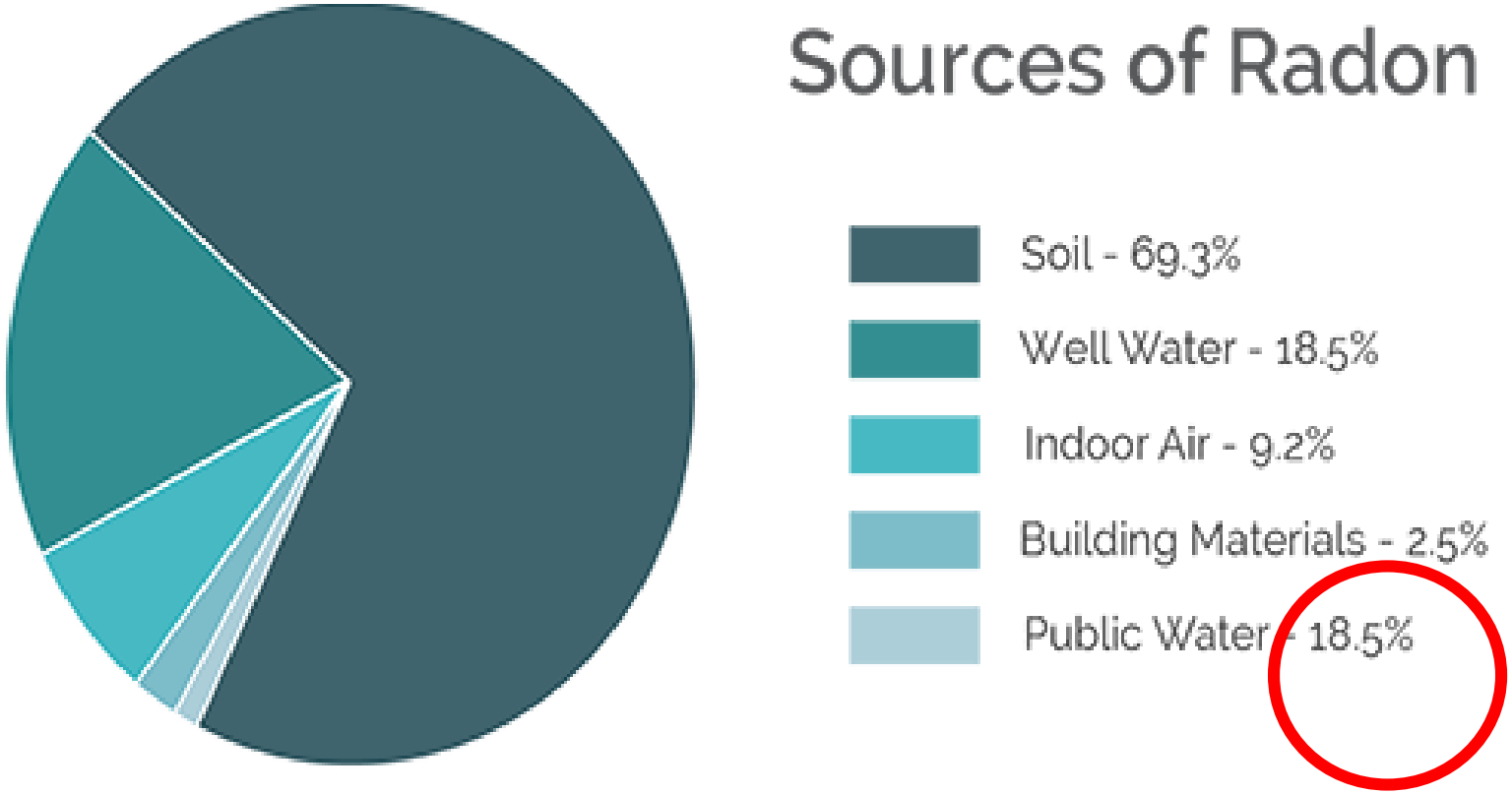
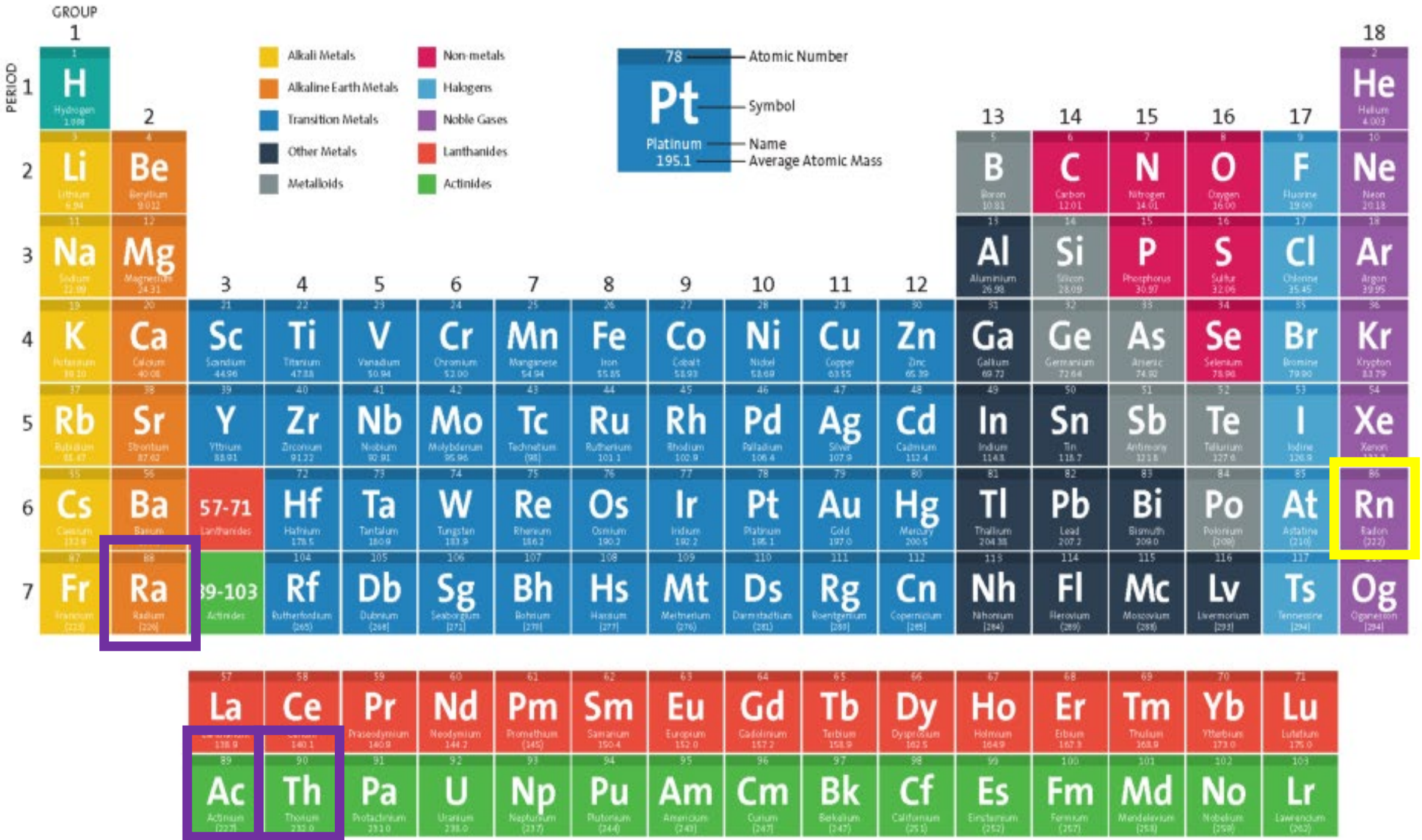
Radon in Iowa

