Introduction To Radon

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What is Radon?

- A naturally occurring radioactive gas
- Colorless, odorless and tasteless
- Found all over the U.S. in all types of buildings

Notes:

- Radon is a radioactive gas that occurs in nature. Radon is one of the nation's most important environmental threats – one that places people at risk in their own homes.

- Radon cannot be detected by our senses. You can't see smell or taste radon. The only way to know if your home has high levels of radon is to test for it.

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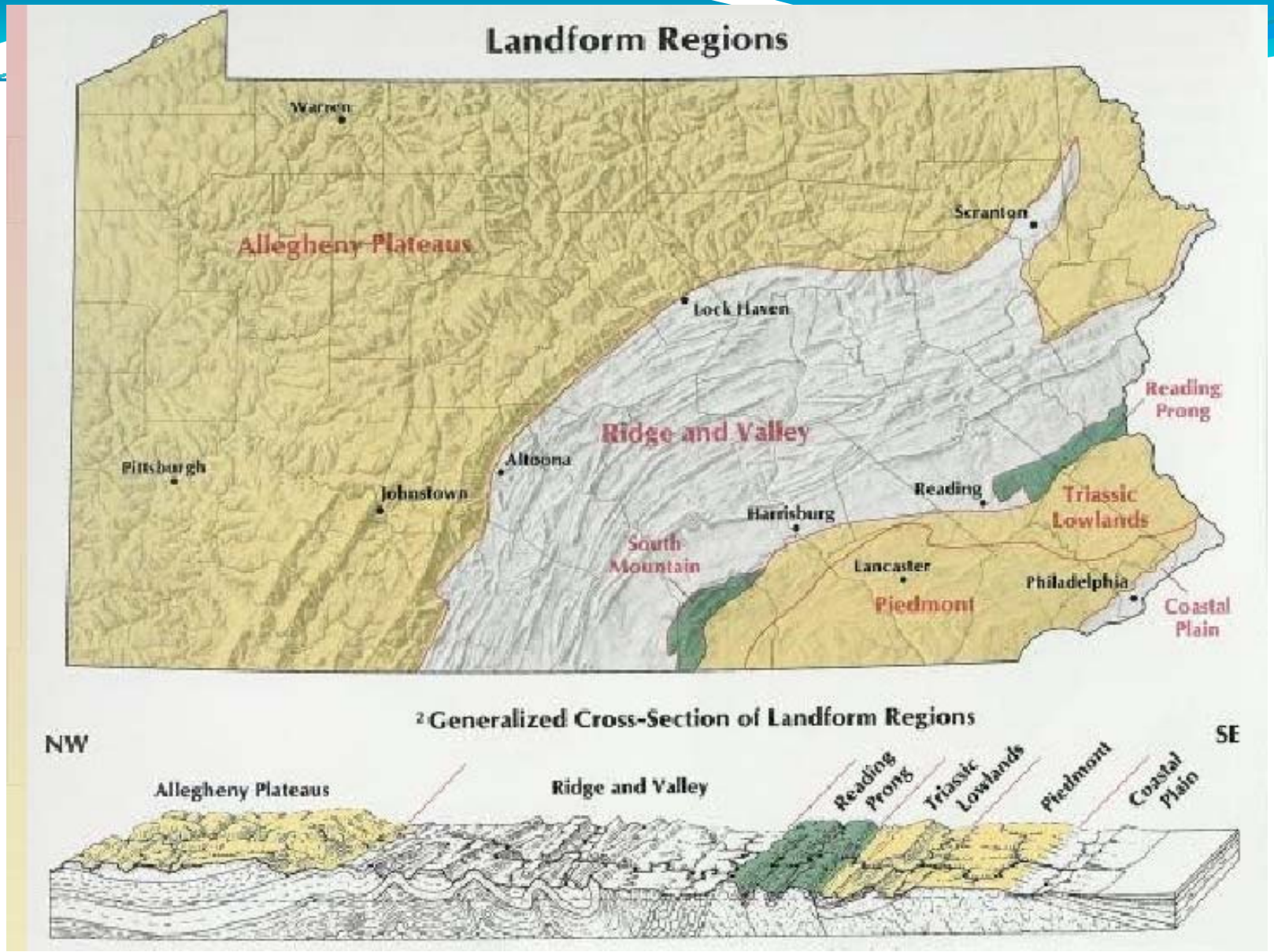
How It All Began

- Radon from home environments initially came to attention in 1984.
- Stanley Watras was an engineer who worked at the Limerick nuclear power plant in Pennsylvania
  - He did not work directly with radioactive materials
- On his way home from work one day, he set off the monitor at a radiation-detection section. He then continued to set off the monitor for 2 weeks as a search was conducted to find the source of the radioactive contamination
- It turned out not to be related to a work-related exposure, but his home was found to have incredibly high radon levels

- Notes: Testing of homes began in mid-1985 after this man's experience was published in newspapers.

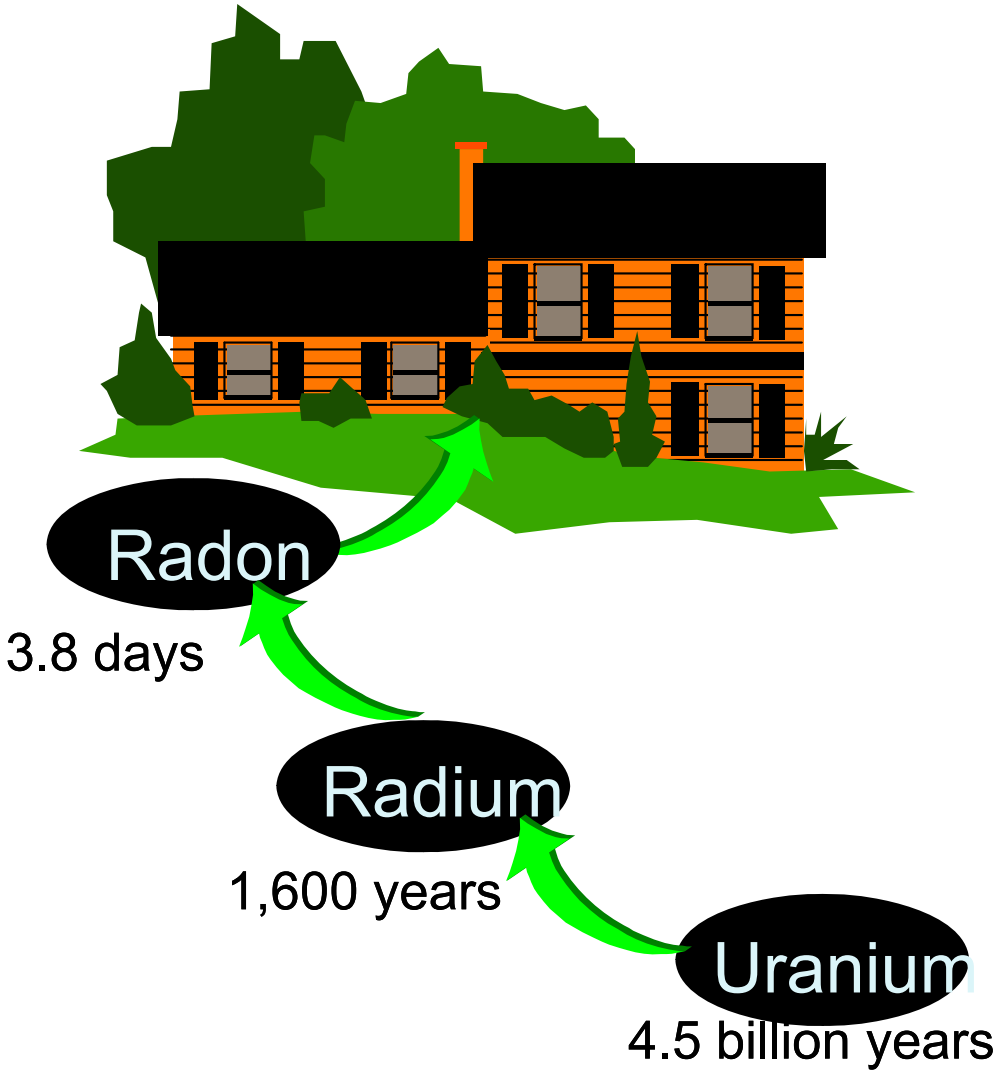
How It All Began

- The basement of that home registered 4,400 picocuries of radon (over 1100 times what is thought to be “safe levels”)
- The relative risk of his (and his family’s) exposure was calculated to be equivalent to smoking 135 packs of cigarettes DAILY
- Mr. Watras found a new career in radon mitigation, finding ways to reduce radon exposure
- What Happened To Stanley Watras?
  - He is still alive as far as anyone knows. He lost his engineering job when the company relocated and was in the radon mitigation business!



Reading Prong region. The geology formation (green) beneath the home of Mr. Watras. Uranium deposits that covers 7 counties in North Western New Jersey into sections of Orange, Rockland, Putnam and Duchess Counties in NY.

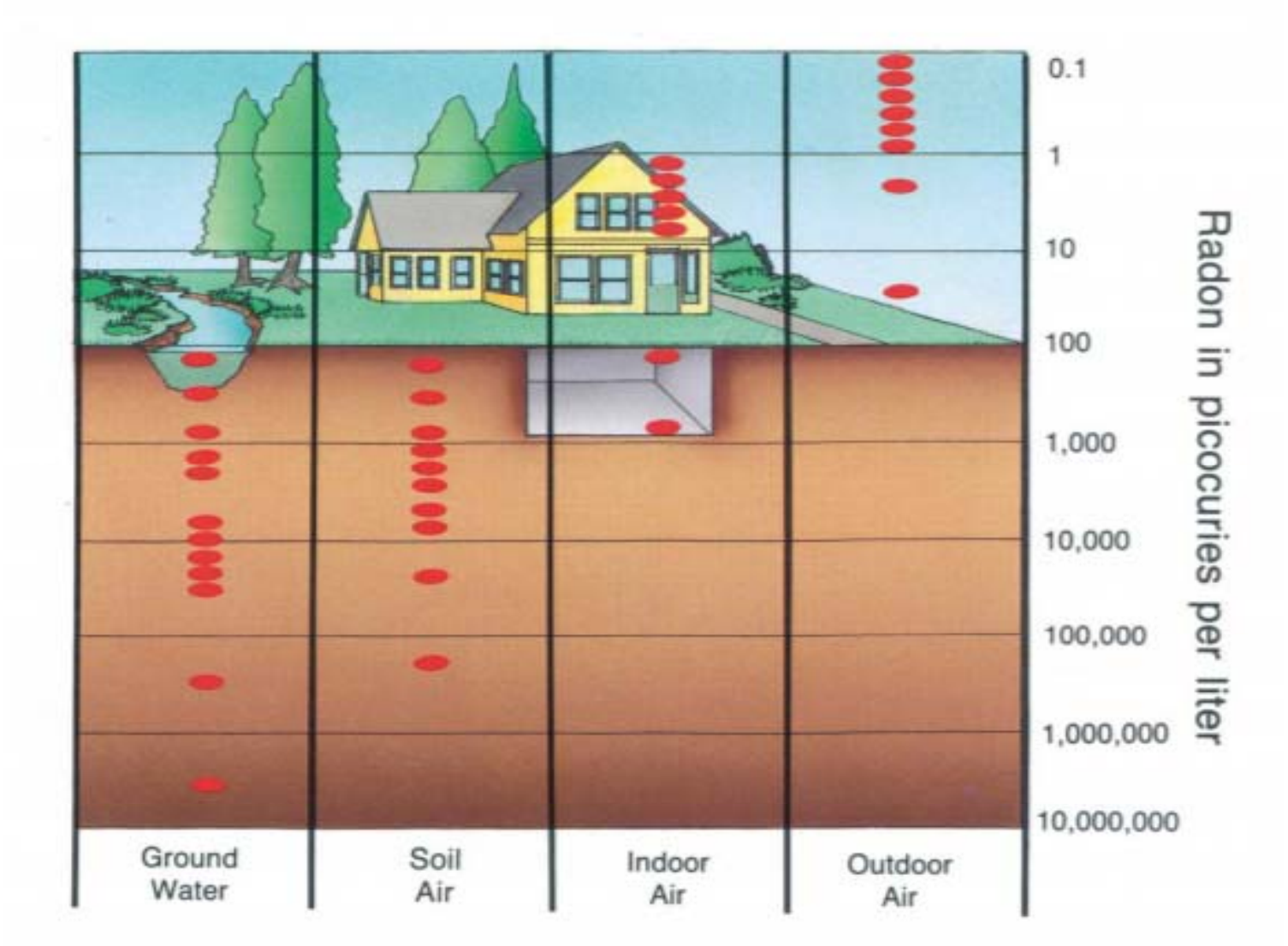
Radon From Geologic Sources



- *Radon is a gas*
- *It is naturally occurring outdoors*
- *You can not see or smell it*
- *It enters buildings primarily from the soil*

