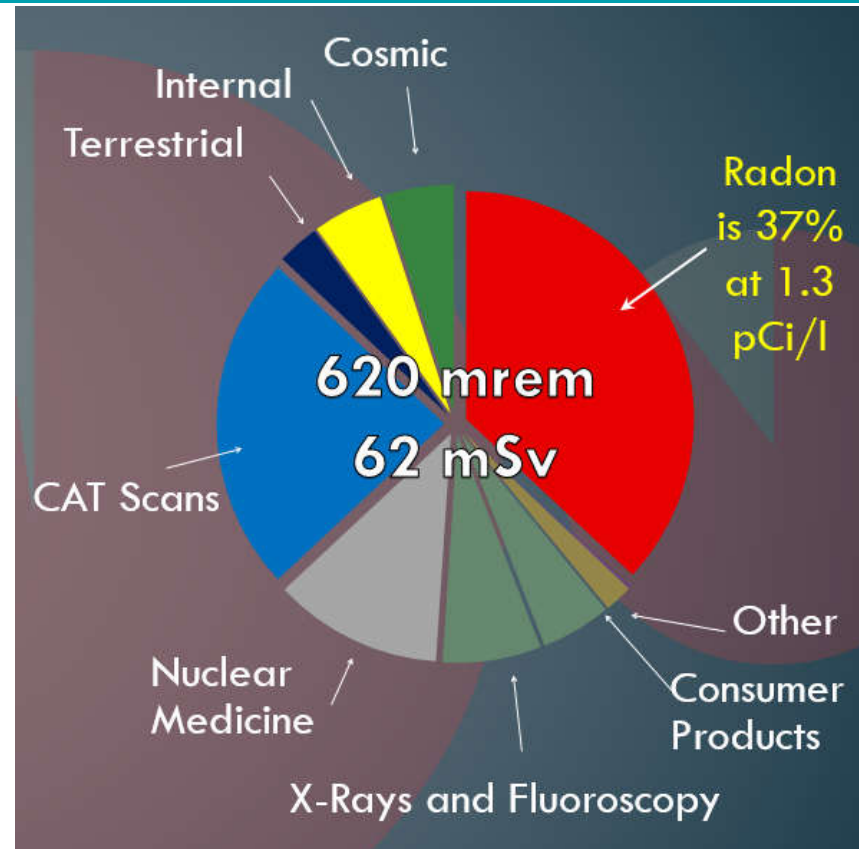
At 4 pCi/L radon contributes to 63% of the **total annual radiation dose**



SOURCE: NCRP - <http://www.ncrponline.org/>

Source of Radiation and Radon Reduction

Promoting and adopting **radon resistant policies** in construction, could **reduce total annual radiation dose to the public** could **by 25%**

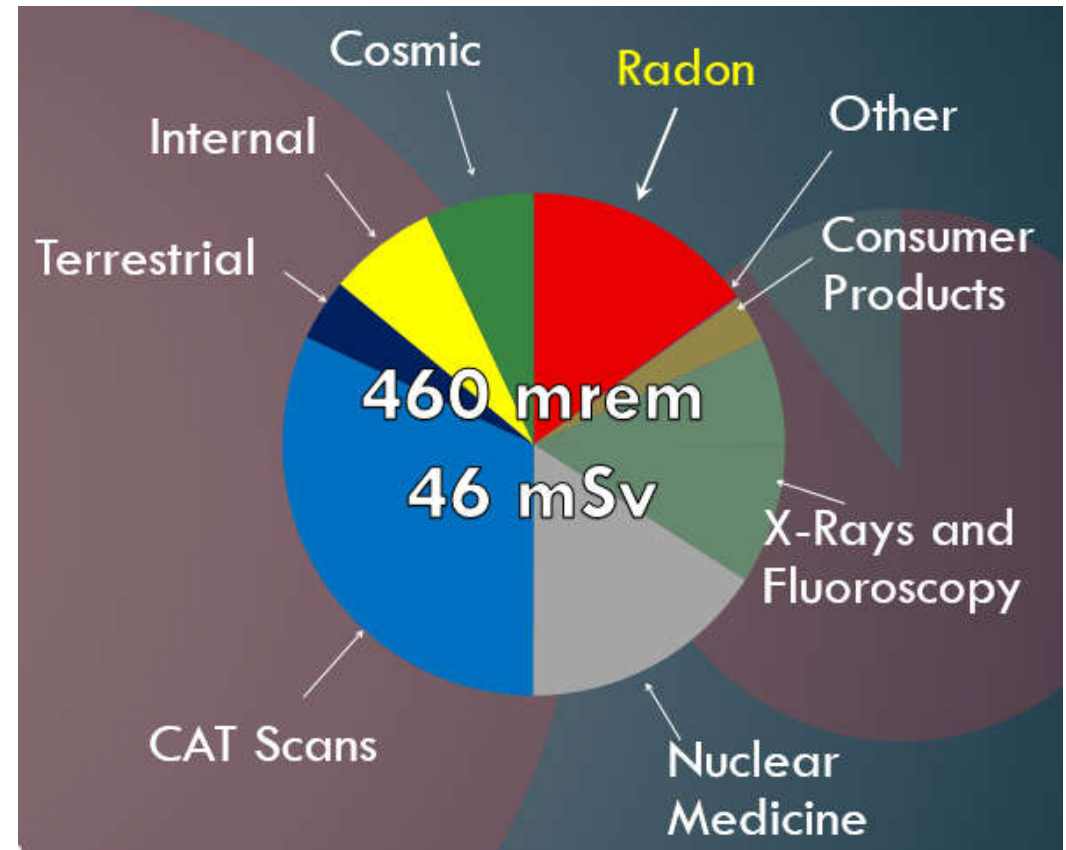


SOURCE: NCRP - <http://www.ncrponline.org/>

Source of Radiation and Radon Reduction

The goals: as low as reasonably achievable (ALARA) or indoor levels no greater than outdoor levels

At 0.4 pCi/L – average levels outdoors



SOURCE: NCRP - <http://www.ncrponline.org/>

Radon History



Source:
The
Morning
Call

December 1984 - Discovery that Stanley Watras's house in Pennsylvania had 4,400 pCi/L (22WL) - an engineer at a nuclear reactor in Pennsylvania set off radiation alarms coming in to work

Why Do We Care?



Why Do We Care?

Second leading cause of lung cancer in the U.S.