UNI – Geochemistry of the Land

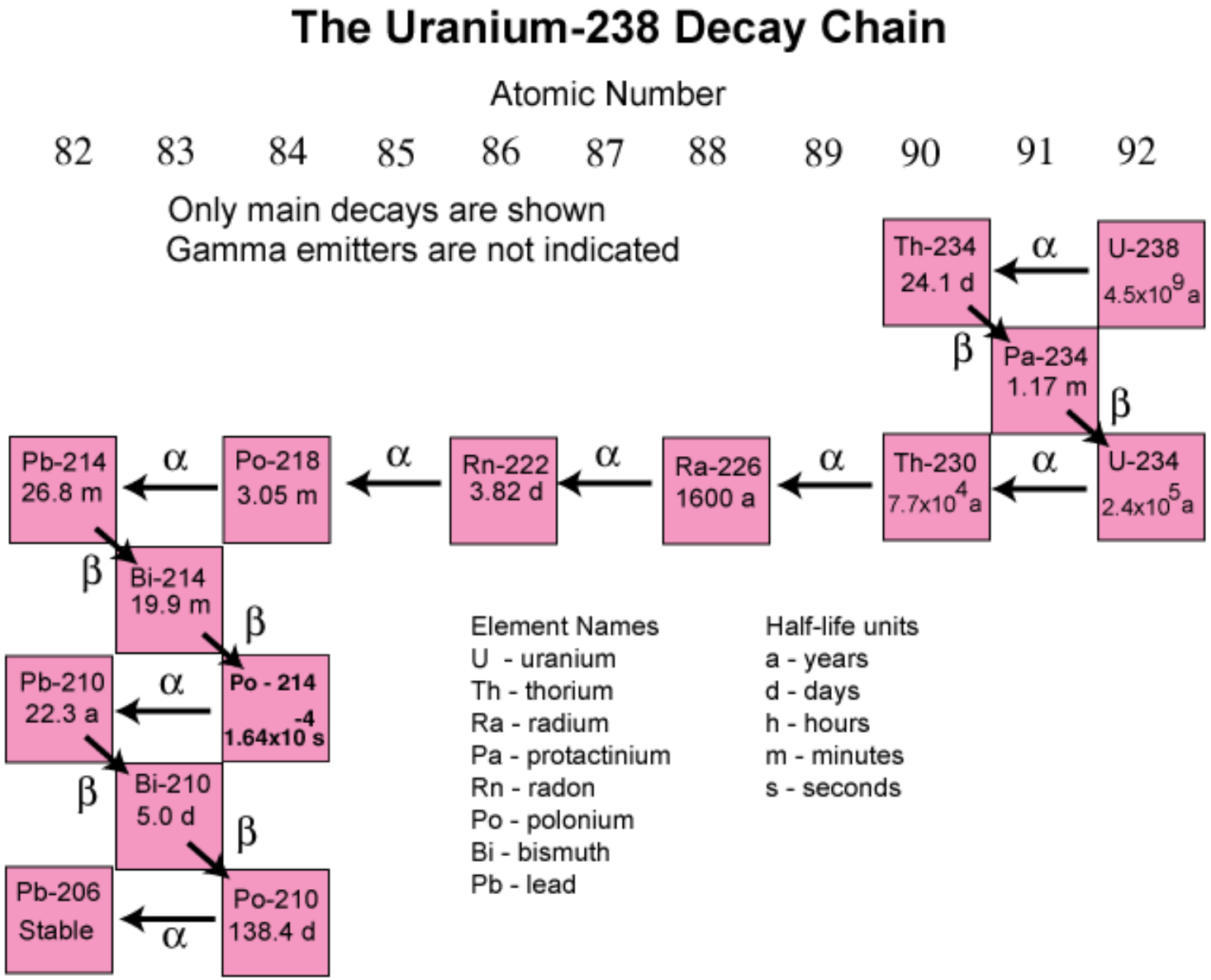
Radon

- Source – Genesis
- Anthropogenic effects
  - Construction
  - Mitigation
- Health implications
- Regulations
- Action




GROUP
PERIOD
Alkali Metals
Alkaline Earth Metals
Transition Metals
Other Metals
Metalloids
Non-metals
Halogens
Noble Gases
Lanthanides
Actinides
78
Pt
Platinum
195.1
Atomic Number
Symbol
Name
Average Atomic Mass
57-71
Lanthanides
89-103
Actinides
Ra
Rn

- Uranium-238 culminates in Lead-206, after forming intermediates such as Uranium-234, Thorium-230, Radium-226, and Radon-22



Radon – parent-elements

- Radium-226 decays by alpha particle radiation to an inert gas, radon-222, which also decays by alpha particle radiation
- Thorium-232 is typically present with its decay product radium-224, which will produce radon-220 gas
- Actinium-227, has a half-life of 21.77 years. It decays into francium-223 through alpha decay or into thorium-227 through beta decay