Notes:

- Radon is a gas that is created in the soils where uranium and radium are found. These elements can be found everywhere in the world, therefore any building has the potential for elevated levels of radon. The more uranium found in the soil, the higher the potential for elevated radon levels within a building constructed above this soil. It is not a question of, "Is there radon? " but rather, "How much radon is there?"
- Radon comes from natural deposits of uranium in the soil. It is not because of a manmade landfill or other suspicious sources.
- Uranium breaks down to radium, which in turn decays into radon gas. Radon is an inert gas, which means that it does not react or combine with the elements in the ground. Because of this, radon gas can move up through the soil into the atmosphere, where it is easily diluted and presents little concern. However, when it enters a building constructed on top of this soil, it can build up and become a health concern.
- You cannot see or smell radon. There is no way that your body can sense the presence of radon, yet it can have a detrimental effect on the inhabitants by increasing their likelihood of developing lung cancer.



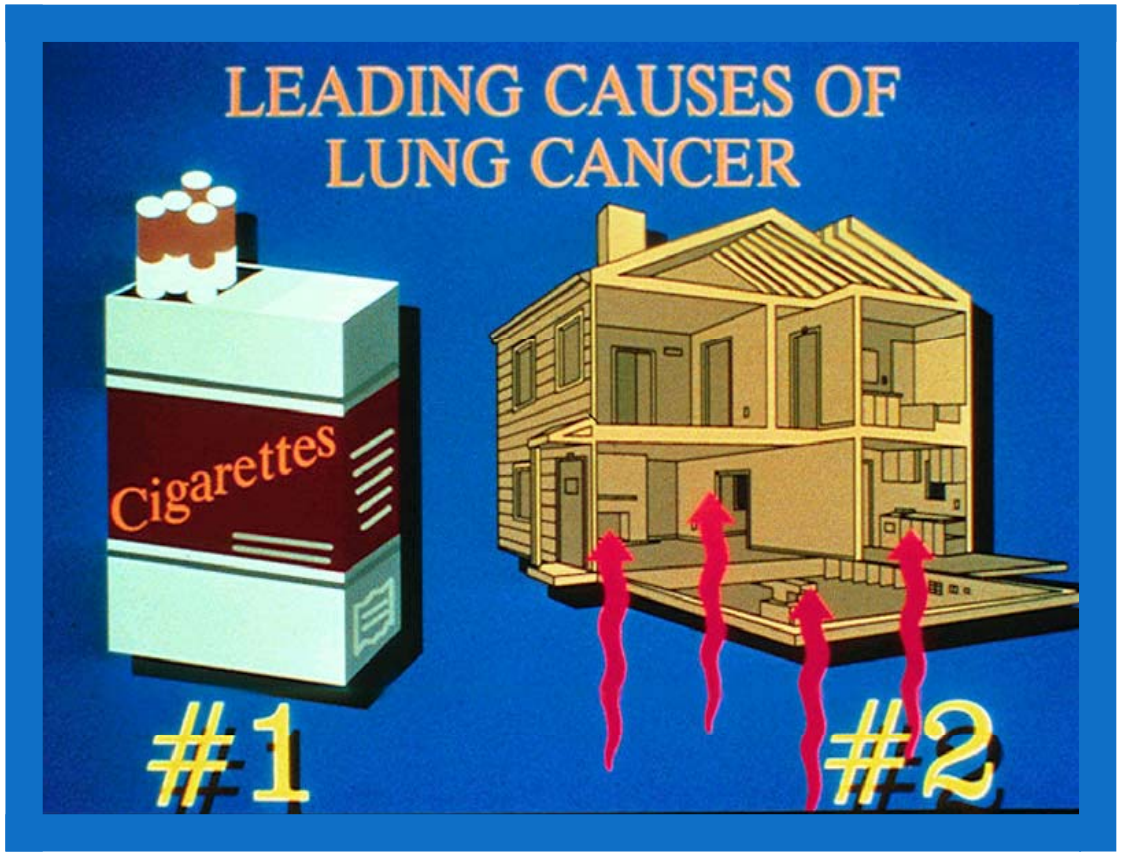
Credit: U.S. Department of the Interior. U.S. Geological Survey – The Geology of Radon

Notes:

https://pubs.usgs.gov/gip/7000018/report.pdf

500 tons of rock generally will have 1 to 3 pounds of uranium scattered through it. Rocks break down mechanically and chemically to form soils at the Earth's surface. It is not surprising, therefore, that most soils also contain small amounts (1 to 3 ppm) of uranium. In general, the uranium content of a soil will be about the same as the uranium content of the rock from which the soil was derived.

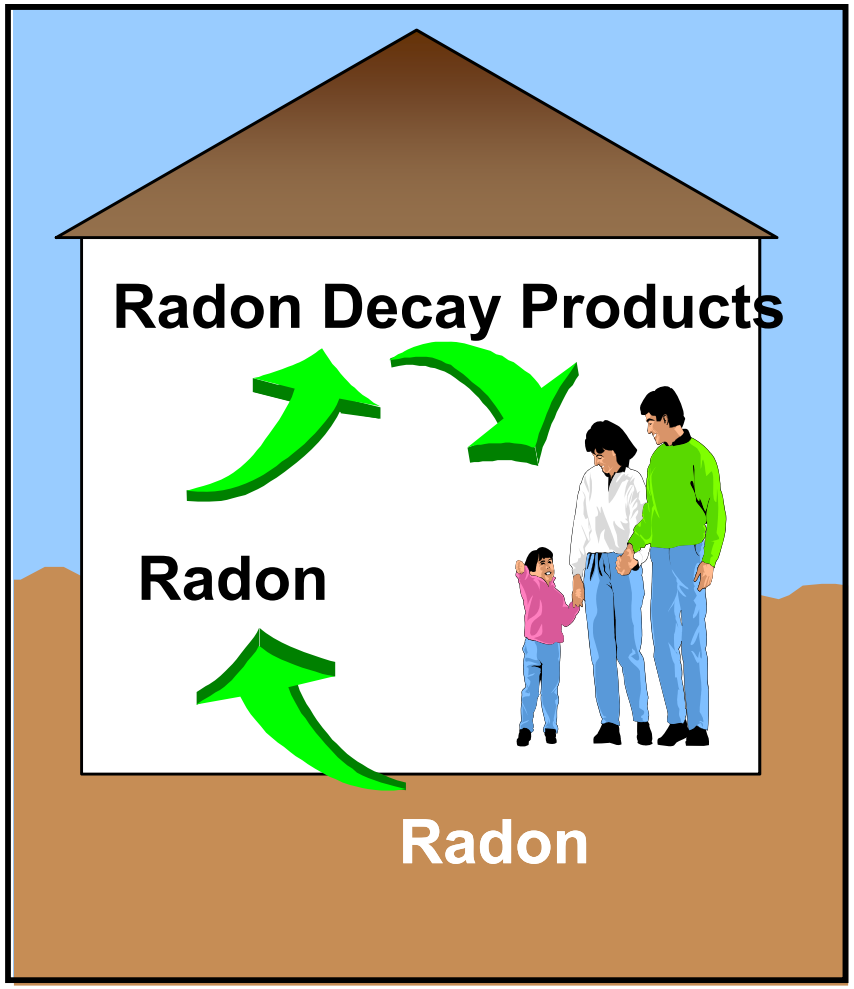
Radon Is SECOND Leading Cause Of Lung Cancer



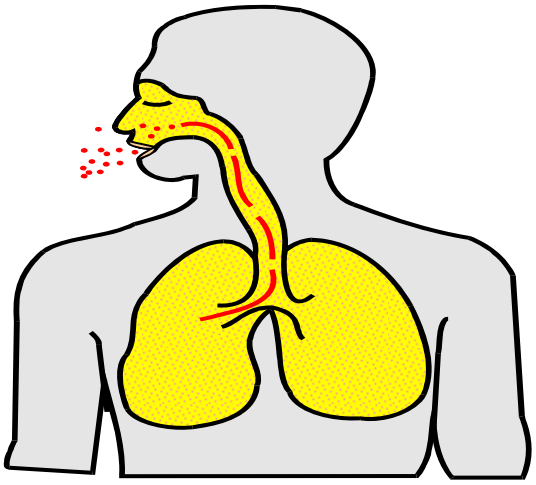
Notes:

- Scientists and the National Academy of Scientists estimate the exposure to elevated levels of radon gas may cause 15,000-22,000 lung cancer deaths a year, making radon the second leading cause of lung cancer, second only to cigarette smoke.
- It is estimated that 86% of radon-related lung cancer deaths are in current and former smokers. [Environmental Protection Agency EPA Assessment of Risks From Radon in Homes. Washington, DC: Office of Radiation and Indoor Air; June 2003], [Lubin JH, Boice JD., Jr Lung cancer risk from residential radon: meta-analysis of eight epidemiologic studies. J Natl Cancer Inst. 1997;89(1):49–57]
- According to the ATSDR, the risk of lung cancer from radon exposure is estimated at between 10 to 20 times greater for persons who smoke cigarettes as compared with those who never smoked. ATSDR = Agency for Toxic Substances and Disease Registry. (CDC.gov)

Why Is Radon A Health Concern?



These particles are easily inhaled and deposited in the lungs where they can damage sensitive lung tissue.

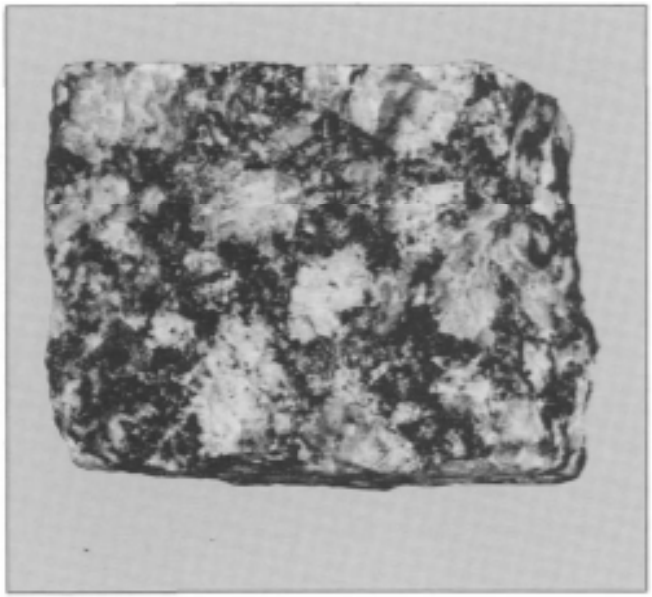


Notes:
Once radon enters a building it is easily dispersed through the air. The radioactive decay process that leads to the creation of radon gas does not stop. The radon decay path leads to several radioactive elements called **radon decay products**. These decay products are made up of different forms of polonium, lead and bismuth (all radioactive).