21,000 annual deaths

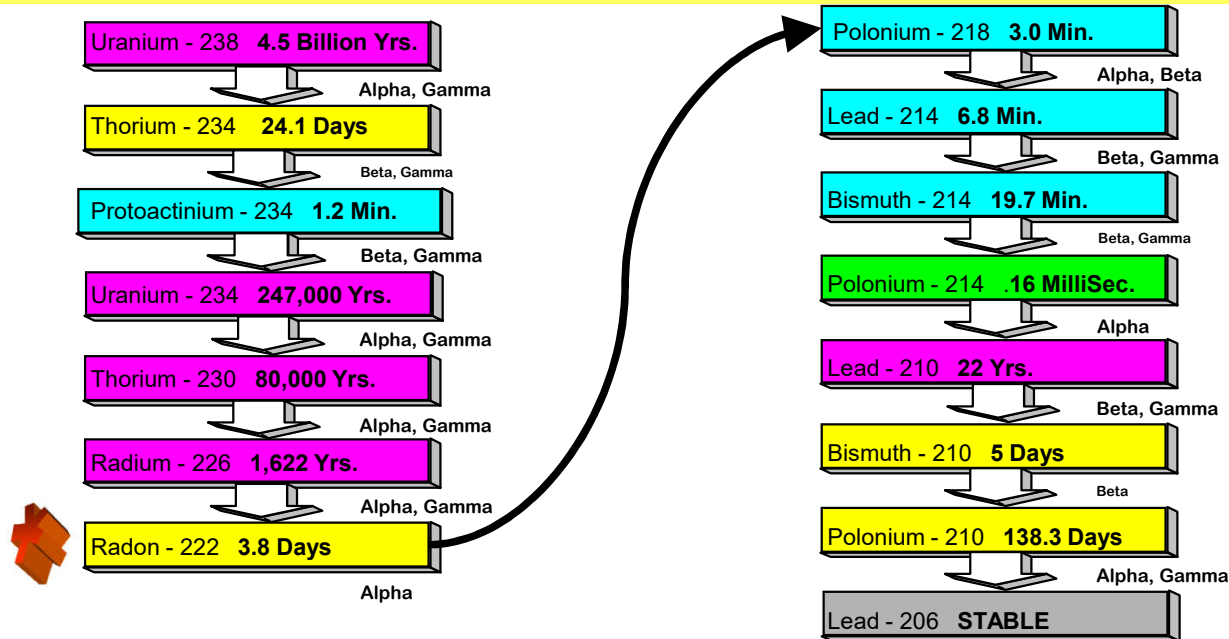
Number one cause of lung cancer among non-smokers

Health risk can be minimized - All radon-induced lung cancer deaths are preventable

Almost 10% of Lung Cancer Mortality from Radon Costing
\$6.8 Billion/Year

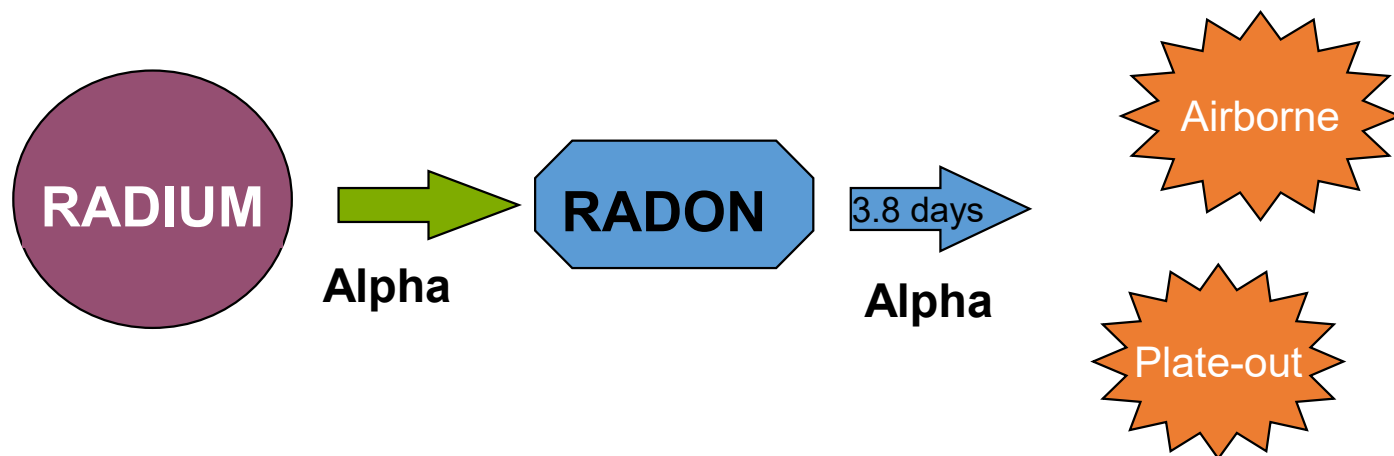


The URANIUM - 238 Radioactive Decay Chain *



- Isotopes with long half lives measured in years.
- Isotopes with **moderate half lives measured in days.**
- Isotopes with short half lives measured in minutes.
- Isotopes with very short half lives measured in milliseconds.
- Stable isotope.

Radon Decays into: Radon Decay Products (RDPs) or “Daughters” or “Progeny”



RDPs solid aerosols, have static charges,
chemically reactive

RDPs Enter the Lungs

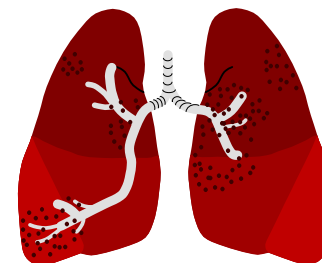
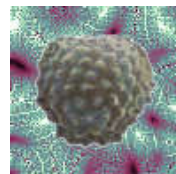
RDPs are charged and release alpha particles

Initially unattached

Some attach to dust Particles in Air (Rn & RDPs inhaled) - May Breathe Particles into Lungs

Then stick to Bronchial Epithelium tissue long enough to undergo radioactive decay and damage lung cells

RDPs Attract to Dust Particles



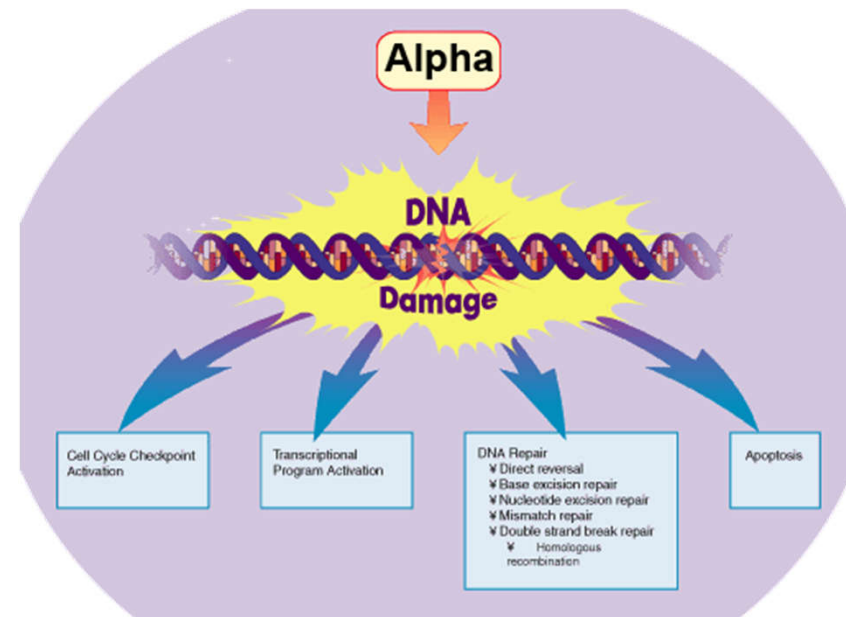
Alpha Particles Damage Lung Cell DNA

RDPs' alpha particles cause physical and chemical damage to DNA

DNA damage results:

Repaired
Cell death

Improperly Repaired:
potential for cancerous growth



Risk is from Total Damage

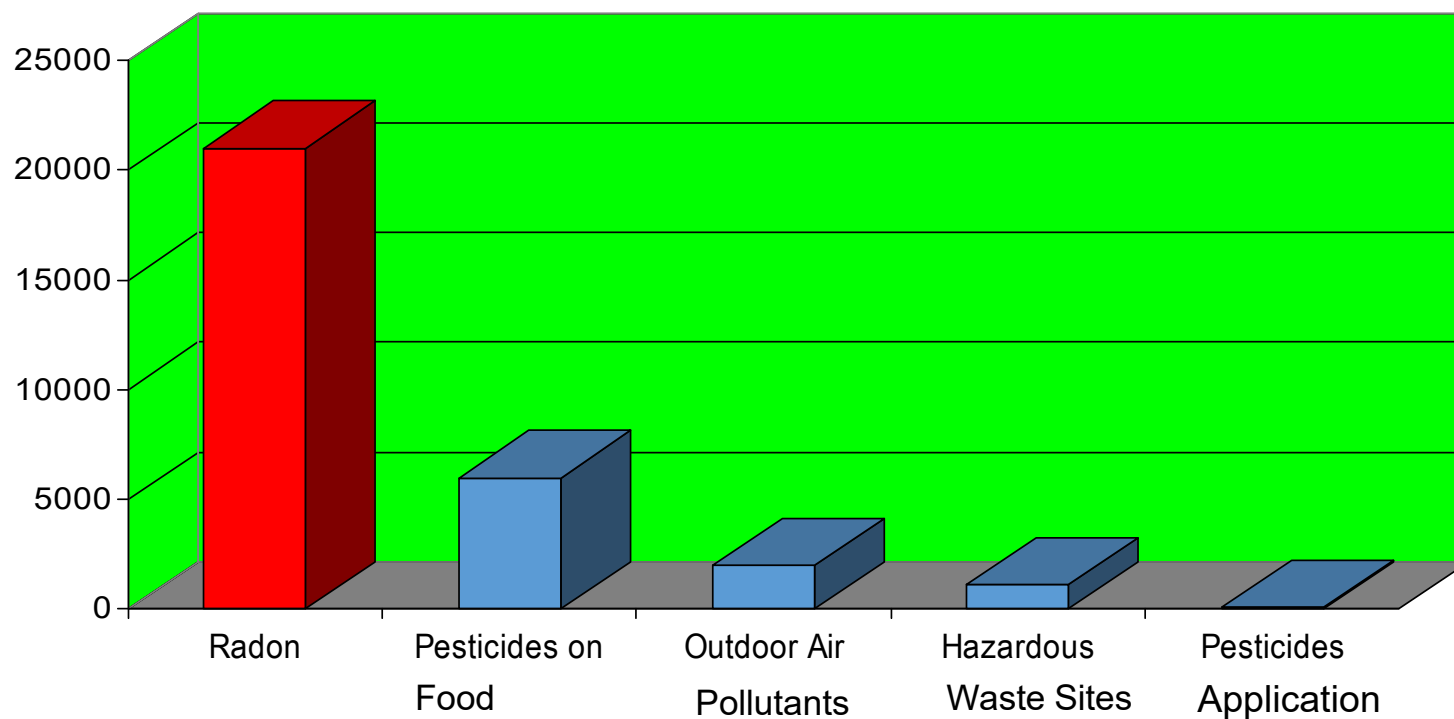
Risk of lung cancer from radon is based on cumulative exposure

What is the total over your life time

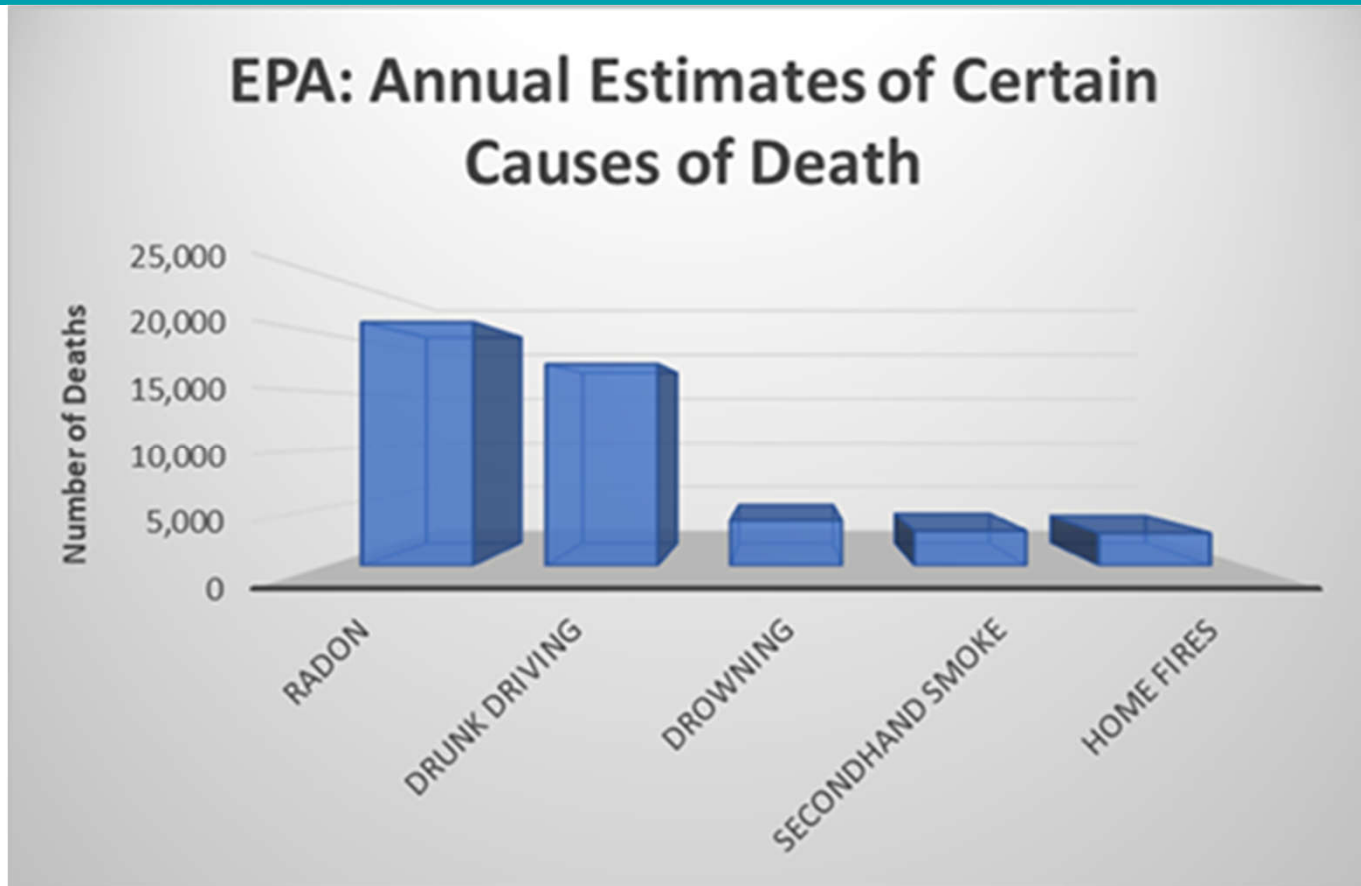
Short term elevated exposures not as meaningful as long term



Radon & Other Carcinogens



Other Causes of Death



Renewed Interest From Public

WTSP 10 News recently ran a week plus investigative Series



FLORIDA SCHOOLS FAIL TO FOLLOW FEDERAL RECOMMENDATIONS FOR CANCER-CAUSING RADON

10-INVESTIGATES

Federal guidelines and Florida law differ when it comes to testing for a cancer-causing gas in schools, but we found some districts seem to miss the bar entirely.

www.wtsp.com/search?q=radon

August, 2018

| | | |
|------------|--------------|-----|
| 3 /27/1996 | Polk | 1.2 |
| 3 /27/1996 | Polk | 0.9 |
| 4 /5 /1996 | Hillsborough | 2.4 |
| 4 /5 /1996 | Hillsborough | |
| 4 /5 /1996 | Hillsborough | |
| 4 /5 /1996 | Hillsborough | |
| 4 /5 /1998 | Hillsborough | 0.3 |

SCHOOL DISTRICTS RESPOND TO RADON TESTING REPORTS

10-INVESTIGATES

School districts say they are testing every single school that is not in compliance.