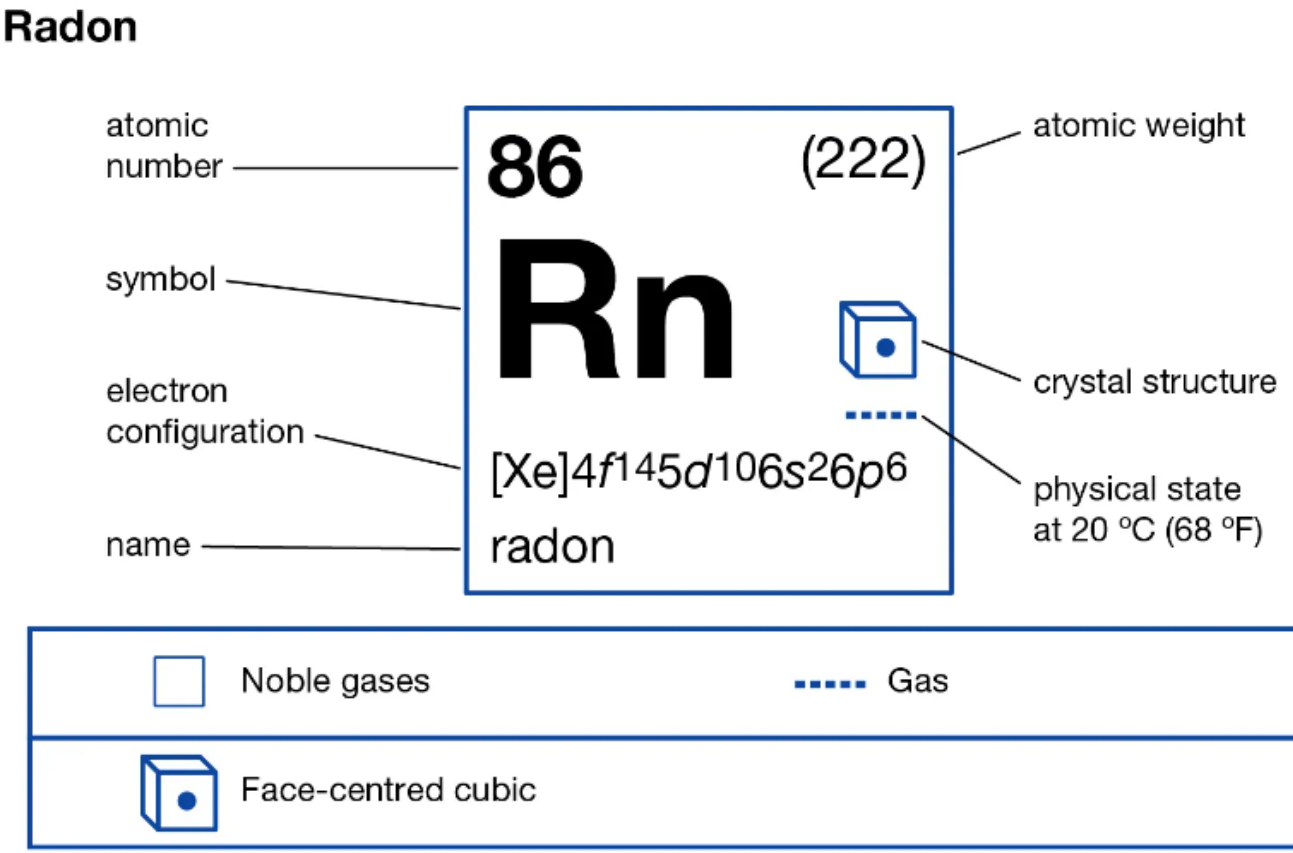
Radon

Radon is a naturally-occurring radioactive gas

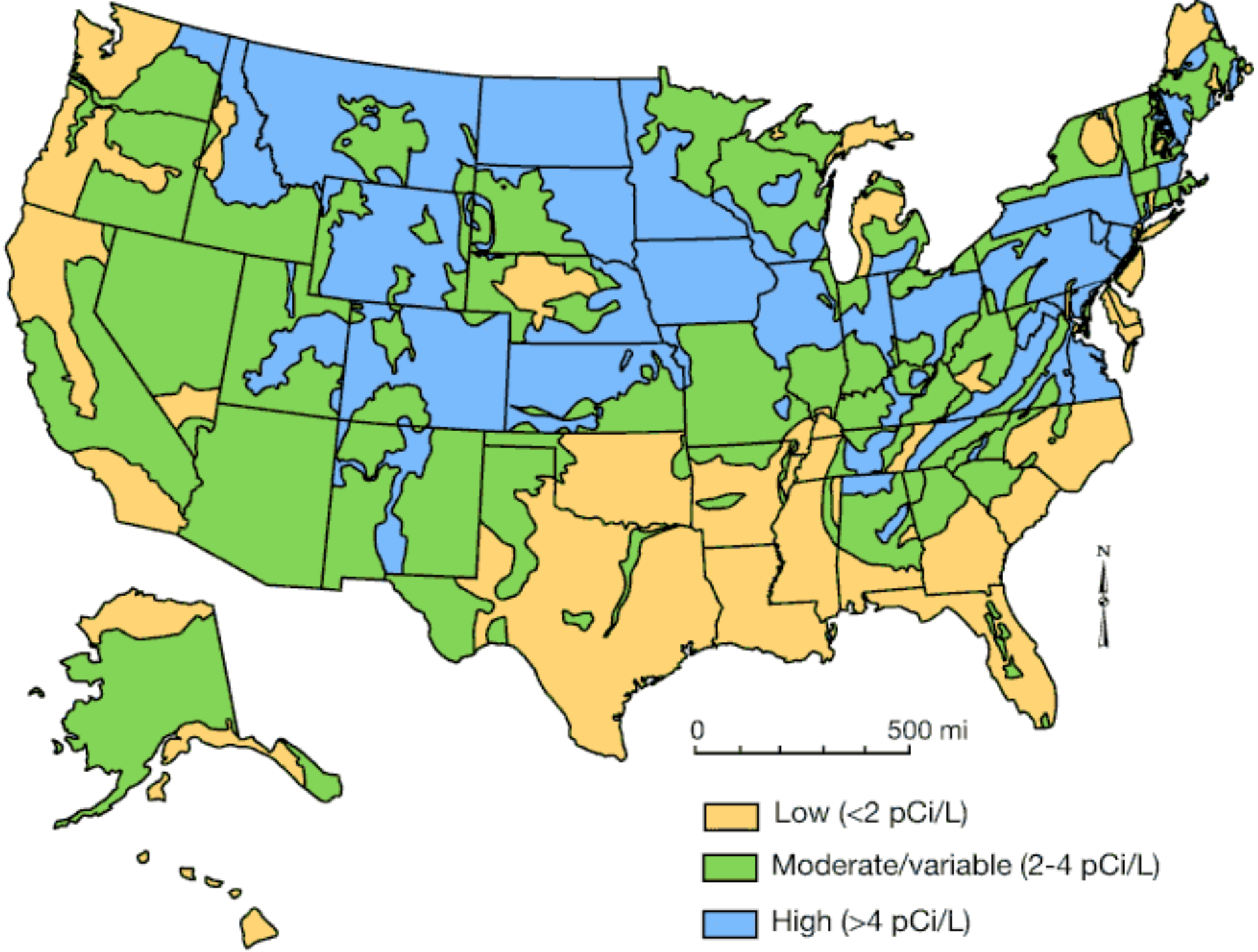
Radon gas is inert, colorless and odorless.

Exposure may contribute to lung cancer.

Smoking intensifies radon exposure and can also contribute to lung cancer



Radon in the U.S.