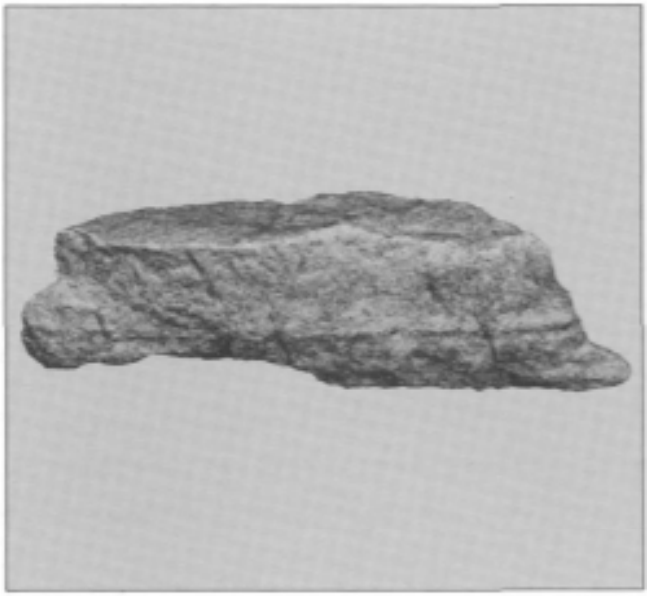
Unlike radon, which is a gas, the radon decay products produced from radon are solid particles. These particles become suspended in the air when they are formed from the decaying radon gas. These particles are extremely small and cannot be seen.

Because they are extremely small particles, radon decay products are easily inhaled and can attach to lung tissue. They have very short “half-lives” which means that they will decay through ionizing radiation relatively quickly after they are formed. In fact, if they are inhaled, they will decay in the lungs before the lungs have an opportunity to ‘clean themselves’.

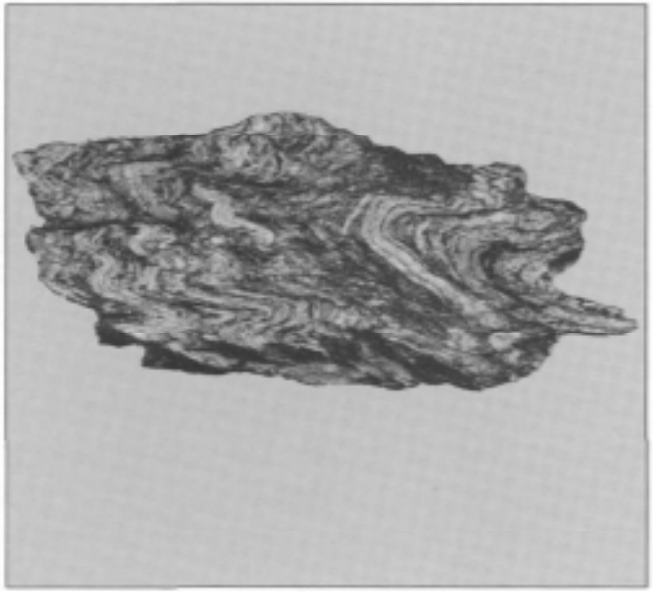
It is the radon decay products that actually present the health risk associated with radon gas.



Igneous



Sedimentary



Metamorphic

The three major rock types.

Notes:

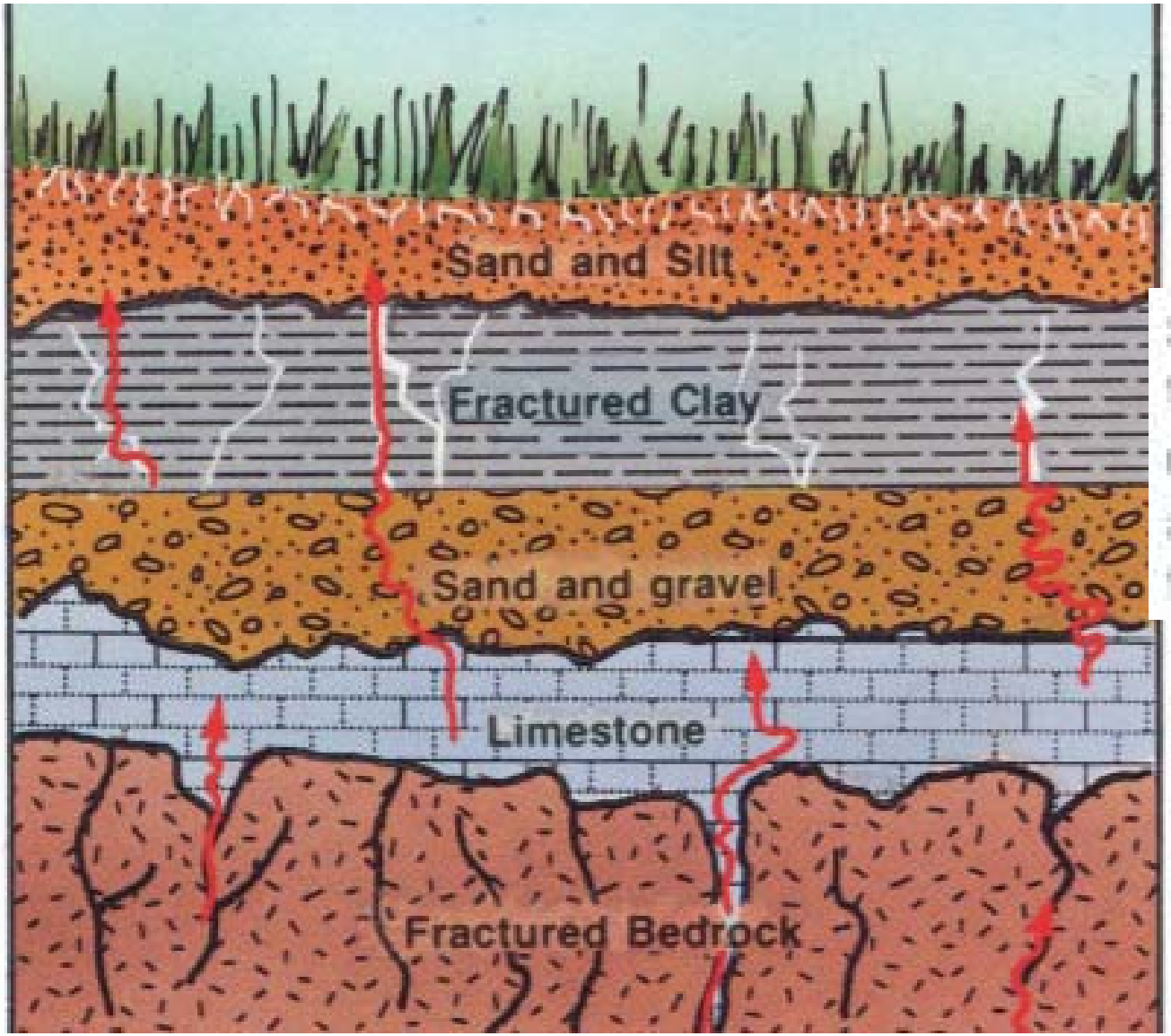
- All rocks contain some uranium – most contain just a small amount: between 1 and 3 pm.

- Some rocks have higher than average uranium concentrations: volcanic rocks, granites, dark shales, sedimentary rocks that contain phosphate, and metamorphic rocks derived from these rocks. These rocks and the soils may contain as much as 100 ppm uranium.

- But some houses in areas with lots of uranium in the soil have low levels of indoor radon, and other houses on uranium-poor soils have high levels of indoor radon. Thus, other factor affect the levels. [https://certmapper.cr.usgs.gov/data/PubArchives/radon/georadon/3.html]

Some types of rocks have higher than average uranium contents. These include light-colored volcanic rocks, granites, dark shales, sedimentary rocks that contain phosphate, and metamorphic rocks derived from these rocks. These rocks and their soils may contain as much as 100 ppm uranium. Layers of these rocks underlie various parts of the United States.

The higher the uranium level is in an area, the greater the chances are that houses in the area have high levels of indoor radon. But some houses in areas with lots of uranium in the soil have low levels of indoor radon, and other houses on uranium-poor soils have high levels of indoor radon. Clearly, the amount of radon in a house is affected by factors in addition to the presence of uranium in the underlying soil.



Some radon atoms remain trapped in the soil and decay to form lead; other atoms escape quickly into the air.

Notes:
Because radon is a gas, it has much greater mobility than uranium and radium. Radon gas can leave the rocks an surrounding soil where it was formed by escaping into fractures and openings in rocks and into the pore spaces between soil grains.
The ease/efficiency that radon moves in the pore spaces or fractures affects how much radon enters a home. Where it decays, after traveling the distance, is how it is likely to collect in high concentrations inside a building/home.

Radon gas movement is controlled by water present in the pore space (soil moisture content), the % pore space in the soil (porosity) and soil permeability.