Renewed Interest From Public - Continued

More headlines:



TAMPA BAY COUNTIES SAY THEY'RE WORKING -- FINALLY -- TO TEST FOR RADON

INVESTIGATIONS

It's the No. 1 cause of lung cancer for non-smokers, which is why every new school in Florida is required to test for radon. But not all school districts follow the law.



HILLSBOROUGH CO. SUPERINTENDENT VOWS SCHOOLS ARE SAFE AMID STUDENT HEALTH CONCERNS

EDUCATION

Superintendent Jeff Eakins says the district is doing its best to deal with concerns about air conditioning, lead in water, and mold and radon issues.

Renewed Interest From Public - Continued

More headlines:



FLORIDA LAWMAKERS REACT TO TAMPA BAY AREA SCHOOLS NOT TESTING FOR RADON IN CLASSES

10-INVESTIGATES

230 schools in the Tampa Bay area haven't tested for radon since 1995.



SOME SCHOOL BOARD MEMBERS SHOCKED AT RADON TESTING RESULTS

10-INVESTIGATES

At this Hillsborough County School Board meeting, Superintendent Jeff Eakins didn't hold back when addressing the school board about testing for radon

Other Local News Teams Also Reporting

ABC Action News WFTS Tampa



FOX 13 News



More News Coverage

NBC Channel 2 News has started their own series in the SW Florida news market:



Most SWFL schools haven't tested for cancer-causing radon in 20 years

...Most SWFL schools haven't tested for cancer-causing **radon** in 20 years...

Tuesday, September 18th 2018, 6:48 pm EDT

WPTV, September 3, 2021 - Radon, mold found at west Boca Raton apartments, residents say,



More Recent News Involving Florida State University (FSU)

Florida Politics, January 26, 2022 - Mold, radon in FSU building tied to eight cancer cases in faculty report

FSU News, January 30, 2022 - FSU closes Sandels building due to mold, radon and cancerous agents

Tallahassee Democrat, February 9, 2022 - Preliminary findings: 'Elevated levels of radon' found in Florida State's Sandels Building

Tallahassee Democrat, Feb 23, 2022 - Florida State will probe every building for mold, radon but some faculty not satisfied



<https://sandlesresponse.fsu.edu>

Radon Recommendations

Classified as carcinogen by

**World Health Organization's (WHO) International Agency for
Research on Cancer**

US DHHS - Department of Health and Human Services

US EPA – Environmental Protection Agency

Test all homes for radon

Action level to Reduce elevated radon

EPA \geq 4 pCi/L

WHO \geq 2.7 pCi/L

FDOH as low as reasonably achievable (ALARA)

Health Canada \geq 5.4 pCi/L

Some Florida Radon Issues



What EPA Says

Red - Zone 1

Highest Potential
Average > 4

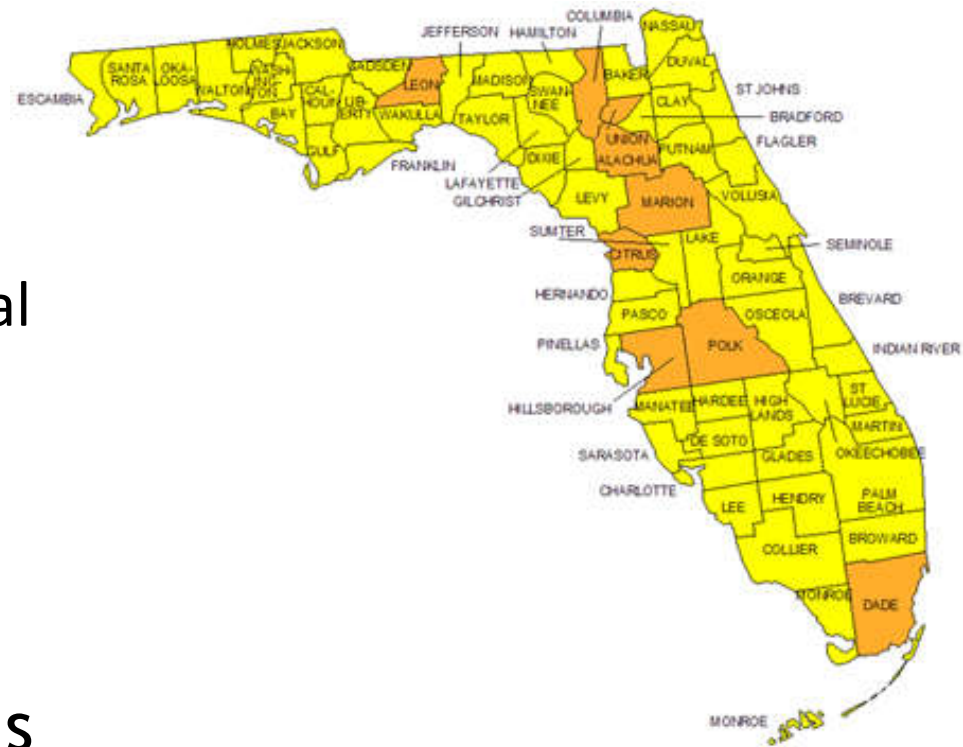
Orange - Zone 2

Moderate Potential
4 > Average > 2

Yellow - Zone 3

Low Potential
2 > Average

No Florida Zone 1s



What Florida Knows

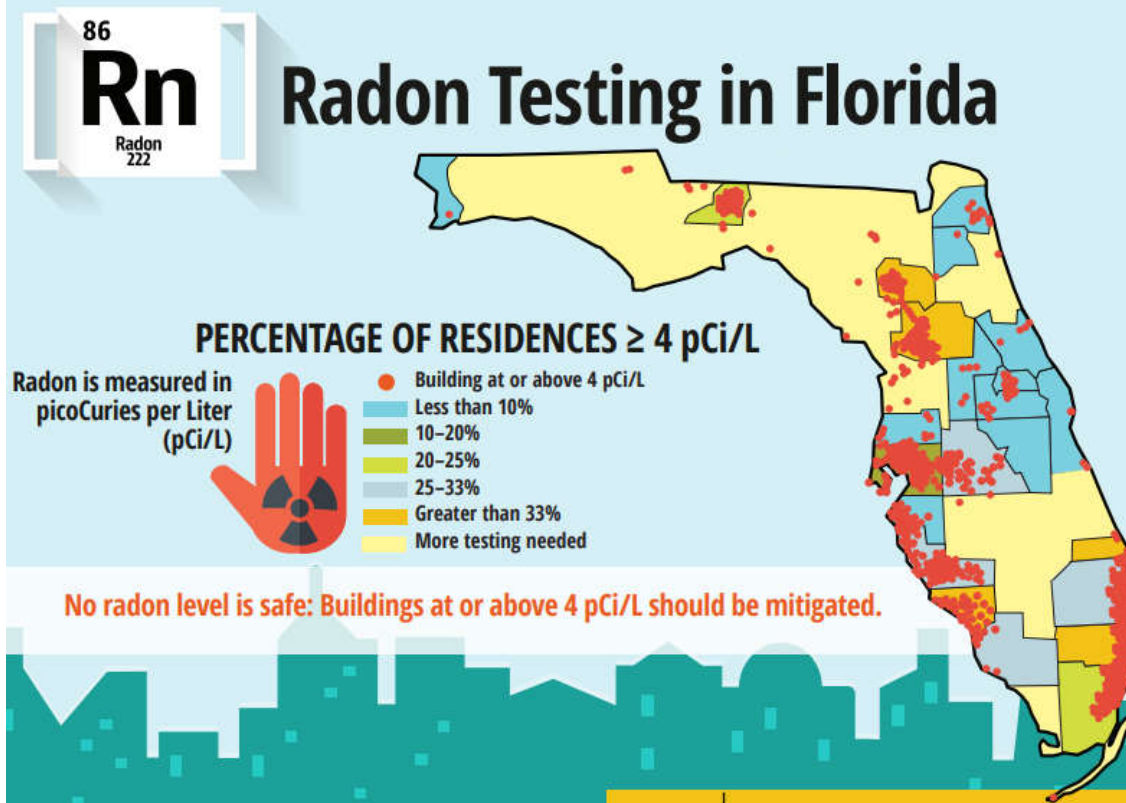
Not every county tested

Depending on the region, 1-70% of the buildings tested have elevated radon

Elevated radon measured on 23rd floor of condo



Elevated Radon Levels Are Everywhere



This product is for reference purposes only and is not to be construed as a legal document. Any reliance on the information contained herein is at the user's own risk. The Florida Department of Health and its agents assume no responsibility for any use of the information contained herein or any loss resulting therefrom.