Anthropogenic modifications

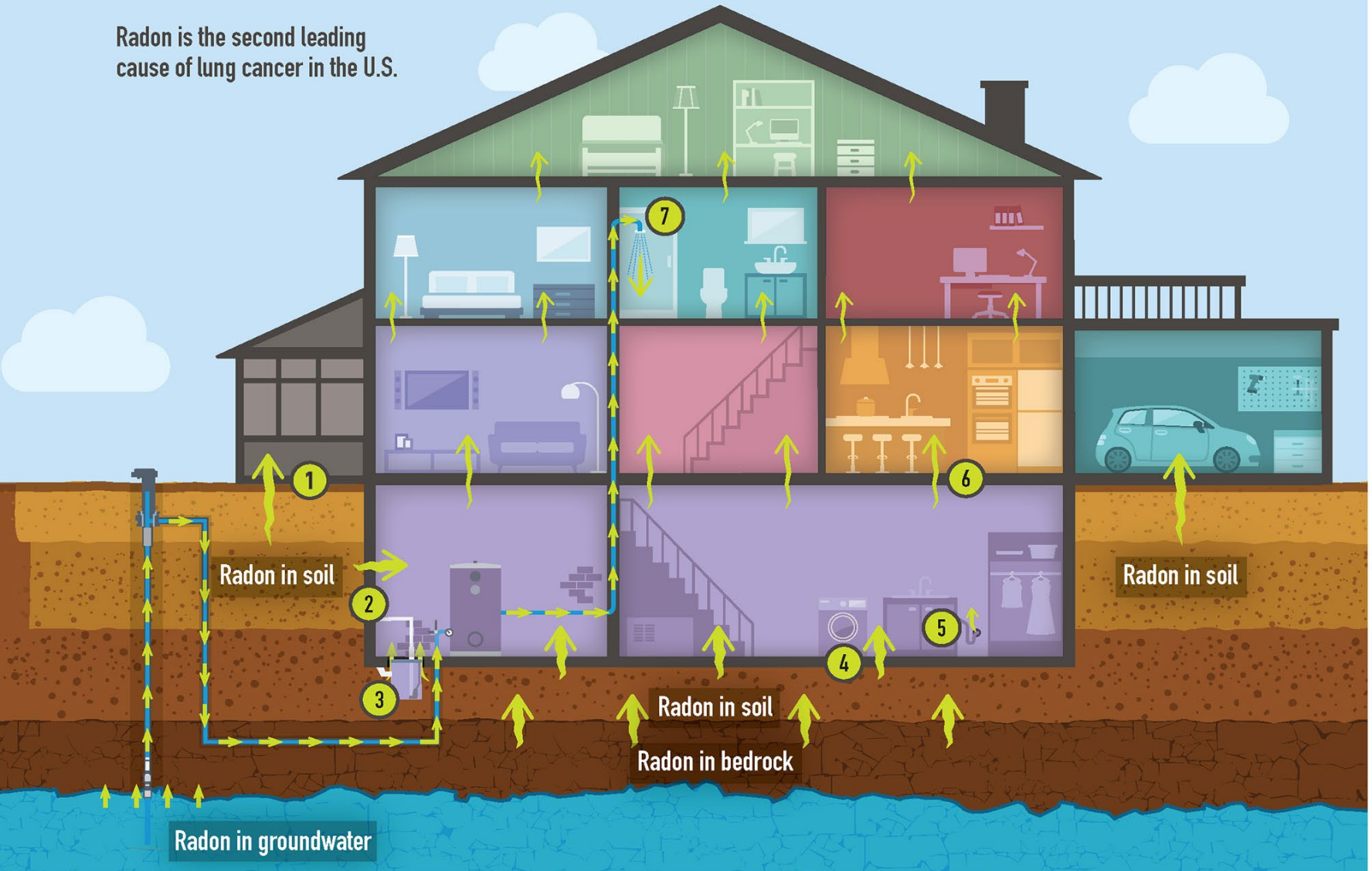
Part 1

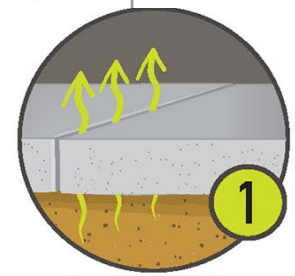
How Radon Gets into Your Home

CS 327538 | 12/01/2021

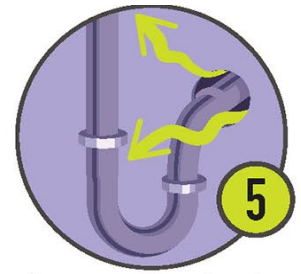
Test your home | Make repairs | Learn more: www.cdc.gov/radon/index.html

Radon is the second leading cause of lung cancer in the U.S.

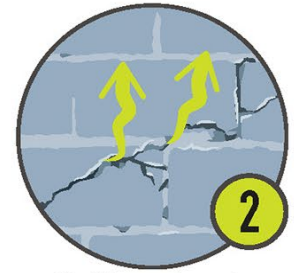




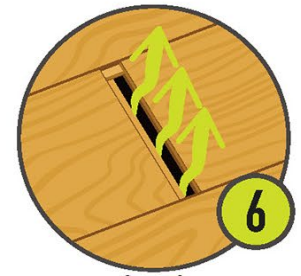
Construction joints



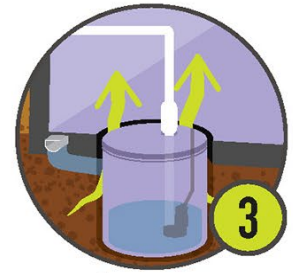
Gaps around service pipes



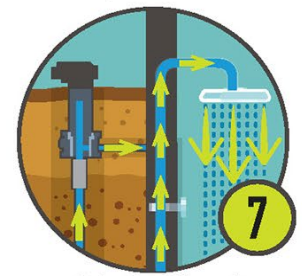
Cavities and cracks inside walls



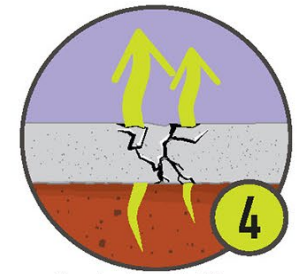
Gaps in suspended floors



Sump pump



Private wells and groundwater supplies*



Cracks in solid floors

* High radon levels in the water supply are more likely when its source is groundwater such as private wells or a public water supply system that uses groundwater. Most public water supplies are sourced from surface water (lakes,

Radon Health Effects

Understanding Radon Levels

EPA recommends fixing your home if radon level is above 4 pCi/L

Radon Level 4 pCi/L	**Equals 200 chest x-ray per year or 8 cigarettes per day**
Radon Level 8 pCi/L	**Equals 400 chest x-ray per year or 16 cigarettes per day**
Radon Level 20 pCi/L	**Equals 1000 chest x-ray per year or 40 cigarettes per day**

Source: U.S. Department of Health and Human Services, ABDR (1990). Toxicological Profile for Radon. Atlanta. GA.

Radon by the Numbers

21,000
lung cancer deaths per year

#1
environmental cause of **any cancer**

#1
cause of lung cancer among people who have **never smoked**

10x risk of lung cancer among **people who smoke** compared with people who never smoked with same radon exposure

1 in 15
homes in the US have **high radon levels**

If radon levels are **≥ 4.0 pCi/L**, EPA recommends installing a **radon reduction system**.

This equals...

200 chest x-rays per year **or** **8** cigarettes per day

pCi/L is shorthand for picocuries per liter, the units of measurement of the amount of radon in an air sample.