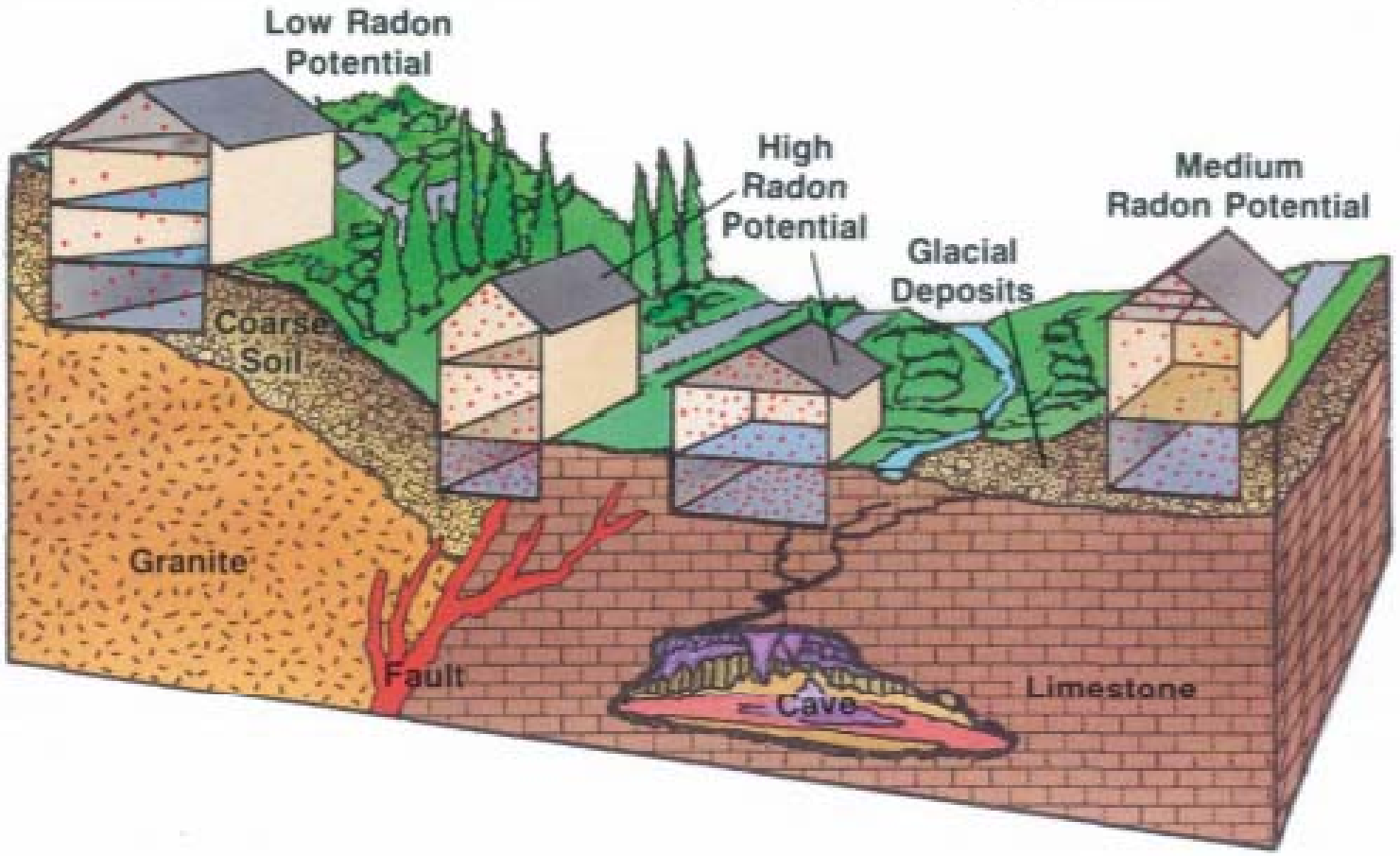
Radon in water moves slower than radon in air. Radon travels shorter distances in wet soils than in dry soils before it decays. For these reasons, homes in areas with drier, highly permeable soils and bedrock, such as hill slopes, mouths and bottoms of canyons, (coarse glacial deposits), and fractured or cavernous bedrock, may have high levels of indoor radon. Even if the radon content of the air in the soil or fracture is in the "normal" range (200-2,000 pCi/L), the permeability of these areas permits radon-bearing air to move greater distances before it decays, and thus contributes to high indoor radon. NEXT SLIDE….

Radon moves more readily through permeable soils, such as coarse sand and gravel, than through impermeable soils, such as clays. Fractures in any soil or rock allow radon to move more quickly.

Radon in water moves slower than radon in air. The distance that radon moves before most of it decays is less than 1 inch in water-saturated rocks or soils, but it is as much as 6 feet through dry rocks or soils. Because water also tends to flow much more slowly through soil pores and rock fractures than does air, radon travels shorter distances in wet soils than in dry soils before it decays.

For these reasons, homes in areas with drier, highly permeable soils and bedrock, such as hill slopes, mouths and bottoms of canyons, coarse glacial deposits, and fractured or cavernous bedrock, may have high levels of indoor radon. Even if the radon content of the air in the soil or fracture is in the normal range (200-2,000 pCi/L), the permeability of these areas permits radon-bearing air to move greater distances before it decays and thus contributes to high indoor radon.

Another type of information that scientists use in determining the radon potential of an area is radon measurements of local soil air. Existing indoor radon data for homes also are useful. These data are the most direct information available about indoor radon potential, even though the houses that have been sampled may not be typical for the area and exact location information for measured houses is seldom available.



Knowing the types of rock and soil at a site helps a geologist determine its radon potential.

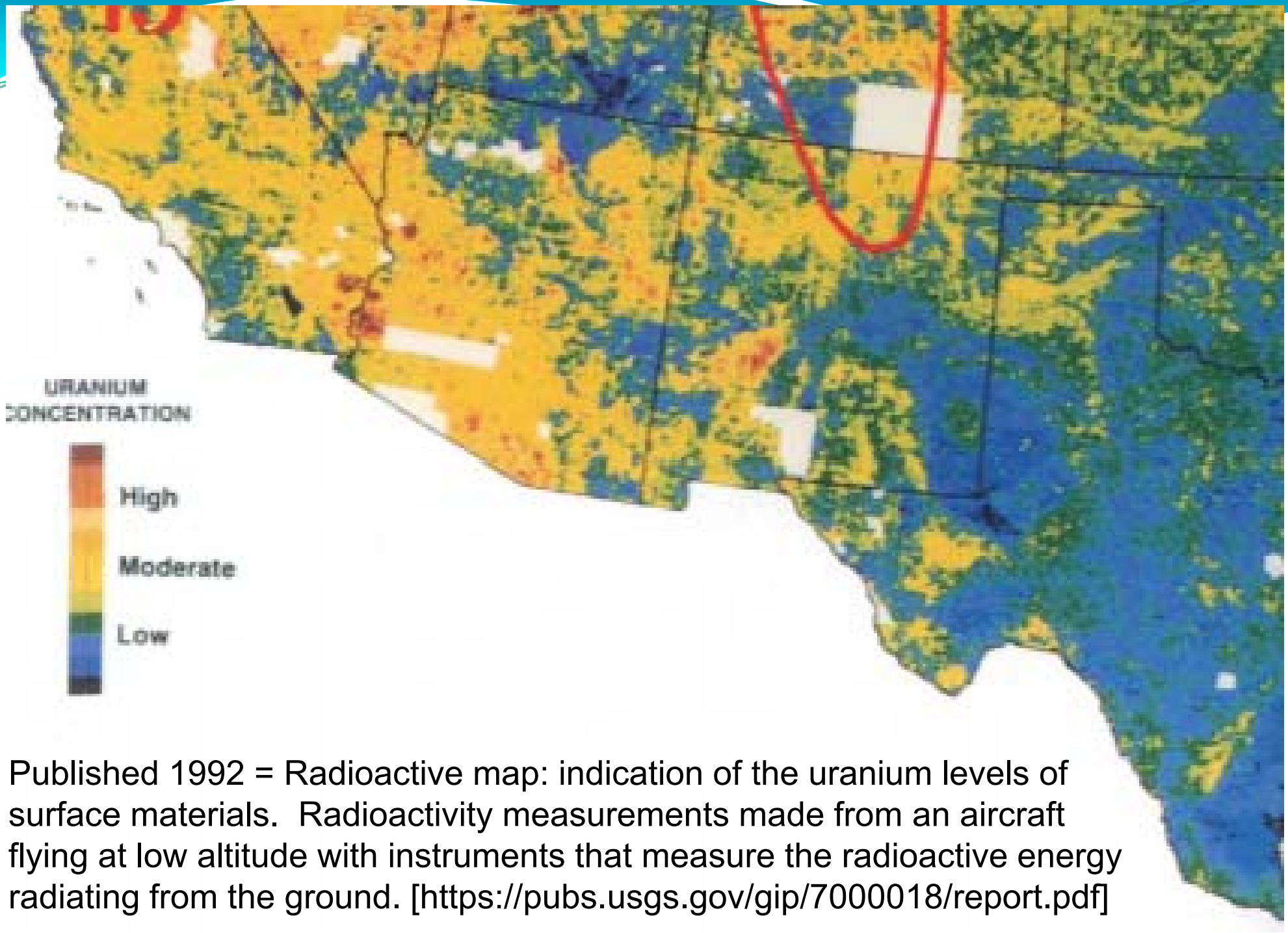
Notes:
Which home is on a hill slope?
Which home is built over fractured or cavernous bedrock?
Which home is on coarse glacial deposits?
[https://certmapper.cr.usgs.gov/data/PubArchives/radon/georadon/3.html]
Tills consisting of mostly coarse material tend to emanate less radon because larger grains have lower surface area-to-volume ratios, but because these soils have generally high permeabilities, radon transport distances are generally longer, and structures built in these materials are able to draw soil air from a larger source volume, so moderately to highly elevated indoor radon concentrations may be achieved from comparatively lower-radioactivity soils (14, 18). **In till soils with extremely high permeability, atmospheric dilution may become significant, and if the soils have low to moderate radium contents, elevated indoor radon levels would be less likely to occur.** Soil moisture has a significant effect on radon generation and transport and high levels of soil moisture generally lower the radon potential of an area. The main effect of soil moisture is its tendency to occlude soil pores and thus inhibit soil-gas transport. Soils in wetter climates from northern Minnesota to northern Michigan generally have lower radon potential than soils derived from similar tills in the southern parts of those states and in Indiana and Illinois, in part because of higher soil moisture conditions to the north.
[https://certmapper.cr.usgs.gov/data/PubArchives/radon/midwest5.html]

Typical of Austin area.

Evaluating radon potential

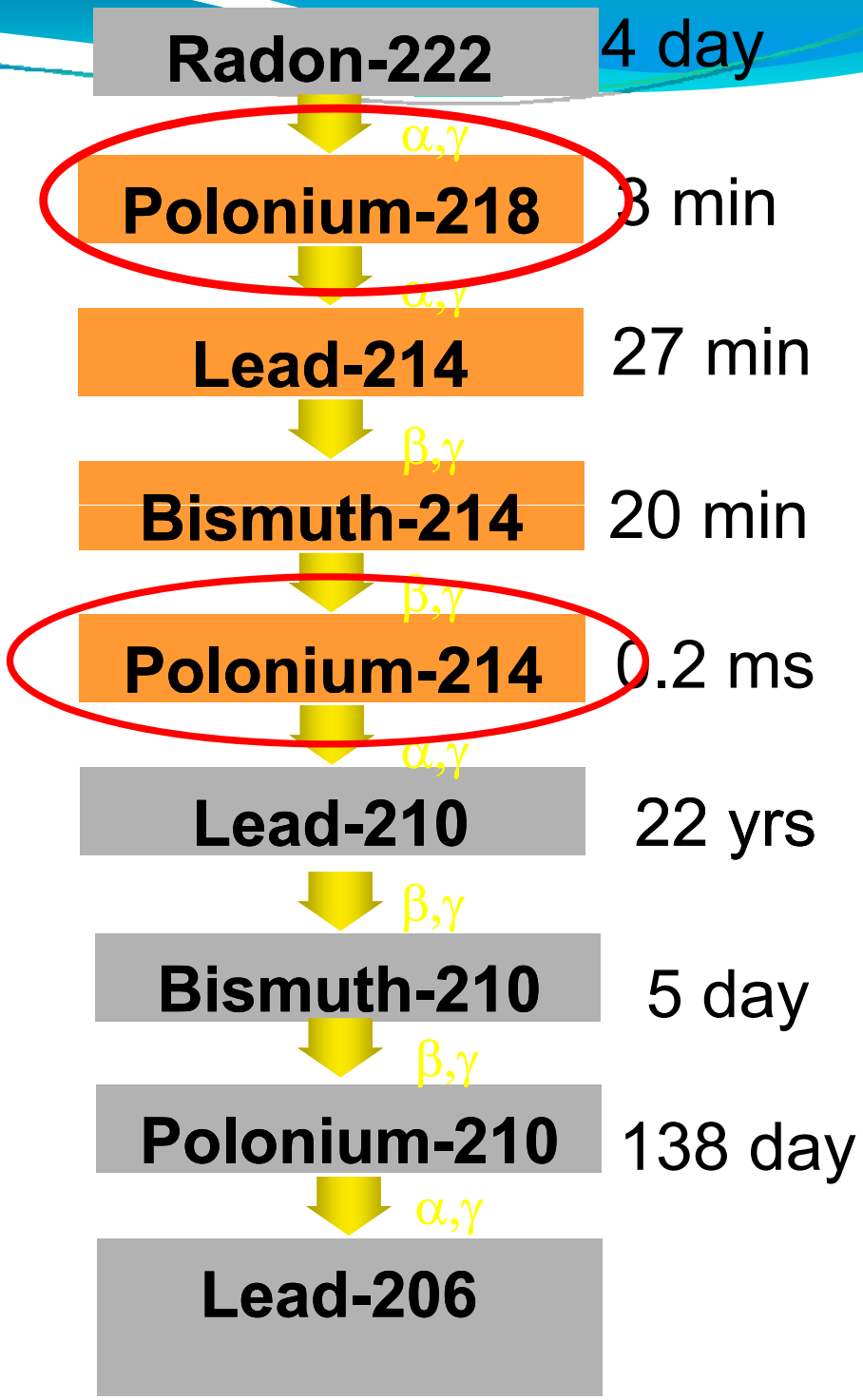
By knowing something about the geology and soils of the area, scientists can evaluate the radon potential for the rocks and soils of housing sites or areas of interest. These factors can increase the probability that an area will have above-average levels of radon.