SELECT COUNTIES, GREATER THAN 10% INCIDENCE IN HOMES (May 2007 - December 2021)

| COUNTY | NUMBER OF BLDG'S MEASURED | PERCENT GREATER THAN OR = 4 pCi/l |
|------------------|---------------------------|-----------------------------------|
| Alachua | 2,778 | 33.5% |
| Broward | 8,036 | 31.9% |
| Citrus | 147 | 12.9% |
| Collier | 8,724 | 26.2% |
| Columbia | 51 | 11.8% |
| Hardee | 3 | 33.3% |
| Hillsborough | 11,702 | 14.8% |
| Lee | 4,574 | 29.3% |
| Leon | 2,563 | 19.3% |
| Marion | 2,144 | 49.6% |
| Miami-Dade | 5,305 | 22.3% |
| Palm Beach | 6,473 | 29.6% |
| Polk | 1,566 | 26.4% |
| Sarasota | 1,038 | 21.4% |
| STATEWIDE | 70,567 | 21.1% |

| COUNTY | NUMBER OF BLDG'S MEASURED | PERCENT GREATER THAN OR = 4 pCi/l |
|------------------|---------------------------|-----------------------------------|
| Alachua | 10,105 | 28.9% |
| Broward | 28,798 | 29.8% |
| Citrus | 233 | 13.3% |
| Collier | 53,161 | 24.0% |
| Columbia | 126 | 4.8% |
| Hardee | 20 | 15.0% |
| Hillsborough | 22,079 | 16.0% |
| Lee | 31,060 | 23.8% |
| Leon | 16,710 | 20.8% |
| Marion | 5,398 | 42.9% |
| Miami-Dade | 19,079 | 26.2% |
| Palm Beach | 24,962 | 25.1% |
| Polk | 4,884 | 26.0% |
| Sarasota | 3,289 | 20.0% |
| STATEWIDE | 265,792 | 21.8% |

Florida's Indoor Radon Program Regulations



Florida DOH Radon Program

Consumer Protection

- Certification of Individuals & Businesses
- Monitor for Fraudulent Activities

Public Information and Education

Radon Data Compilation

Mandatory Testing of Licensed Facilities



Florida DOH Radon Program - Continued

Indoor Radon Standards and Protocols

Real Estate Disclosure (FS 404.056)

“additional information may be obtained from your county health department.”

Indoor Air Quality Issues



Radon's Rules and Regulations

Florida Statute 404.056

Florida Administrative Code (FAC) 64E-5
Parts X and XII

Mandatory testing protocol document



Florida Statute 404.056(5) - Notification

"RADON GAS: Radon is a naturally occurring radioactive gas that, when it has accumulated in a building in sufficient quantities, may present health risks to persons who are exposed to it over time. Levels of radon that exceed federal and state guidelines have been found in buildings in Florida. Additional information regarding radon and radon testing may be obtained from **your county health department.**"



FAC 64E-5 Parts X and XII

Establishes rules, requirements and procedures for certification and for protocols for mandatory measurements

- Training Providers Approval
- Certified Measurement Business
- Certified Measurement Specialist
- Certified Measurement Technician
- Certified Mitigation Business
- Certified Mitigation Specialist
- Certified Mitigation Technician



Mandatory Testing

Facility Types:

Public / private school sites housing students in kindergarten – grade 12
State-owned, -operated, -regulated or -licensed 24-hour care facilities
All state-licensed day care centers for children or minors

Mandatory testing protocol document
Incorporated by rule



Who is Required to test?

Facilities in certain counties are required to test. (Previously the radon testing was required statewide)

Two different lists depending on the construction of the building:

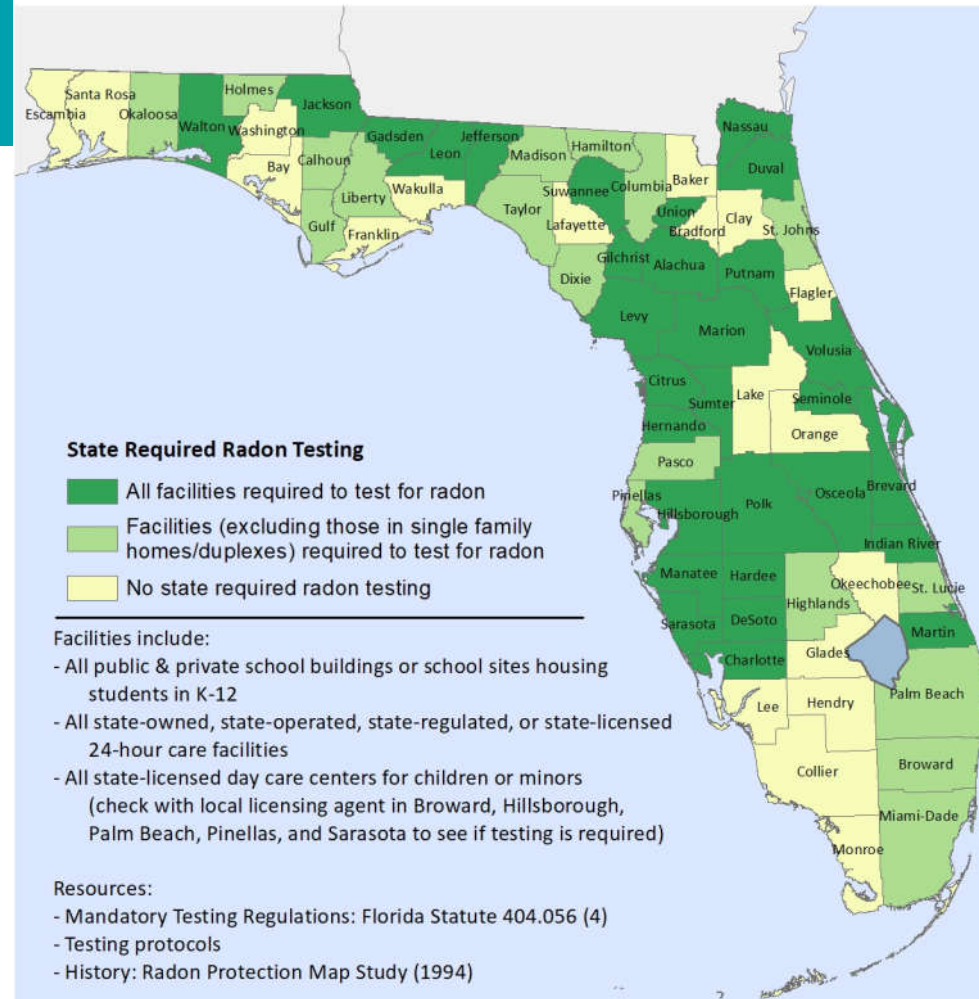
- Buildings built as a single-family home or duplex that are **still used as a home**
- **All other types of buildings (large)** including apartments and condos