2 steps
to protect yourself from radon-associated lung cancer:

Test your home's **radon levels.**

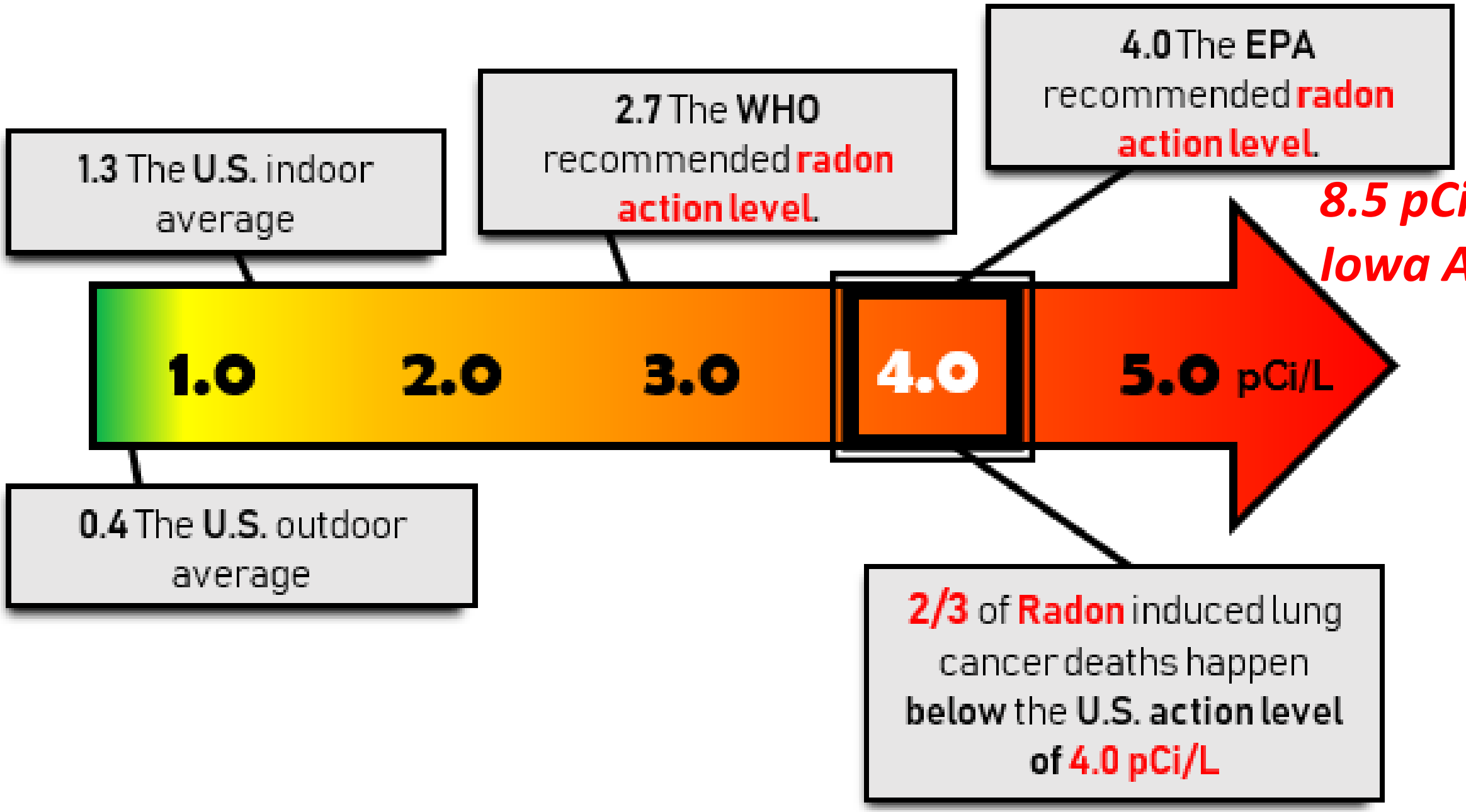
Fix your home if radon levels are **≥ 4pCi/L.**

www.cdc.gov/radon

Data sources: Environmental Protection Agency (EPA) and the American Association of Radon Scientists & Technologists

Radon Regulation*

TESTING: The only way to know if you have a radon



Iowa Regulations

- 2022 A new Radon Testing Bill was signed into law, May 24,requiring thorough and more frequent radon testing for schools.

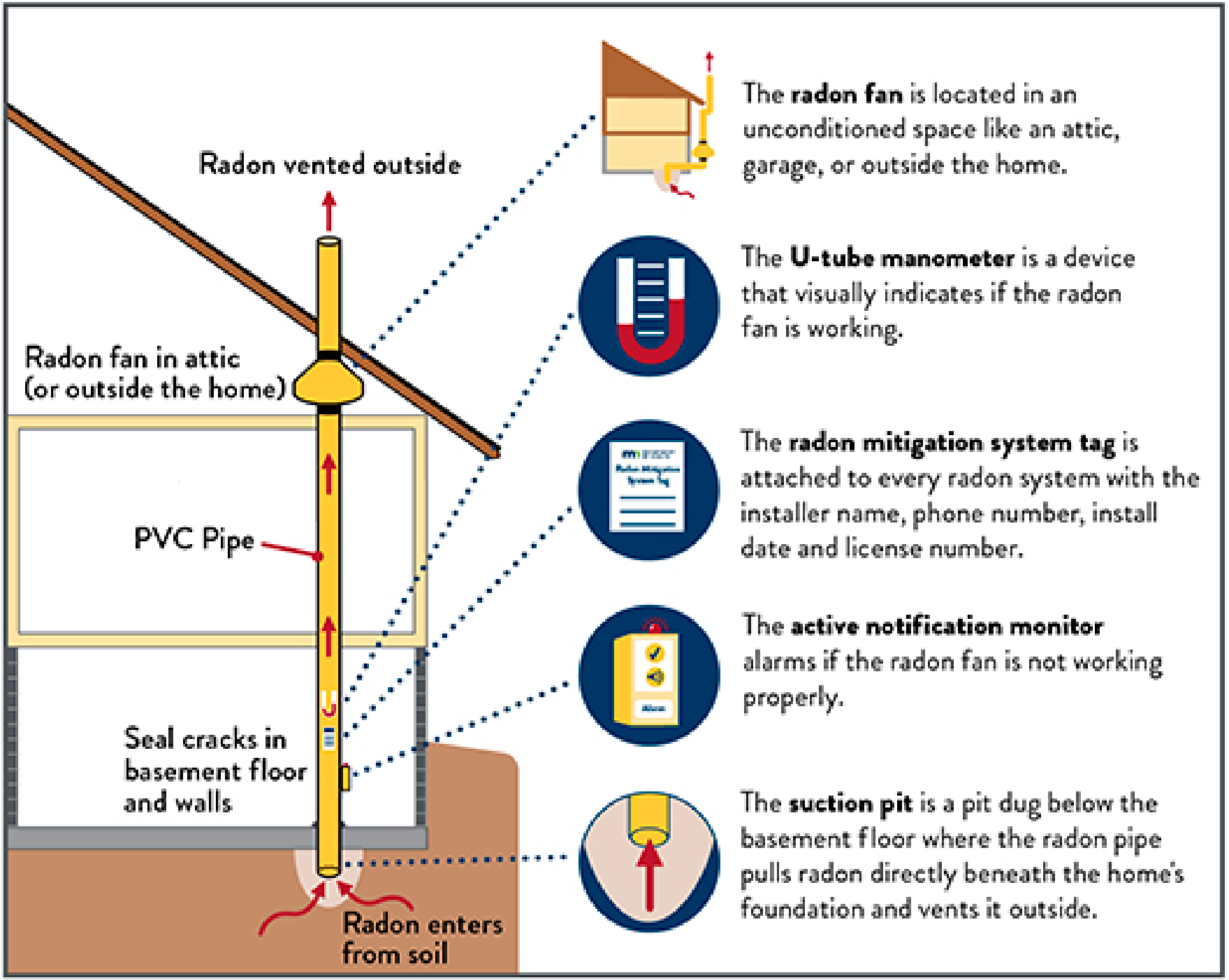
- 2021 Iowa City: Radon mitigation systems for rental units will be required to be installed by a Radon Mitigation Specialist certified by the State of Iowa. Most rental units will be required to retest for hazardous radon levels every eight years, to ensure continued functionality of the system.