1. Uranium-rich rocks occur in the area.
2. Highly permeable soils are present.
3. Soils are well-drained or dry most of the time.
4. Soils form deep cracks during dry times of the year.
5. The site is located on a hill or slope.
6. The soils are thin and bedrock is close to the surface.
7. Underlying rocks are fractured.
8. The underlying rock contains limestone caverns.
9. High levels of indoor radon have been reported in the county or neighborhood.



Published 1992 = Radioactive map: indication of the uranium levels of surface materials. Radioactivity measurements made from an aircraft flying at low altitude with instruments that measure the radioactive energy radiating from the ground. [https://pubs.usgs.gov/gip/7000018/report.pdf]

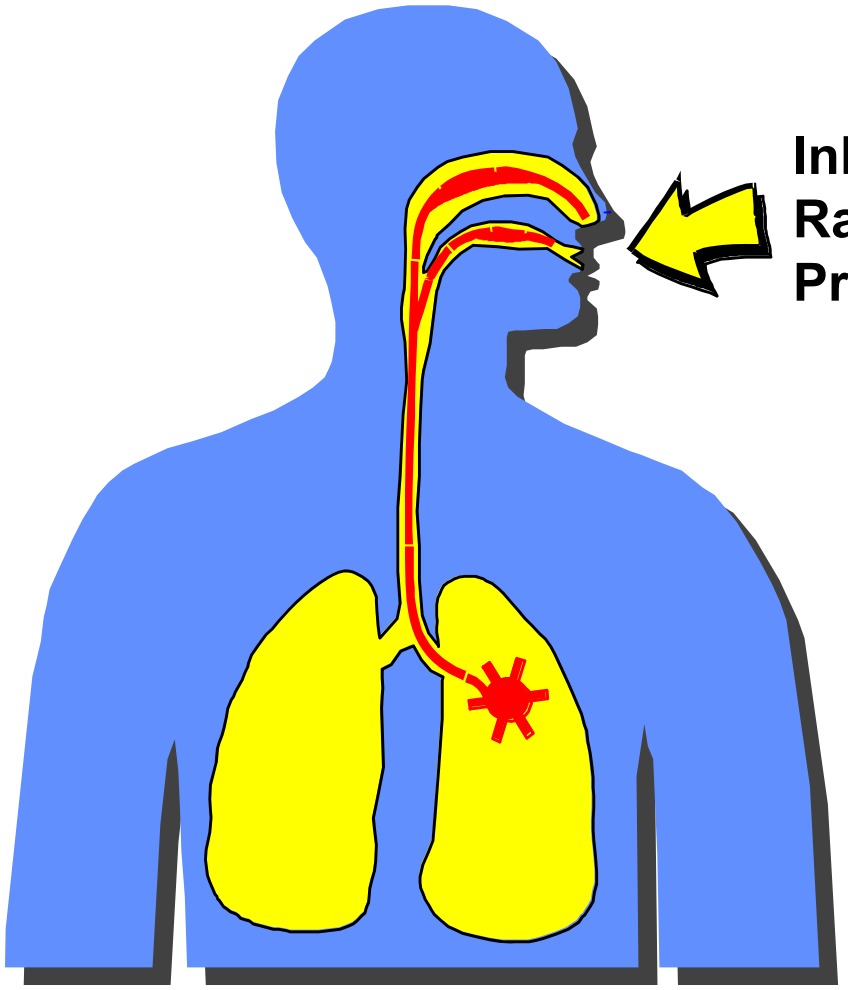
Radon Decay Products



Po-218 and Po-214 deliver the majority of radiation dose to the lung.

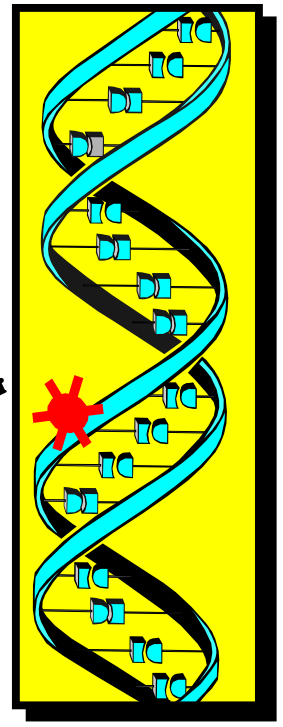
Predict how much potential radioactivity will occur in coal ash by measuring the uranium content in the parent coal

How Radon Causes Lung Cancer



Inhalation of Radon Decay Products

Alpha Particle



Radiation Damage to DNA

Notes

- As you breathe radon and radon decay products enters your lung. As radon decays, it releases small bursts of energy called alpha particles. These energy bursts can damage lung tissue and over time lead to lung cancer. The higher your radon level, the greater your risk of developing lung cancer.

- [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3256534/] At the worst, this results in a malignant cellular transformation and, as a consequence of that, the development of lung cancer. In general, naturally occurring radionuclides (e.g., 222Rn, 40K) are attached to so-called carrier aerosols. The aerodynamic diameters of such radioactively labeled particles generally vary between several nanometers (ultrafine particles) and few micrometers, whereby highest particle fractions adopt sizes around 100 nm. .... distribution patterns of radiation doses mainly depend on the size of the carrier aerosol. Ultrafine (< 10 nm) and large (> 2 μm) aerosol particles are preferentially deposited in the extrathoracic and upper bronchial region, whereas aerosol particles with intermediate size (10 nm–2 μm) may penetrate to deeper lung regions, causing an enhanced damage of the alveolar tissue by the attached radionuclides.....Normally, point or cluster damages of the DNA molecule are restored with the help of various reparation mechanisms. A failure of this restoration may generally occur in two forms: first, DSBs of the DNA remain unrejoined, resulting in cytotoxic effects; second, DNA damages are repaired incorrectly, causing the development of mutations.

What Are the Health Risks of Radon?

- Breathing air with elevated radon levels over long periods of time is known to increase your risk of lung cancer.
- Radon is a class “A” carcinogen.
- Second leading known cause of lung cancer, with cigarette smoking being number one.

Notes:

- There are three kinds of scientific evidence used to determine health risk to humans. Human data, animal data and medical models, which are projections on paper expected to be true based on known evidence and reasonable assumptions. Studies based on human data are considered the most reliable and are classified as class "A". Radon is a class "A" carcinogen.
- Based on animal and human evidence, several expert agencies have evaluated the cancer-causing potential of radon.
- The **International Agency for Research on Cancer (IARC)** is part of the World Health Organization (WHO). One of its goals is to identify causes of cancer. Based on sufficient evidence that radon and its progeny can cause lung cancer, IARC classifies them as "carcinogenic to humans."
- The **National Toxicology Program (NTP)** is formed from parts of several different US government agencies, including the National Institutes of Health (NIH), the Centers for Disease Control and Prevention (CDC), and the Food and Drug Administration (FDA). The NTP has classified radon as "known to be a human carcinogen."
- The US **Environmental Protection Agency (EPA)** monitors the human health effects from exposure to various substances in the environment. The EPA lists radon as the second leading cause of lung cancer and the number one cause of lung cancer among non-smokers, estimating it is responsible for about 20,000 lung cancer deaths every year.
- The EPA considers *Class A carcinogens* as pollutants with adequate human data indicating the chemical causes cancer in people.
- IARC and NTP - Group 1: Carcinogenic to humans.

Radon is A Serious National Health Problem

- National health experts recommend testing your home for radon:
  - Surgeon General
  - American Lung Association
  - American Medical Association
  - American Cancer Society
  - American Public Health Association
- The 1998 report by the National Academy of Sciences ‘Health Effects of Exposure to Indoor Radon’ reaffirmed the risk from radon and estimated that radon causes between 15,000 and 22,000 lung cancer deaths per year in the U.S.

Notes:

- A report released by the National Academy of Sciences (BEIR VI) in 1998 states emphatically that there is no question that exposure to elevated levels of radon increases risk of developing lung cancer.

How Does Radon Rank As A Cancer Causing Agent?

- Radon is ranked as a Group A carcinogen
  - Highest ranking for cancer potential
  - Known to cause cancer in humans
  - Tobacco smoke and tobacco products in same category

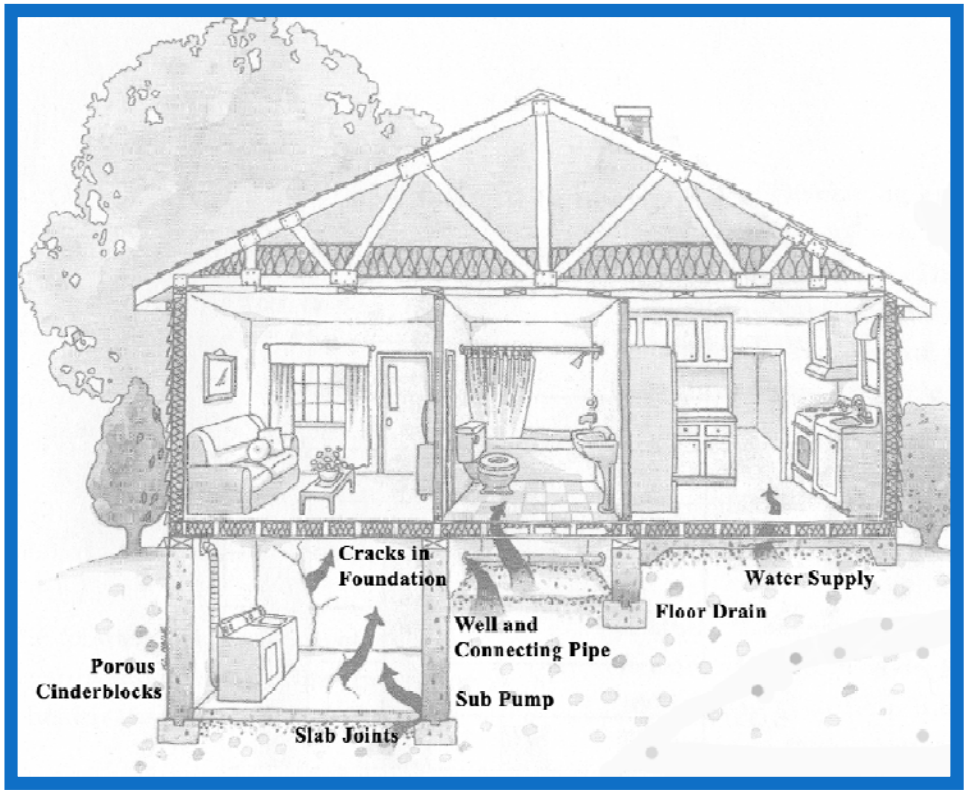
International Agency for Research on Cancer

Notes:

- Due to the amount and strength of data that has been collected, radon is placed in the highest category of cancer causing agents. This category is referred to as Group A, which contains materials that are known to cause cancer in humans.
- Being a Group A carcinogen certainly underscores the reasons there are concerns about radon.
- Being a Group A carcinogen also strengthens concerns about liability when a home or commercial building is sold. This is why radon testing has become more common at the time of sale.