Radon Rules and Regulations

The list of counties was provided to DOH by the Florida Department of Community Affairs (DCA)

Florida Radon Testing Requirements



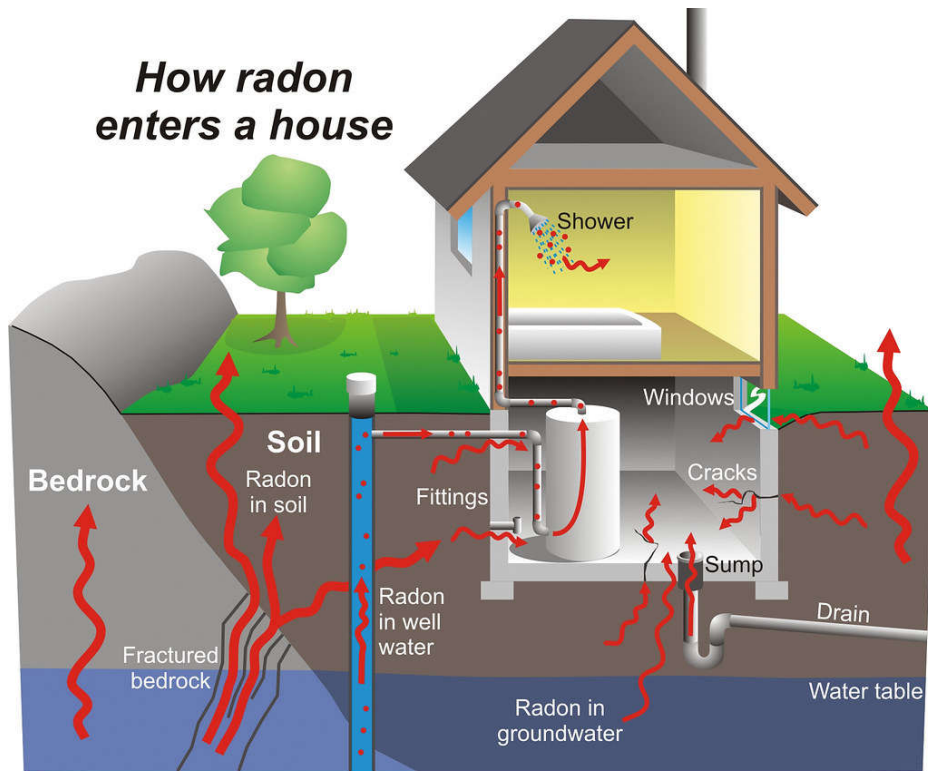
Last updated: 03Dec18

Radon Entry and Behavior



Radon Entry

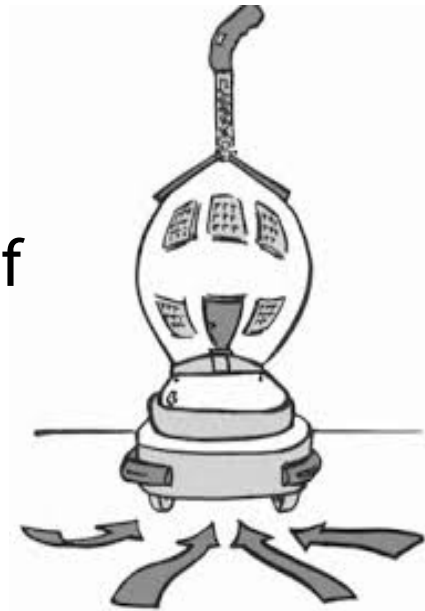
How radon enters a house



Pulled in through cracks, plumbing/electrical penetrations, and construction joints of homes

Becomes trapped and concentrated

May come from building materials



Radon Entry and Behavior

Source strength

Soil, bedrock

Water

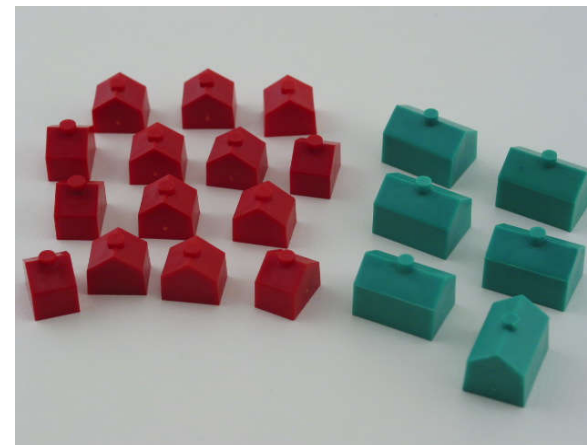
Effectiveness of delivery indoor

Soil porosity

Air pressure differentials

Materials containing radon

Ventilation rate



What Drives Radon Movement?

Concentration gradient diffusion

From high to low concentration
The more porous the soil the faster & the farther

Rain

Soil Capping / Sealing Effects
Piston Effect



Credit: Oregon Health Authority

What Drives Radon Movement?