- Cedar Falls - ? https://www.cedarfalls.com/1182/Rental-Code-Information

Anthropogenic modifications

Part 2- Mitigation


VS



The **radon fan** is located in an unconditioned space like an attic, garage, or outside the home.

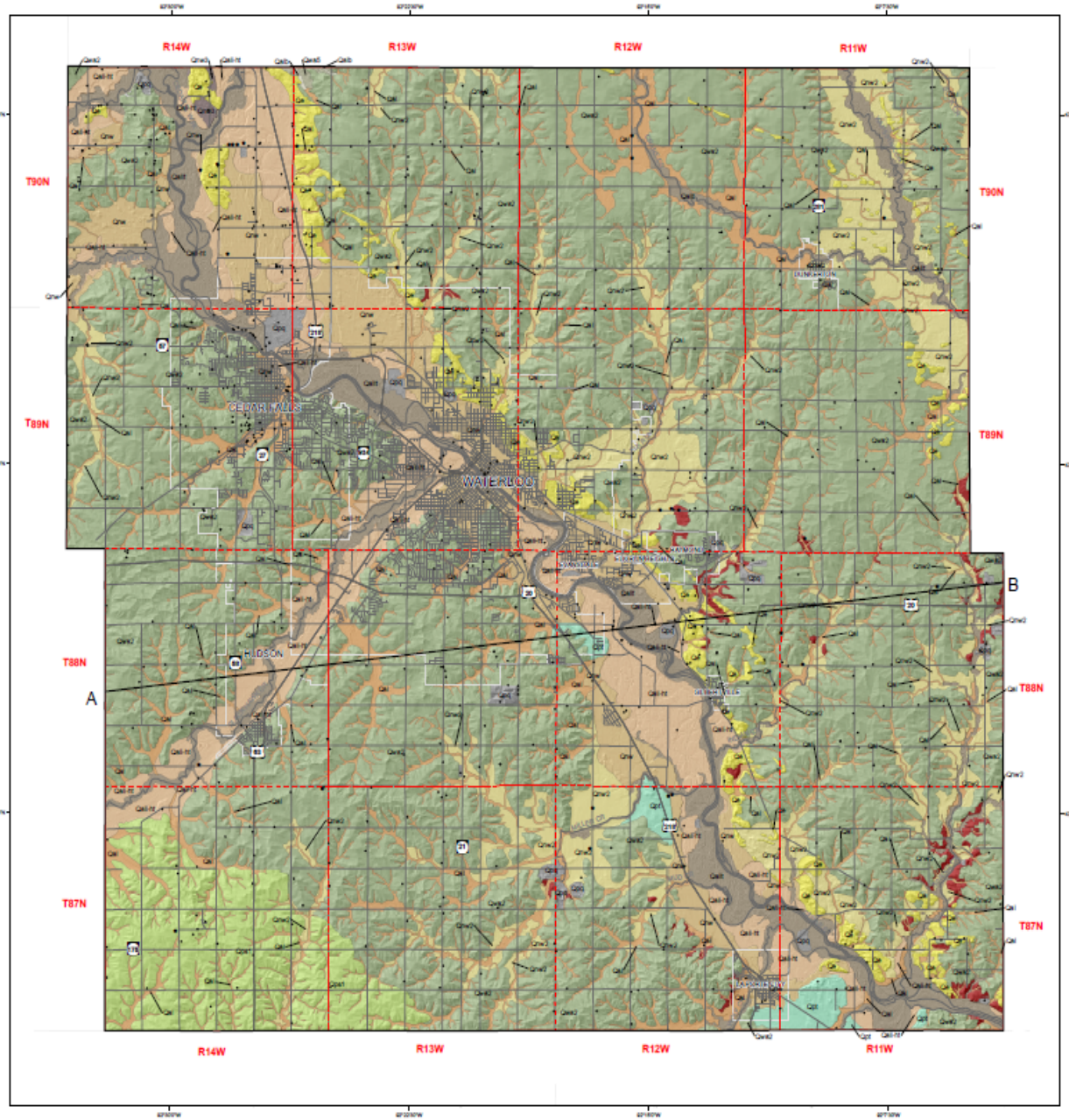
The **U-tube manometer** is a device that visually indicates if the radon fan is working.

The **radon mitigation system tag** is attached to every radon system with the installer name, phone number, install date and license number.

The **active notification monitor** alarms if the radon fan is not working properly.

The **suction pit** is a pit dug below the basement floor where the radon pipe pulls radon directly beneath the home's foundation and vents it outside.

Surficial Geology of Black Hawk County, Iowa



LEGEND

CENOZOIC

QUATERNARY SYSTEM

HUDSON EPISODE

Qal - **Alluvium** (DeForest Formation/Undifferentiated) Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, unconsolidated to cohesive, massive to stratified silty clay loam, clay loam, loam to sandy loam alluvium and colluvium in stream valleys, on hillslopes and in closed depressions. May overlie Noah Creek Formation, Wolf Creek or Albumett formations, or bedrock. Associated with low-relief modern floodplain, closed depression, modern drainageways or local topographic positions on the landscape. Seasonal high water table and potential for frequent flooding.

Qalb - **Alluvium Shallow to Bedrock** (DeForest Formation/Undifferentiated) Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, unconsolidated to cohesive, stratified silty clay loam, clay loam, loam to sandy loam alluvium and colluvium in stream valleys, on hillslopes and in closed depressions. May overlie Noah Creek Formation or Devonian carbonate bedrock. Bedrock surface is within 5 m (16 ft) of the land surface. Associated with low-relief modern floodplain, closed depression, modern drainageways or local topographic positions on the landscape. Seasonal high water table and potential for frequent flooding.

Qalt - **Low Terrace** (DeForest Formation-Camp Creek Mbr. and Roberts Creek Mbr.) Variable thickness of less than 1 to 3 m (3-16 ft) of very dark gray to brown, unconsolidated, stratified silty clay loam, loam, or clay loam. Associated with the modern channel belt of the Cedar and Wapsipinicon river valleys and their tributaries. Overlies the Noah Creek Formation. Occupies lowest position on the floodplain, in modern channel belts. Seasonal high water table and frequent flooding potential.

Qall-ht - **Intermediate-High Terrace** (DeForest Formation-Dunkle Mbr.) Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, unconsolidated, silty clay loam to loam alluvium or colluvium that overlies the Noah Creek Formation. Occupies terrace and valley margin positions 1 to 2 m (3-7 ft) above the modern floodplain. May be mantled with 2 to 3 m (7-10 ft) of well sorted medium to fine sand derived from wind reworking of the alluvium. Seasonal high water table and low to moderate flooding potential.