How Radon Gets Into A Home

- Radon enters your home through openings to the soil in and around your home
- The most common pathways include openings around water pipes, sump pumps and drains as well as cracks in the floor wall joints and visible cracks from “settling”



Notes:

- High concentrations of radon in soil gas in soils with high transport efficiency (i.e. loose, porous, dry soil) can lead to elevated radon concentrations in buildings.
- Transport from soil into buildings because the pressure inside buildings is usually lower than that in the soil, especially in the winter. Houses with no barrier between the soil and the interior, i.e., with a dirt floor in the basement or crawl space, are especially vulnerable. Houses with porous foundations, e.g. concrete block or fieldstone, present only a minimal barrier to flow. Even houses with poured concrete basement floors and foundations usually have routes of entry for soil gas through joints, penetrations, cracks, sumps, and drains. Radon can enter a house from soil gas through ground level drainage systems, through flaws in a concrete floor slab, and through concrete block walls.
- Radon concentrations indoors will generally be highest in the basement or on the ground level since the major source is influx from the soil under and around the house. First floor concentrations will be lower by about a factor of two. Indoor radon concentrations are typically a factor of 2 to 3 higher than outdoor levels. The radon concentration in the upper levels and in apartments above the first floor are usually of no concern.
- In addition to soil and water sources of indoor radon, home construction materials can be a significant contributor. The concrete used in building depending on its origin can be a major contributor, and in all cases, concrete is a more significant radon source than other building materials.

What Factors Can Influence Radon Levels In My Home?

- The strength of the source; how much uranium/radium is in the soil
- Porosity of the soil
- House construction including foundation type: Basement, Crawlspace, Slab-on-grade
- Weather conditions: Wind, temperature, barometric pressure
- Occupant activity

Notes:

- First and foremost, the strength of the source influences radon levels. Secondarily, the type of soil is an important factor. If soil is porous, soil gases (including radon) can travel more easily. Note that soil conditions can change: hard red clay may not allow for soil transport but dry, cracked clay can. Statistically, basement homes are more likely to have elevated radon levels, but high levels have been found in all home types. Normal everyday activity puts a house under negative pressure. Things that "use" or "pull" the air in a house include running a furnace, bathroom or kitchen fan or clothes dryer. Also, a fireplace can pull air from the house. This air is replaced and often the replacement air comes through basement walls and floors, pulling soil gases, including radon, into the house. If a heavy storm or high winds occur, radon levels can be affected too.

- Additional note:
- Have you ever walked up to a building and tried to pull open the door to enter and the door hits you in the face? Like it's almost being blown into you? That building is under "positive" pressure. There is so much air in the building, it is rushing to get out. Now think about a building you have tried to enter and you can barely get the door open, and as you do, you can feel the rush of air being pulled in. That building is under "negative" pressure, needing to make up air that has been lost. Or think of the house as a giant vacuum cleaner on the soil, pulling soil gas into the breathable air space of the house to make up the air being lost.

Testing Is The Only Way To Know If You & Your Family Are At Risk

Notes:

- Because radon comes from geology, rock and soil, because geologic formations are not uniform, and because of all of the variables in house construction and occupancy patterns, one home can be high and the one next door low.

- Note: it is not practical nor feasible to test the soil before constructing a home to predict what the radon level might be.

How Do You Know If You Have A Radon Problem?

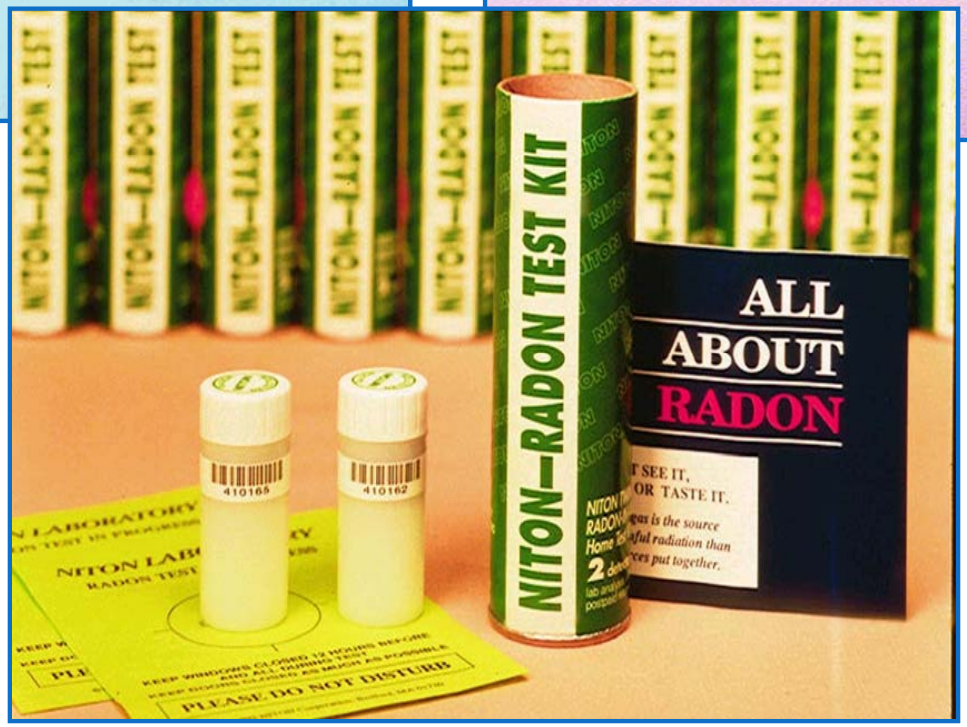
TEST

TESTING IS EASY AND INEXPENSIVE

Notes:
At slide 16 or 18 presenter should mention any specific info on how to get a test kit. If possible show and pass around various types of detectors. There are several ways to measure a home for radon. For self testing, the most commonly used devices are the charcoal detector and the alpha track detector. Both types of detectors come with easy-to-follow instructions. To perform a reliable radon test in your home: 1. Obtain a fresh test from a reliable source. 2. Follow instructions. 3. Deploy the detector and return it to the lab in a timely fashion. For a short term test it is important to observe closed house conditions, meaning all doors and windows are kept closed (except for normal entry and exit) 12 hours prior to the test and for the duration of the test.

These testing devices are placed in the home for 2-7 days for the charcoal detector and from 3 months to a year for the alpha track detector (a long term testing device). Other testing devices are available such as electret ion chambers and active sampling devices often used by radon professionals. These more active sampling devices often can read variations in temperature and barometric pressure changes and movement to detect any possible tampering. They are often used in real estate transactions.


KEEP BAG SEALED
197632


NITON—RADON TEST KIT
ALL
ABOUT
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410165
410162
PLEASE DO NOT DISTURB

Notes:
To do a screening test, place a testing device on the lowest livable level of the home for the specified testing period, remembering closed house conditions. A charcoal canister is sensitive to moisture so it should not be placed in a bathroom or kitchen where humidity may be higher.

For practical reasons when conducting test with an alpha track detector, whether for a 3 month screening or a one year confirmatory, closed house conditions can not always be observed, but it is suggested that a portion of the test be done over the winter months when the house is closed up.

Additional: Consider what you are trying to learn about your home when testing; what your family is being exposed to and the worst case scenario, potential risk for the building. Worst case conditions for an initial screening are lowest livable level (no exposed soil is usually considered a “finished” basement) during the winter months. Some people choose to do a concurrent test on the main floor for comparison, especially if they spend little or no time in the basement. In a real estate transaction, the potential risk for the building is at issue because the occupancy patterns of the new residents are unknown, and there are time factors to consider. For more information see the EPA publication *Home Buyers and Sellers Guide to Radon*.

How Is Radon Measured?

- Radon is measured in pico-curies per liter of air (pCi/L). While no level of radon exposure is considered safe, EPA has set an action level at 4 pCi/L
- If radon test in a home shows levels at or above 4 pCi/L, the home should be retested and then fixed!

Notes:
Radon results are reported in terms of picocuries per liter of air (pCi/l). Picocuries are a measurement of radiation. While no level of radiation is considered safe, the EPA has established an action level of 4 picocuries per liter. This guideline takes into account both health risks and current technology. In most homes, radon levels can reliably be reduced to this level and often even lower.

The higher the radon level in your home, the more urgent it is to take corrective action to lower the levels and avoid unnecessary health risks.

TEST NOW AND BE SURE

What Should I Do If My House Has Elevated Radon Levels?

- Contact your state radon program office
  - Lucy Lim – TX Tech University
- EPA's booklet, *A Citizens Guide to Radon,* can help you interpret your results and determine next steps
- Visit EPA's website at www.epa.gov/radon
- If the levels in your home are high, take steps to reduce the levels in your home

Notes:

A screening measurement between 4 and 20 picocuries per liter should be confirmed with a one year confirmatory test. Between 20 and 200 a follow-up test of no more than three months should be completed. And over 200 picocuries, you should not wait more than a few weeks to take corrective actions.

How Can I Fix My House If It Has Elevated Levels?

- Mitigate Your Home for Radon. A contractor can:
  - Install a system to reduce radon levels
  - Prevent it from ever entering the living space
- Contact your state's radon program office for a list of qualified radon mitigators
- EPA's booklet *A Consumers Guide to Radon* will be helpful in understanding radon mitigation in your home

Notes:

If you have tested and confirmed your measurements and you have elevated radon levels, know that it is a problem which can be fixed. There are three basic approaches to reducing radon levels: prevent its entry by sealing cracks and openings, dilute the levels by increased ventilation and install an active system venting the gas from under the foundation before it enters the house.

http://aarst-nrpp.com/wp/database-search/
Search by state and provider services

Can't I Just Seal Cracks in the Floor or Open Windows?

- Sealing visible cracks is a basic part of most radon mitigation approaches, but sealing alone is NOT enough
- Opening doors and windows to dilute the radon may sometimes be effective, but it is NOT a practical long-term solution

Notes:

Sealing alone is generally not a solution, but an important first step to take. Dilution, opening doors and window, or using forced ventilation to blow fresh air into the basement (which may also create a positive pressure in the room keeping radon out) can be effective, but is impractical as a long term solution and would typically only be done until a more permanent solution can be implemented.