Air flow differential

Pressure driven from
high to low

Temperature
differences

Wind pressure

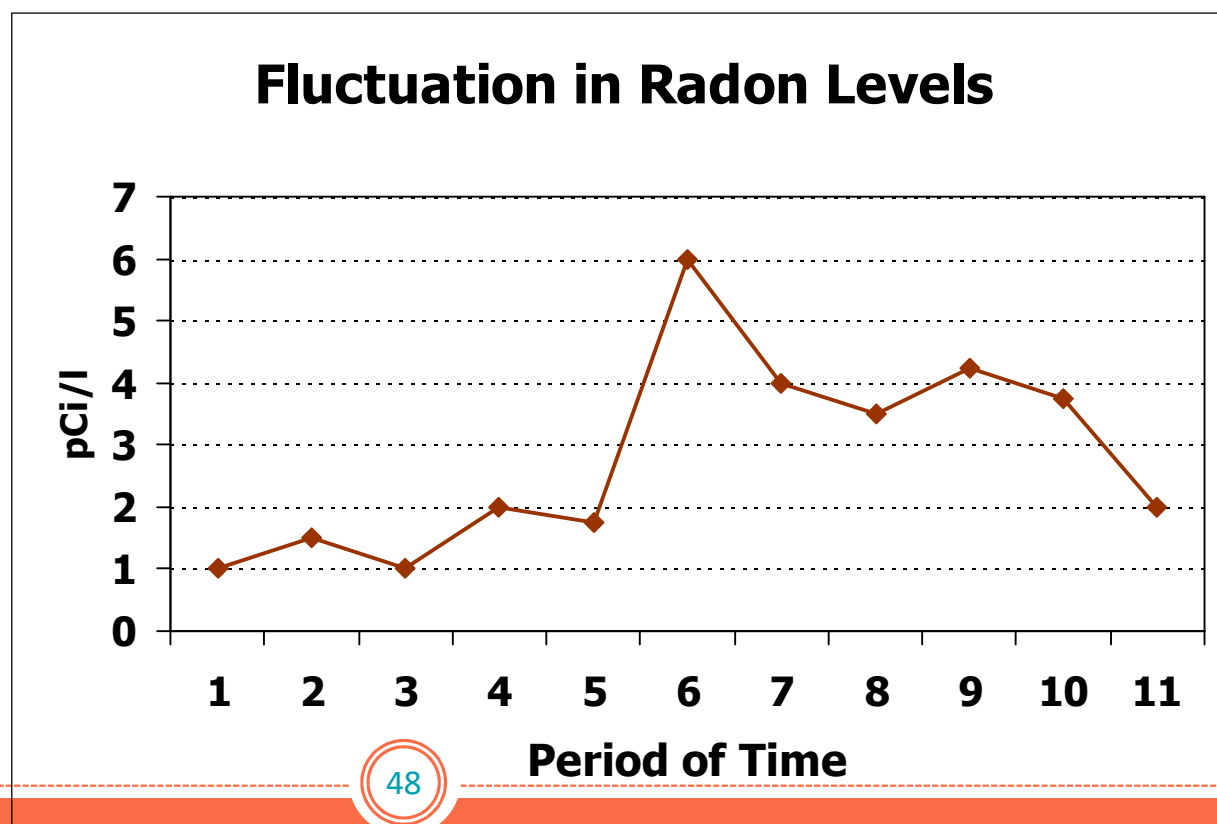
Barometric pressure



All Adds Up to Radon Variability

All Factors affect Radon levels

Hourly
Daily
Seasonally
Weather



Radon Measurement



Measurement Types

Length of time

Short Term - Screening for Potential health risk
Long Term - Indicates True/actual health risk

Protocol / Purpose

Screening
Diagnostic
Pre/Post Mitigation
Evaluate Health Risk



How to Test - Options

Testing Options

Self Testing

Obtain kits from local hardware stores, online

Certified Business (DOH)

Ask questions, shop around



Radon Measurement Devices

Passive radon tests (sent to a lab for analysis)

Active radon tests (First four hours may be disregarded; may be able to indicate tampering)



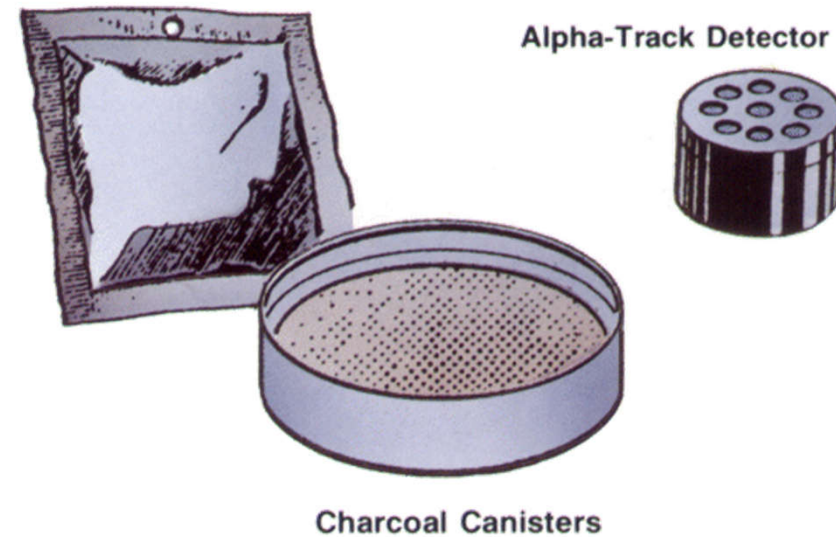
Passive Radon Measurement

Passive radon tests

Examples: charcoal canister, alpha track detector

Do not require power

Usually require laboratory to analyze results



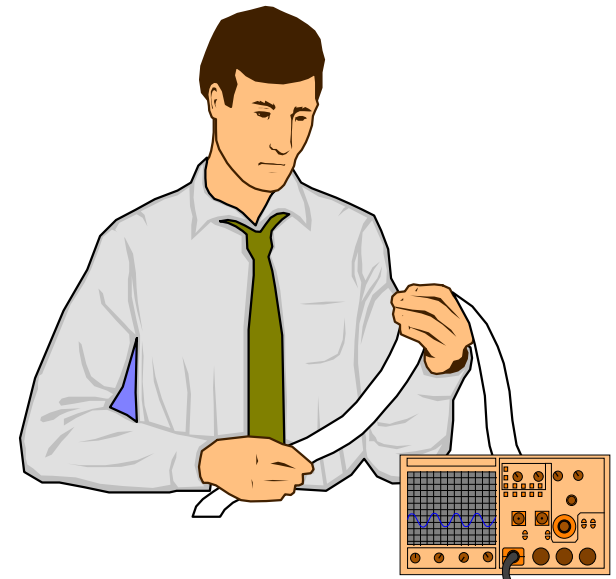
Active Radon Measurement

Active radon tests

Example: continuous radon monitor,
working level (WL) monitor

Usually give instantaneous results
over set time intervals

Run by certified individual



Measurement Protocols



Testing Protocols...

Why are you testing

Just to know

Real estate transaction

Mandatory Testing



Test Because You Want To (Non-mandatory)

Residences/Dwellings

EPA *Citizen's Guide to Radon*

Single test device in commonly used room

Retest to confirm elevated levels

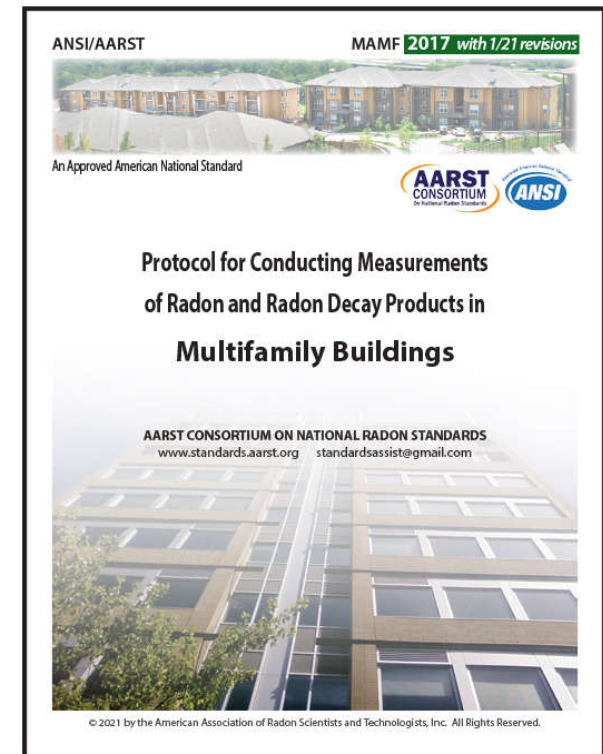
All other buildings

No official protocol

Refer to ANSI/AARST standards

ANSI = American National Standards Institute

AARST = American Association of Radon Scientists & Technologists



Commercial / Large Buildings

A/C has fresh air intake

Frequently occupied for only part of 24-hour period

Radon levels can vary significantly from room to room

Only way to be sure is to test all rooms



Testing Protocols

Closed building conditions

12 Hours prior

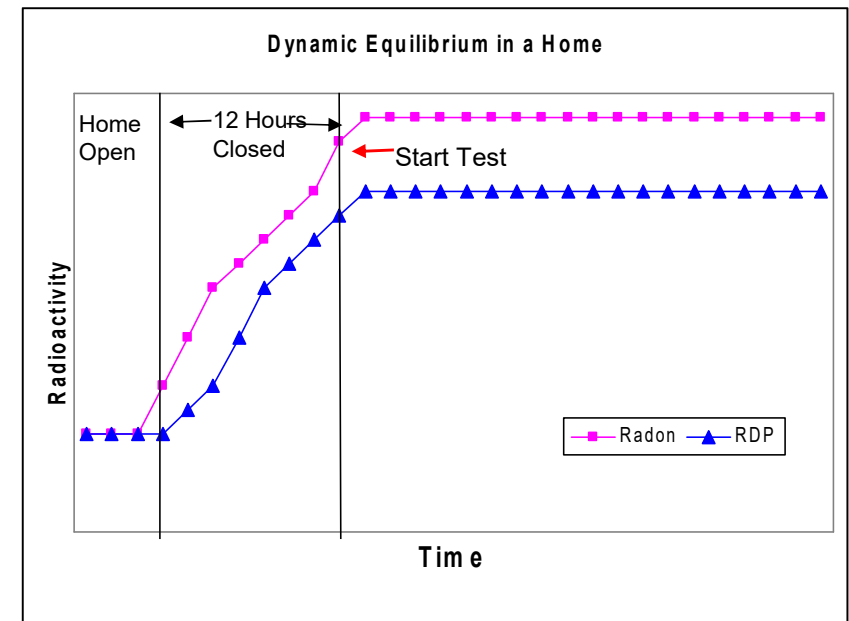
Normal in/out allowed

Location

Lowest inhabited space (occupiable
– Real Estate)