HUDSON and WISCONSIN EPISODE

Qe - **Sand Dunes and Sand Sheets** (Peoria Formation-sand facies) Generally less than 3 m (10 ft) of yellowish brown, massive, calcareous loamy sand to fine sand. It may overlie yellowish brown sand and gravel (Noah Creek Formation) or reworked unsorted loamy sediments associated with the Iowan Erosion Surface and/or it may overlie yellowish gray to gray brown, often calcareous and fractured clay loam to loam diamicton of the Wolf Creek and Albumett formations.

Qnw2 - **Sand and Gravel** (Noah Creek Formation) Generally 2 to 8 m (6-26 ft) of yellowish brown to gray, poorly to well-sorted, massive to well stratified, coarse to fine lithopublic quartz sand, pebbly sand and gravel in fair interbedding layers of silty clay. A thin mantle of loess, reworked loess or fine-grained alluvium may be present. This unit includes silty colluvial deposits derived from the adjacent steep uplands. In places this unit is mantled with 1 to 3 m (3-10 ft) of well sorted medium to fine sand derived from wind reworking of the alluvium. This unit encompasses deposits that accumulated in low relief stream valleys during the Wisconsin and Holocene episodes. Seasonal high water table and some potential for flooding.

WISCONSIN EPISODE

Qpt - **Loess Mantled Terrace** (Peoria Formation-silt and/or sand facies) 2 to 8 m (7-26 ft) of yellowish brown to gray, massive, jointed, calcareous or noncalcareous, silt loam and interstratified fine to medium, well sorted, sand. May grade downward to poorly to moderately well sorted, moderately to well stratified, coarse to fine lithopublic quartz sand, loam, or silt loam alluvium (Late Phase High Terrace) or may overlie a Farmdale Geosol developed in Pisgah Silt which in turn overlies a well-expressed Sangamon Geosol developed in poorly consolidated well sorted, moderately to well stratified, coarse to fine sand, loam, or silt loam alluvium (Early Phase High Terrace).

Qpd - **Loess and Interstratified Eolian Sand** (Peoria Formation-silt facies) Generally 2 to 5 m (7-16 ft) of yellowish brown to gray, massive, fractured, noncalcareous grading downward to calcareous, silt loam and interstratified fine to medium, well sorted, sand. Sand is most abundant in the lower part of the eolian package. Overlies massive, fractured, loamy glacial till of the Wolf Creek or Albumett formations with or without intervening clayey Farmdale/Sangamon Geosol.

Qnw - **Sand and Gravel** (Noah Creek Formation) 3 m (10 ft) to more than 20 m (66 ft) of yellowish brown to gray, poorly to well-sorted, massive to well stratified, coarse to fine lithopublic quartz sand, pebbly and sand and gravel. Inclusions mantled with 1 to 3m (3-10 ft) of fine to medium, well sorted sand derived from wind reworking of the alluvium. This unit encompasses deposits that accumulated in stream valleys during the late Wisconsin era and subsequent Pre-Illinois Episode deposits of the Wolf Creek and Albumett formations. Deposits may be slightly thicker along the Cedar River.

Qnw3 - **Sand and Gravel Shallow to Bedrock** (Noah Creek Formation) 1 to 6m (3-20 ft) of yellowish brown to gray, poorly to well sorted, massive to well stratified, coarse to fine lithopublic quartz sand, pebbly and sand and gravel. May be overlain by up to 3 m (10 ft) of silty alluvial material. In places mantled with fine to medium well sorted lithopublic quartz sand derived from wind reworking of the alluvium. Fractured carbonate bedrock is less than 6 m (20 ft) below the land surface. The unit encompasses deposits that accumulated in river and stream valleys during the late Wisconsin era and subsequent Pre-Illinois Episode deposits of the Wolf Creek and Albumett formations. Deposits may be slightly thicker along the Cedar River.

Qwa2 - **Loamy and Sandy Sediment Shallow to Glacial Till** (Unsorted erosion surface sediment) Generally 2 to 8 m (6-26 ft) of yellowish brown to gray, massive to weakly stratified, well to poorly sorted loamy, sandy and silty loess Erosion Surface sediment. May seal includes some areas mantled with less than 2 m (7 ft) of Peoria Formation materials (loess and eolian sand). Overlies massive, fractured, loess, glacial till of the Wolf Creek and Albumett formations. Seasonally high water table may occur in the map unit.

Qwa5 - **Loamy and Sandy Sediment Shallow to Rock** (Unsorted erosion surface sediment) Generally 1 to 6 m (3-20 ft) of yellowish brown to gray, massive to weakly stratified, well to poorly sorted loamy, sandy and silty erosion surface sediment. May seal includes some areas mantled with less than 3 m (10 ft) of Peoria Formation sand facies (eolian sand). Eolian sand may lie directly on top of bedrock in isolated areas. Overlies fractured Devonian carbonate rocks. Seasonal high water table may occur in this map unit.

PRE-ILLINOIS EPISODE

Qwa3 - **Till** (Wolf Creek or Albumett formations) Generally 3 to 75 m (10-240 ft) of very dense, massive, fractured, loamy glacial till of the Wolf Creek or Albumett formations with or without a thin loess mantle (Peoria Formation - less than 2 m) or thin loamy sediment mantle. An interviewing clayey Farmdale/Sangamon Geosol may separate these units. This mapping unit is shown only in the cross section and may be buried by unsorted erosion surface sediments, loess or alluvium.

Other Mapping Units

Qpq - **Pits and Quarries** Sand and gravel pits and rock quarries. Mined mapped exclusively in county soil survey reports and as identified on aerial imagery.

Bedrock - All areas of bedrock outcrop regardless of the unit are shown in red on the map, without any labels. Bedrock units are shown on the cross-section with the following descriptions:

PALEOZOIC

DEVONIAN SYSTEM

Dlgc - **Dolomite, Limestone, and Shale** (Lithograph City Formation/Middle to Upper Devonian) The total thickness of this map unit is up to 30 m (97 ft), consisting of interbeds of laminated lithographic and mold/biographic limestone and dolomitic limestone with scattered to abundant brachiopods, corals and/or stromatoporoids. This unit occurs on some bedrock highs in the western one-third of the county.

Dcv - **Limestone and Dolomite** (Coralville Formation) Middle Devonian. The thickness of this map unit varies between 0 and 31 m (0-100 ft) within the county. The lower Gizzard Creek Member is a fossiliferous carbonate with an abundant marine fauna and is dominated by dolomite and dolomitic limestone, becoming slightly argillaceous in part, with common calcitic filled vugs; the low diversity fauna are characterized by crinoid debris and brachiopods and corals produced in pioneers. The upper Iowa City Member is carbonate dominated, with laminated, bioturbated, or stromatolitic textures and some restricted marine fauna; the restricted marine fauna is dominated by favositid corals and/or branching and dismal stromatoporoids. Stromatoporoid-rich biostromal intervals occur within and around the map area.

Dlc - **Dolomite and Limestone** (Little Cedar Formation) Middle Devonian. The thickness of this map unit ranges from 3 to 40 m (10-130 ft) within the county. The map unit is dominated by slightly argillaceous to argillaceous dolomite and dolomitic limestone, usually vuggy and partially laminated and/or slowly. This unit is commonly fossiliferous and brachiopods are especially abundant in the lower portion. The upper portion (Rockford Member) is a dense carbonate/chert. Biogenetic or mold/biographic limestone or dolomitic limestone, with laminated, pelleted, intraclastic, and bindstone fabrics.