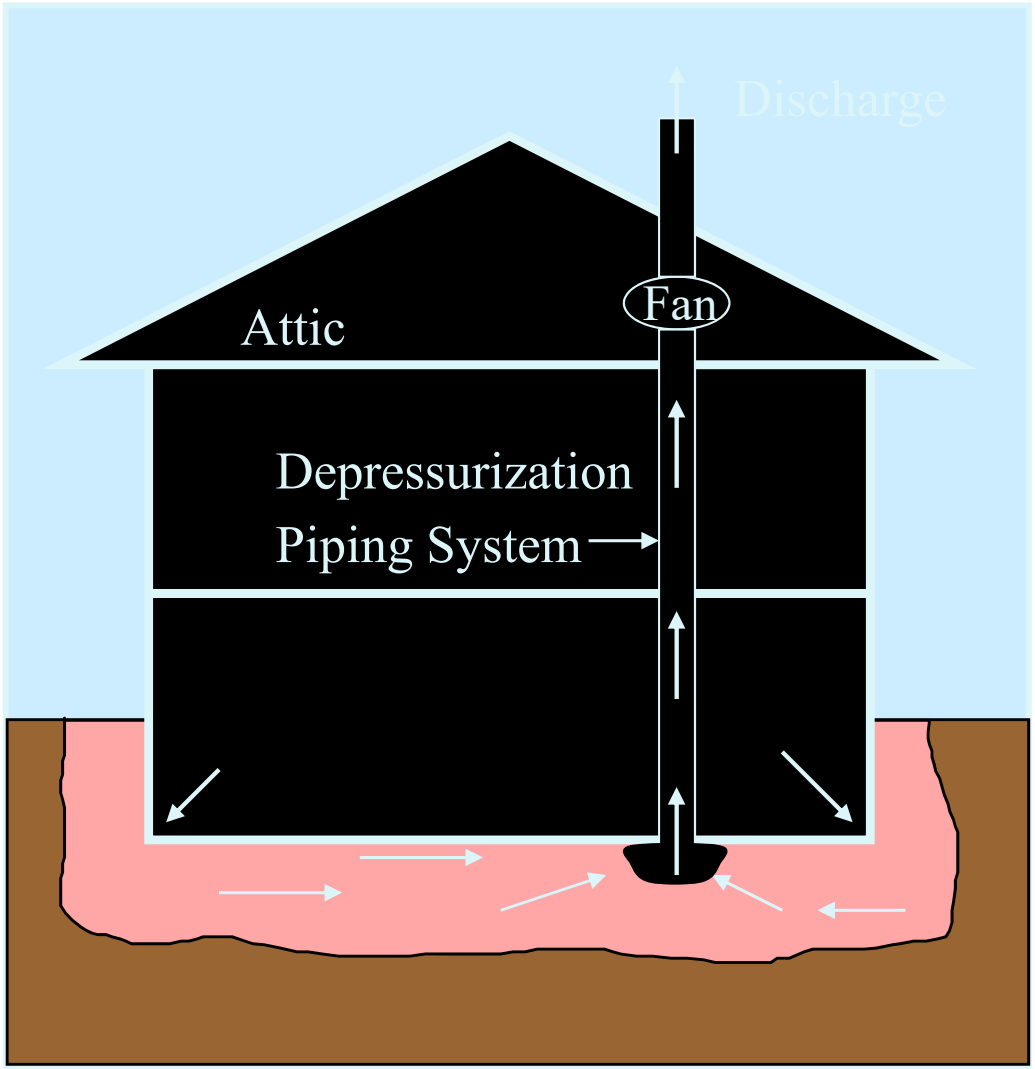
Radon Mitigation In Your Home

- Most commonly installed system is called “sub-slab depressurization”
- System is simple, effective and energy-efficient
- Uses plumbing-type PVC pipe and a small fan to remove radon
- In most cases levels can be reduced below 2 pCi/L

Notes:

That solution most often would be “sub slab depressurization” or “active soil depressurization.” The real work horse of radon mitigation, this system is used more than 90% of the time. Simply put, it pulls radon from underneath the slab (or in a crawl space from underneath an installed plastic membrane) and vents it to the outside.

How Sub-slab Depressurization Works in a Home



- Suction created by fan draws radon from beneath the concrete slab and safely vents radon outdoors
- Most common type of radon mitigation system

Notes:

PVC pipe, usually 3-4 inches in diameter, is installed from a hole drilled in the slab. It runs through the home, usually through closet space and exits out the roof. A special quiet, energy-efficient fan is installed in the pipeline at the attic level. The fan pulls the radon from beneath the slab and vents it to the outside, before it can enter the breathable air space of the house. Rarely, it may be acceptable to install the vent on the side wall of a house, but this should be done with extra caution. The pipe exit should not be within 10 feet of a door and window, or radon exiting the pipe could be re-entrained into the house. Also the fan should not be located in the living space. If a leak were to occur on the “up” side of the fan, radon would be pulled into the house at a very high concentration.

It's a Myth

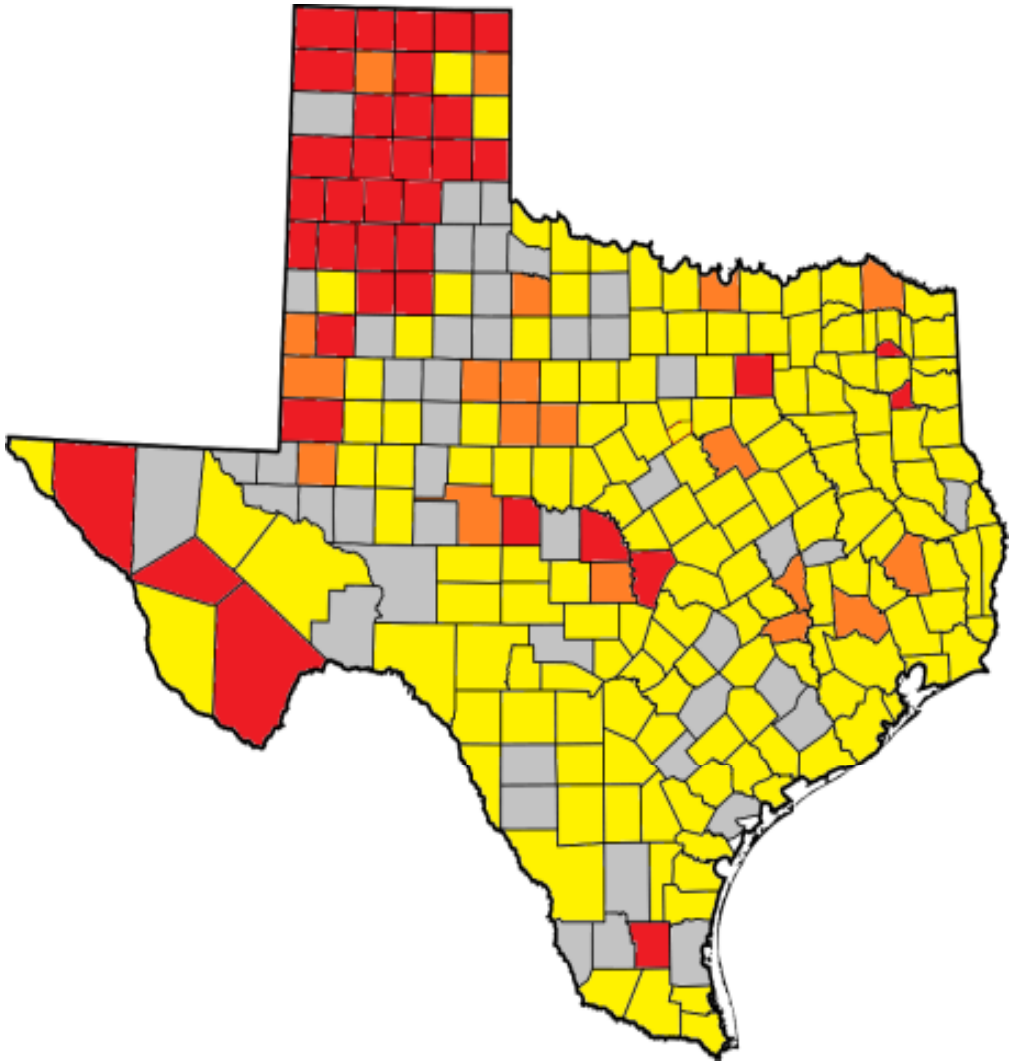
- If people are given enough information about radioactivity, they'll make a wise decision on how to react

- **NOT!**

- There is ALWAYS an emotional component to a decision

Making Radon Emotional

- Radon is a colorless, odorless, tasteless gas that comes from radium in the soil
- Every house has radon
- Radon increases your chance of getting lung cancer
- There is radioactivity in your house
- You won't know it's there
- Even this house has radioactivity
- You've got it—how much?
- Radon kills people



Texas

Notes:

In the process of being updated. Red = Highest Potential → greater than 4 pCi/L; Orange = Moderate Potential (from 2 to 4 pCi/L); Yellow = Low Potential (less than 2 pCi/L); Gray = counties with no results received by testing lab sourced for data.

https://www.epa.gov/radon/find-information-about-local-radon-zones-and-state-contact-information#radonmap

Early map version: data collected late 1970s and published early 1980s. More homes, yields improved data, improved technology yields improved data.

Texas

- 38,274 Results
  - 72.24% below 2 pCi/L
  - 8.64% between 2-4 pCi/L
  - 7.40% between 4-10 pCi/L
  - 11.72% above 10 pCi/L
- Most tested counties
  - Dallas County – 19,466
  - Travis County – 5,001
  - Tarrant County – 3,526
  - Collin County – 1,759
- State Average – 3.45 pCi/L
- State Population – 26.96 Million

Texas

State Population – 26.96 Million

- 10,255,642 homes (2.62 persons per home)
  - Only 0.4% of homes tested with Alpha Energy Lab since 2001!
- Up to 10,217,368 untested homes!
  - Up to 26,769,504 people living in untested homes!
- Up to 1,953,560 untested homes above 4.0 pCi/L
  - 19.12% of homes above 4.0 pCi/L (based on Alpha Energy Lab Results)
- Up to 5,118,329 people living in homes above 4.0 pCi/L
  - 5,118,329 people at risk in these homes!
  - Up to 35,828 people may develop lung cancer (based on EPA radon risk chart at 4.0 pCi/L)