Away from windows, doors, vents,
fans, high humidity areas

Undisturbed (short or long term)



Testing Protocols - Time

Requirements:

Always minimum 48 hours

24-hour increments at 48, 72 and 96 hours

After 96 hours partial days not statistically significant



Testing Protocols - Device location

At least 4” from other objects

At least 12” from any wall

At least 20” from floor

At least 3 feet from exterior doors, windows, or potential openings

If suspended, optional height 6 to 8 feet from floor

The ‘normal’ breathing zone

Mandatory testing protocol document DH/PI 150-334

Provides radon measurement procedures to establish occupant exposure when elevated concentrations are found

Used to satisfy legal requirements of 404.056 F.S.

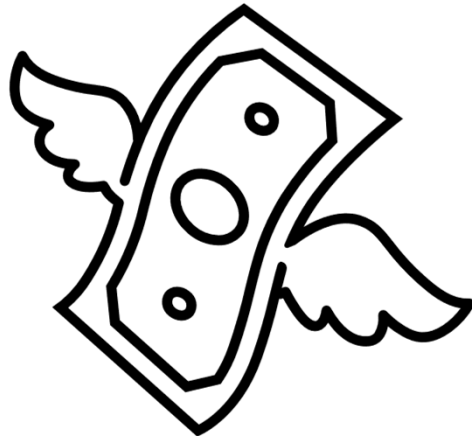
Can identify structures in which the potential exists for elevated radon concentrations

Certain exclusions



Administrative Penalties

All subsections of Chapter 404, Florida Statutes are subject to administrative penalties of \$1000 per item per day for noncompliance according to Section 404.162



Radon Mitigation and Building Investigations



Investigating and Fixing a Radon Problem

A radon mitigation system is any system or steps designed to reduce radon concentrations inside a building

The challenge is NOT reducing radon levels, but doing so without compromising **aesthetics**, **building integrity** and at a **reasonable cost**

Radon reduction/mitigation systems are very effective and have been known to reduce radon levels by as much as 98%



Radon Reduction Techniques

Active soil depressurization
aka sub-slab suction

Ventilation - Positive Pressure

Sealing

Aeration and filtration of water

For commercial buildings –
adjustment of air handler
settings

Must meet building codes

Check with local municipality for
permitting requirements



Active Soil depressurization

Slab drilled, PVC piping and fan to remove gas from underneath the slab



Active slab depressurization

Determine pressure and air flow for appropriate fan

~90 to 300 watt fan installed in attic or outside

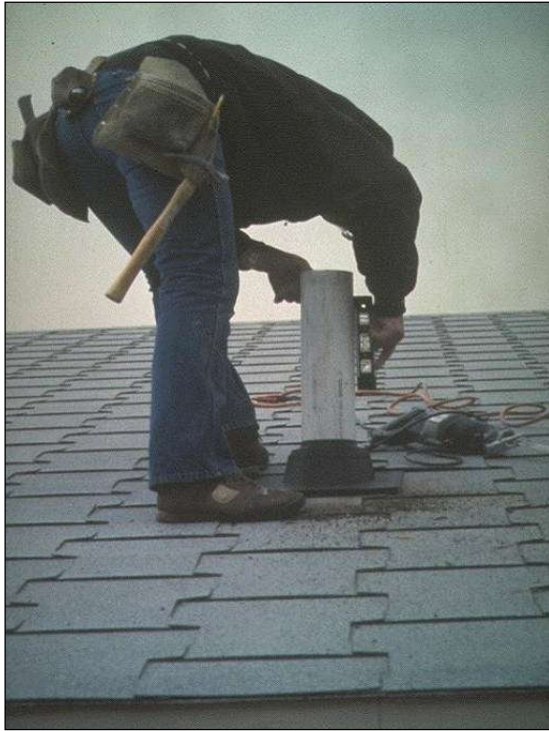
Visible or audible warning system - manometer

System Label



Active slab depressurization

Gas is exhausted above the roof line and away from windows



Sub membrane depressurization

When properly applied, sub-membrane suction is the most effective way to reduce radon levels in crawlspace houses



Radon Reduction Techniques

Ventilation – Positive Pressure

Useful only for lower concentrations

May reduce other pollutants

May increase humidity related problems

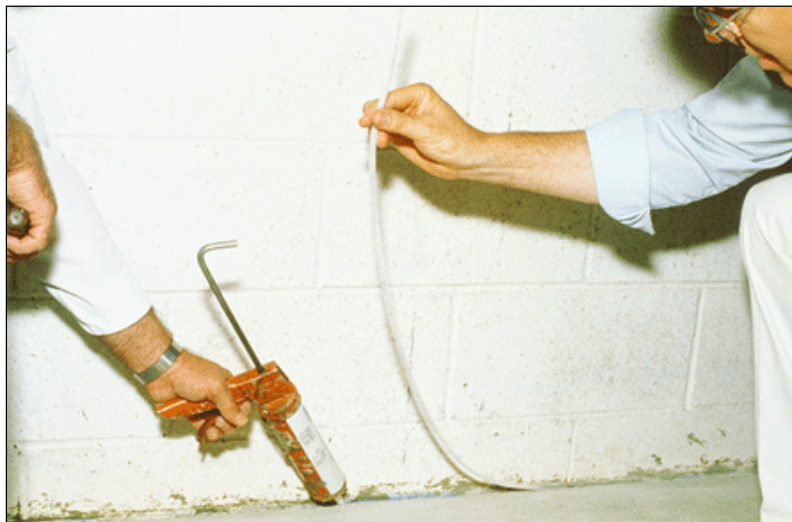
More applicable to large scale buildings

Energy costs



Radon Reduction Techniques

Sealing can enhance other methods (air leaks can introduce radon and reduce mitigation system pressure fields)



In Florida

Soils are tight

Suction fields do not extend very far

Suction point every 600 – 1000 square feet

Condos - Apartments

Almost exclusively use ventilation techniques

Foundation issues for sub-slab

What else to do on 20th Floor

Politics of Condos

Water

While could be a problem in other states, has not been identified as a problem here



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Post Mitigation assessment

Post Mitigation Radon Testing

Best option – same procedure as pre-mitigation test
Independent from mitigator

What to do if levels are not below 4 pCi/l

Perform building investigation
Take corrective actions
Retest



Review

Radon is a Class A carcinogen,
known to cause lung cancer in
humans

Radon is the leading cause of lung
cancer for non-smokers

The only way to know is to test

Indoor radon levels can be reduced

Radon testing may be required in
some facilities



The only way to know who has a radon problem is to test



Questions?

Thank you

850-245-4288

800-543-8279 (toll-free)

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Webpage: Radon.FloridaHealth.gov