Dw - **Dolomite, Limestone, Shale, and minor Sandstone** (Wapsipinicon Group) Middle Devonian. This map unit contains only the Princeton Ridge Formation of the group, with a total thickness that varies from 0 to 24 m (0-80 ft) in the mapping area. It is dominated by laminated or bioturbated, carbonate/chert limestone and dolomite that is more fossiliferously and liberty at its base. This unit occurs in some deeper bedrock valleys within the map area.

SILURIAN SYSTEM

Sl - **Limestone, Dolomitic Limestone and Dolomite** (LaPorte City Formation) upper Llandovery-lower Wenlock Lower Silurian. This unit is a limestone facies that correlates with the upper Waukesha-lower Scotch Grove formations. These units are conscilvously overlain by the Wapsipinicon Group. The total thickness of the map unit is up to 45 m (140 ft). The formation is dominated by dense, fossiliferous limestone that is slowly to very slowly. Secondary lithologies include dolomitic limestone and dolomite. Minor lithologies include argillaceous to shaly sheet mudstone at the top of the interval (may be basal Wapsipinicon Group) and green-gray shale. This unit occurs in a bedrock valley within the southeastern part of the county.

Shb - **Dolomite with Chert** (Hopkinton and Blanding formations) Lower Silurian. The total thickness of this map unit is up to 49 m (160 ft). The unit is fossiliferable to vuggy dolomite and shaly to very shaly with nodular to bedded chert in the upper part of the Blanding Formation. Fossils include corals, brachiopods, and stromatoporoids. The Hopkinton rocks are generally more fossiliferous and less shaly than the underlying Blanding rocks. This unit occurs in some of the deeper portions of the bedrock valleys within the map area.

ORDOVICIAN SYSTEM

Om - **Shale and Dolomite** (Maquoketa Formation) Upper Ordovician. The total thickness of this map unit is up to 91 m (300 ft). The unit is comprised of interbedded green to gray dolomitic shale and shaly dolomite with minor limestone, variably shaly and variably fossiliferous with brachiopods and graptolites, thin known to be orange dolomitic shale layers occur in the lower 10 m (33 ft). This unit occurs in the deepest portions of the bedrock valleys in the northeast part of the map area.

● **Drill Holes**

✦ **Wells**

SURFICIAL GEOLOGY OF BLACK HAWK COUNTY, IOWA

Iowa Geological and Water Survey
Open File Map OFM-13-4
September 2013

prepared by

Stephanie Tassier-Surine, Deb Quade, Robert Rowden, Robert McKay, Huaibao Liu, and James Giglierano

Iowa Geological and Water Survey, Iowa City, Iowa

Iowa Department of Natural Resources, Chuck Gipp, Director
Iowa Geological and Water Survey, Robert D. Libra, State Geologist

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Introduction to the Surficial Geology of Black Hawk County

Black Hawk County lies within the Iowan Erosion Surface (IES) Landform Region (Prior and Kohrt, 2006) in northeast Iowa. This area has been subjected to multiple periods of Quaternary glaciations and subaerial erosion. Generally speaking, the map area consists of unnamed loamy sediments (IES materials) of variable thickness overlying Pre-Illinoian glacial sediments. The Cedar and Wapsipinicon river valleys are filled with Wisconsin Episode Noah Creek Formation sand and gravel and mantled with younger Holocene terrace materials. These deposits are regionally extensive.

Previous surficial geologic mapping completed as part of the STATEMAP program includes the Gilbertville (Tassier-Surine et al., 2011) and Cedar Falls (Tassier-Surine et al., 2012) quadrangles in Black Hawk County and mapping to the north in adjacent Bremer County (Tassier-Surine et al., 2007, 2009, 2010). The only other regional surficial map of the area consists of the Des Moines 4° x 6° Quadrangle at a scale of 1:1,000,000 (Hallberg et al., 1991).

At least seven episodes of Pre-Illinoian glaciations occurred in this region between approximately 2.2 and 0.5 million years ago (Boellstorff, 1978a,b; Hallberg, 1980, 1986). Episodic erosion during the last 500,000 years has led to the destruction of pre-existing glacial landforms associated with Pre-Illinoian glaciations. A period of intense cold occurred during the Wisconsin full glacial episode from 21,000 to 16,500 years ago (Bettis, 1989). This cold episode and ensuing upland erosion led to the development of the distinctive landform recognized as the IES (Prior, 1976). A periglacial environment prevailed during this period with intensive freeze-thaw action, solifluction, strong winds, and a host of other periglacial processes (Walters, 1996). Surface soils were removed from the IES and the Pre-Illinoian till surface was significantly eroded; resulting in the development of a region-wide colluvial lag deposit referred to as a "stone line." Another common feature of this region are paha, isolated and uneroded topographic highs of loess-mantled Pre-Illinoian till with a directional orientation from northwest to southeast that exist as erosional outliers of the once higher and older landscape. Thick packages of stratified loamy and sandy sediments located low in the upland landscape and adjacent to streams are remnants of solifluction lobes associated with the formation of the IES. These materials can commonly be found along tributaries of the Cedar River.

Black Hawk County is covered by various Quaternary deposits with a maximum thickness of up to 73 m (240 ft) occurring in bedrock valleys. Surficial deposits of the map area are composed of five formations: DeForest, Noah Creek, Peoria, Wolf Creek, and Albumett formations as well as unnamed erosion surface sediments. Hudson age deposits associated with fine-grained alluvial and colluvial sediments are composed of the DeForest Formation which is subdivided into the Camp Creek, Roberts Creek, Gunder, and Corrington members. The Noah Creek Formation includes coarse sand and gravel associated with outwash from the Des Moines Lobe, as well as coarse to finer grained fluvial deposits associated with local stream and river valleys. Unnamed erosion surface sediments consist of reworked till and slopewash deposits associated with peri-glacial activity during the Wisconsin ice advance and may be up to 8 m (26 ft) thick. Peoria Formation eolian materials consist of fine sand and silt. A relatively thin (up to 3 m, 10 ft) loess mantle is present in the southwest portion of the county. Thick deposits of eolian sand are only present adjacent to the Cedar and Wapsipinicon river valleys. Additional eolian materials may be intermittently present mantling most other mapping units and are more abundant near stream valleys and on terraces. Pre-Illinoian glacial deposits in northeast Iowa consist of two formations: the younger Wolf Creek Formation and the Albumett Formation. The Wolf Creek Formation is divided into the Winthrop, Aurora, and Hickory Hills members (oldest to youngest). The Albumett Formation consists of several "undifferentiated" members. Pre-Illinoian till is not exposed in the map area but is mantled throughout Black Hawk County by IES materials, eolian sand, or alluvial sediments.

The Quaternary materials are underlain by Devonian and Silurian carbonate bedrock. Eleven bedrock outcrops (five quarries, five road cuts and one excavation for a lift station) were found in the map area during the field investigation. In