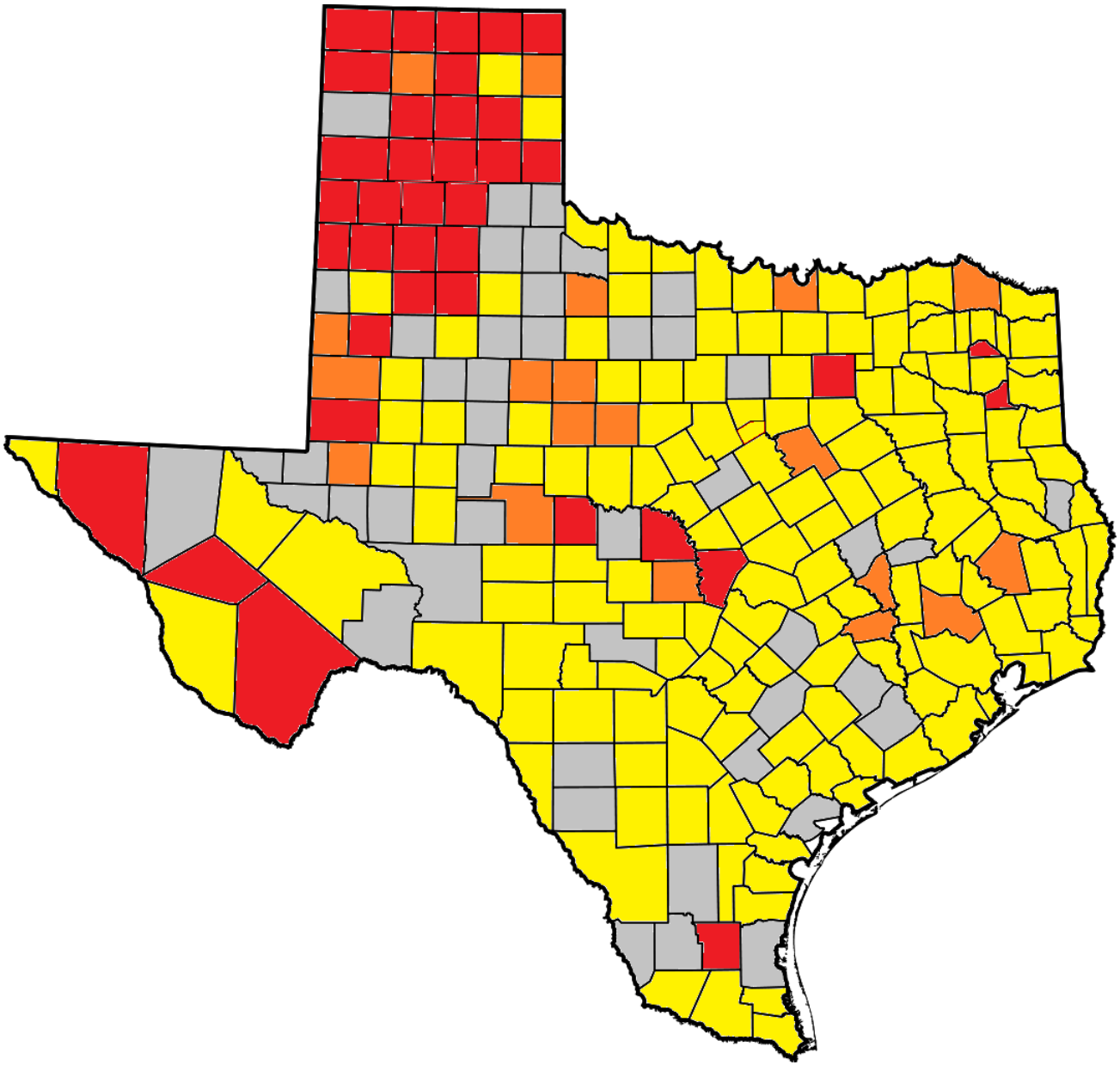
Texas

Highest Counties (min 30 results)

- Brewster County (9.76 pCi/L) – 35 results
  - Population 9,286
  - 37.14% above 10 pCi/L
- **Randall County (8.50 pCi/L) – 307 results**
  - Population 126,474
  - 19.87% above 10 pCi/L
- **Lubbock County (6.02 pCi/L) – 186 results**
  - Population 289,324
  - 16.13% above 10 pCi/L
- **Dallas County (5.42 pCi/L) – 12,990 results**
  - Population 2.48 Million
  - 22.75% above 10 pCi/L
- Hale County (4.33 pCi/L) – 49 results
  - Population 35,764
  - 4.08% above 10 pCi/L
- **Potter County (4.19 pCi/L) – 229 results**
  - Population 121,661
  - 11.79% above 10 pCi/L

Texas

Radon Risk Map – Alpha Energy Database



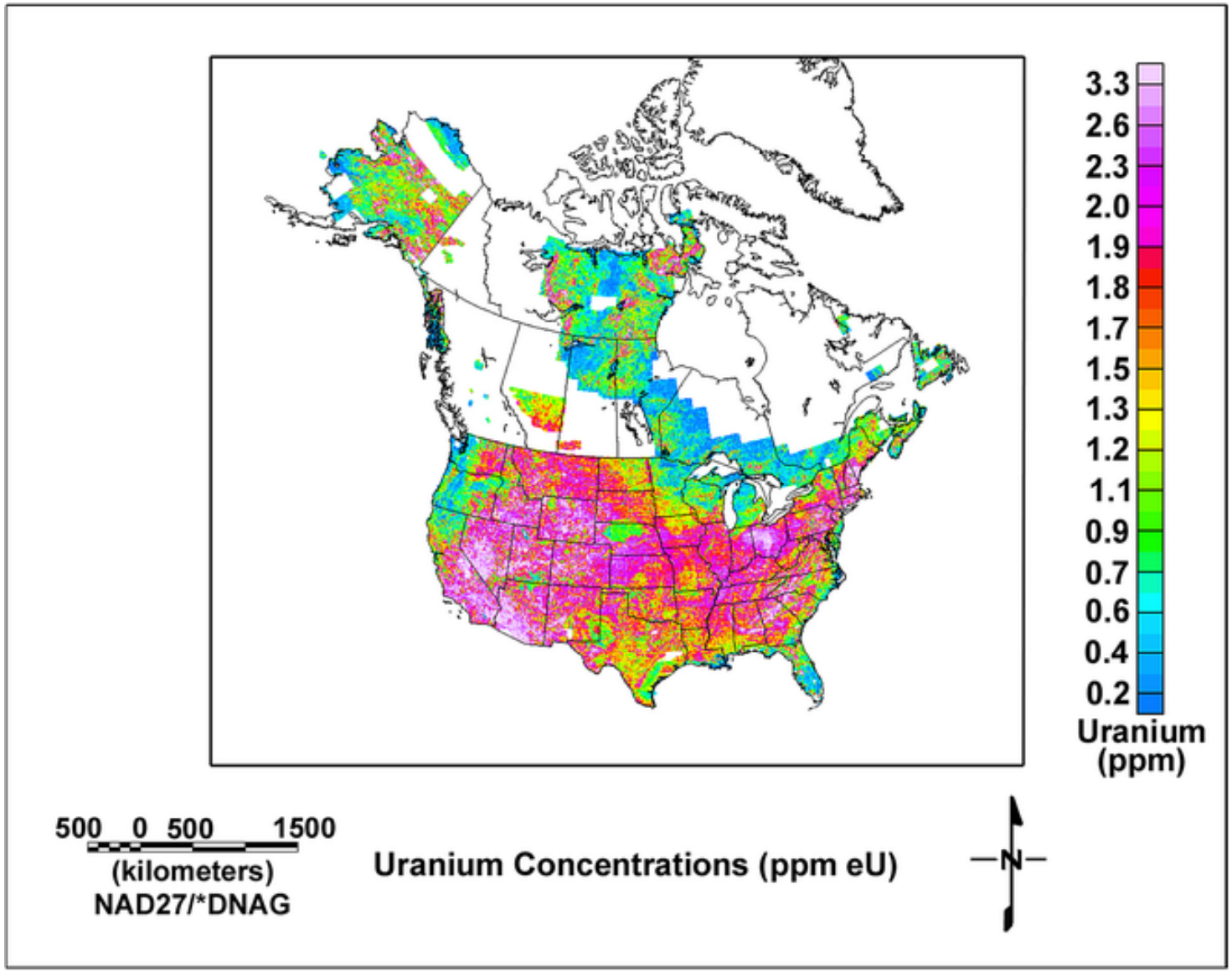
LEGEND:

- <2 pCi/L
- 2-4 pCi/L
- >4 pCi/L
- Not enough data

Notes:

In the 1930's, when Lake Buchanan was planned, the value of the water supply exceeded the value of continued mining. Mine production included commodities feldspar, fluorinefluorite, zirconium, REE, beryllium, uranium, titanium, metal, thorium, molybdenum, lead, lithium, rubidium, phosphorus-phosphates, copper, and zinc. A new rare-earth deposit has been discovered a few hundred miles west of the field-trip area. Hulse, et al., (2013) report that a large porphyry-style rare-earth deposit found at Round Top, Texas has been drilled indicating large tonnage, high in so-called light rare-earths and heavy rare-earth oxides, plus additional metals of economic interest. For example, the deposit also contains significant uranium, thorium and other specialty metals, as well as other incompatible elements such as Li, Be, F, U, Th, Nb, Ta and Hf (see Table 9), and evenly distributed yttrofluorite and yttrocerite with minimal overburden.

Uranium was discovered in Texas in the mid-1950s in Karnes County. Deposits were found in Tertiary formations in a mineralized zone that extends from the central Coastal Plain southwestward to the Rio Grande. Uranium mineralization was subsequently discovered in the Trans-Pecos area, the Llano Uplift, and the High Plains. A small amount of uranium was produced from deposits in the High Plains during the 1950s, but most of the Texas production has been from the Coastal Plain. In the past uranium was produced from surface mines in Atascosa, Gonzales, Karnes, and Live Oak counties.

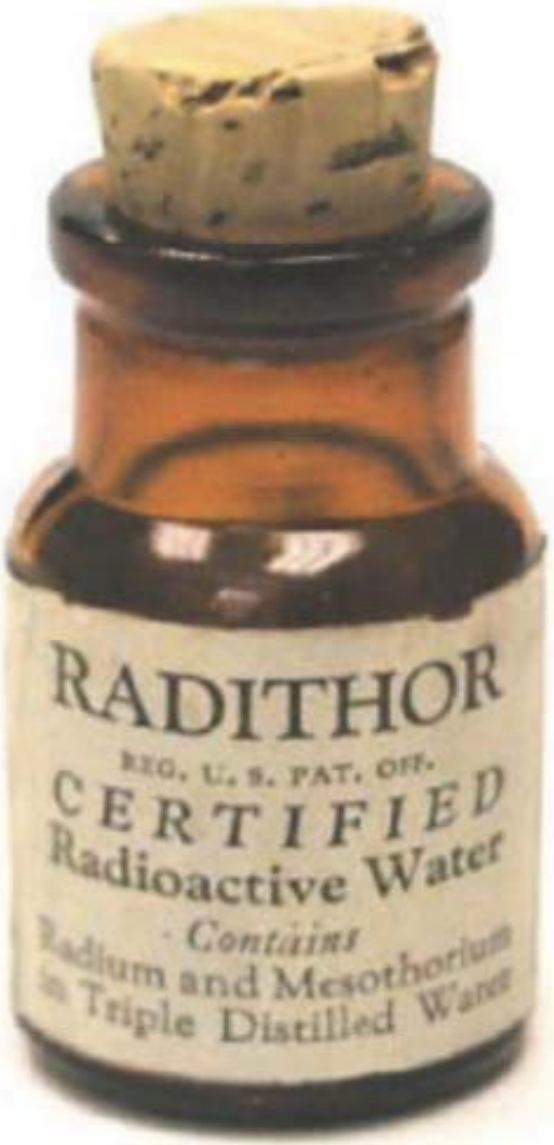


A map showing radioactive uranium concentrations throughout N. America. Credit: USGS (Updated Feb 28, 2017)

Notes:

Uranium is a naturally occurring element that has the highest atomic weight (~238 g/mole) and is slightly radioactive. It can be found in minute quantities in most rocks, soils and waters (normally < 5 ppm), but the real challenge is to find it in high enough concentrations to make it economically feasible to mine. Uranium is easily oxidized and forms a number of common uranium oxides and oxy-hydroxide like uraninite (or pitchblende) and schoepite (including meta- and para-).

. Nothing cures the common cold like a little radioactive water.



Notes:
A healthy elixir? In the early 1900s, radioactive water was all the rage. A century ago radioactivity was new, exciting and good for you--at least if you believed the people selling radium pendants for rheumatism, all-natural radon water for vigor, uranium blankets for arthritis and Thorium-laced medicine for digestion (you don't even want to know about the radioactive suppositories)

Health Effects of Naturally Radioactive Water Ingestion: The Need for Enhanced Studies. [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3261972/]

http://news.nationalgeographic.com/news/2010/01/100118-radiation-toxic-water-revigator/

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Protect Your Family!
TEST FOR RADON TODAY

"I HOPE THEY'VE CHECKED THIS PLACE FOR RADON."