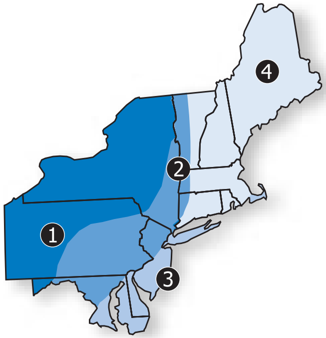
Recognition of landslide-prone areas is important for land use planning and zoning decisions. Damage from landslides can be prevented by not building in areas that commonly experience landslides or show evidence of past landslides.

Radon

Radon is a chemical element: an odorless, colorless, radioactive gas that commonly forms from the breakdown of the element uranium. Radon first came to wide public attention as an environmental issue in the mid 1980's when high concentrations of the gas were found in houses overlying the Precambrian rocks of the Reading ***Prong*** in southeastern Pennsylvania. Though scientists continue to debate the health risks of radon, it is clear that smokers exposed to high levels of radon gas have an increased risk of lung cancer.

see Rocks, p.40, for more about Precambrian **prongs.**



The number following the name of an element (U-238) refers to the mass number of the element. Though any two atoms of the same element will have the same number of protons and electrons, the number of neutrons may vary. Variations in the number of neutrons will change the mass of an atom. Atoms of the same element with different numbers of neutrons are called **isotopes**. *Thus uranium-238 and uranium-235 are both isotopes of uranium.*

Porosity is the amount of pore space within a rock; permeability is the connectedness of the pore spaces, allowing water or gas to move through a rock or soil.

Uranium-238, the uranium isotope from which radon originates, is a radioactive substance. When a radioactive substance decays, the nucleus breaks down by the loss of protons, electrons or neutrons, forming another element. The decay process continues until a stable (non-radioactive) ***isotope*** is reached. The decay of uranium-238 produces a series of unstable elements, including radon-222 *(Figure 8.5)*.

Radon-222 is also radioactive, decaying to eventually produce a stable form of lead. Though it takes 4.4 billion years for half of a given amount of uranium-238 to decay, it takes radon-222 only a few days.

Both uranium and radium are solids and incapable of moving through rocks and soil. Radon, however, is a gas. Where soils and rocks are ***porous*** and ***permeable***, radon can migrate upwards towards the surface. We are naturally exposed to low levels of radon in the air and water around us with no ill effects; radon, however, can become concentrated at high levels indoors. Poorly sealed house foundations with inadequate air flow allow the radon gas to enter homes, becoming concentrated and possibly inhaled. Radon may also be naturally dissolved in well water and released indoors when the tap is turned on.

Half-life

Radioactive elements have a half-life. *After 4.4 billion years, half of the uranium-238 in a given rock has decayed to radium-226. The radium continues the decay process, producing radon-222, polonium-218, lead-214 (an unstable isotope of lead), bismuth-214 and finally a stable isotope of lead (Lead-210). Radon-222 has a much shorter half-life than uranium-238. It only takes 3.8 days for radon to decay. For some radioactive elements, such as polonium-218 and bismuth-214, the decay process is a matter of minutes.*

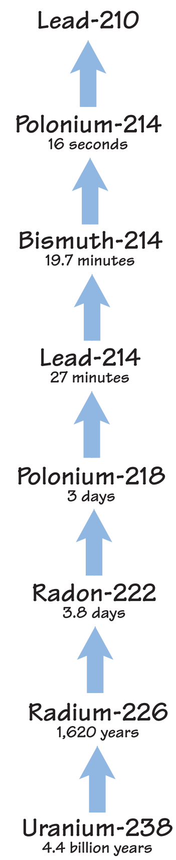
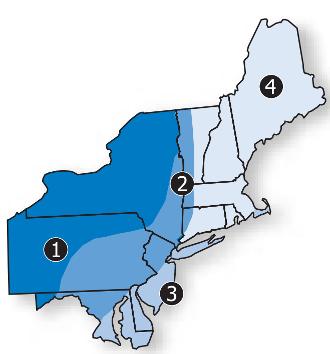


Figure 8.5: The radioactive decay of Uranium-238.

Most susceptible to high radon levels, are those areas with uranium-rich rocks. Though most rocks have a small amount of uranium, certain types of rocks have higher concentrations of the radioactive element, such as light-colored volcanic rocks, granites, dark shales, sedimentary rocks with phosphates and some metamorphic rocks. Rocks that have pathways such as fractures, faults and connected pore spaces between grains allow radon gas to move upwards to



the surface. Likewise, thin, permeable and porous soils with cracks aid in the upward migration of radon. Additionally, because moisture inhibits the movement of the gas, radon moves more quickly in dry, well-drained soils. The igneous and metamorphic rocks of the Appalachian Mountains and Adirondacks are uranium-rich and sliced by numerous faults, resulting in an area with the potential for high levels of indoor radon. The mineral glauconite, found in parts of the Coastal Plain sediments, is also uranium-rich. For the most part, however, the Coastal Plain has one of the lowest levels of radon risk in the country *(Figure 8.6)*.

Local radon risk depends upon the type of bedrock underlying a home (uranium-rich bedrock may cause elevated radon levels); the porosity and permeability of the bedrock (which provides pathways for movement of the radon gas); the porosity and permeability of soils; and the air flow rate and foundation construction that could potentially concentrate radon indoors.

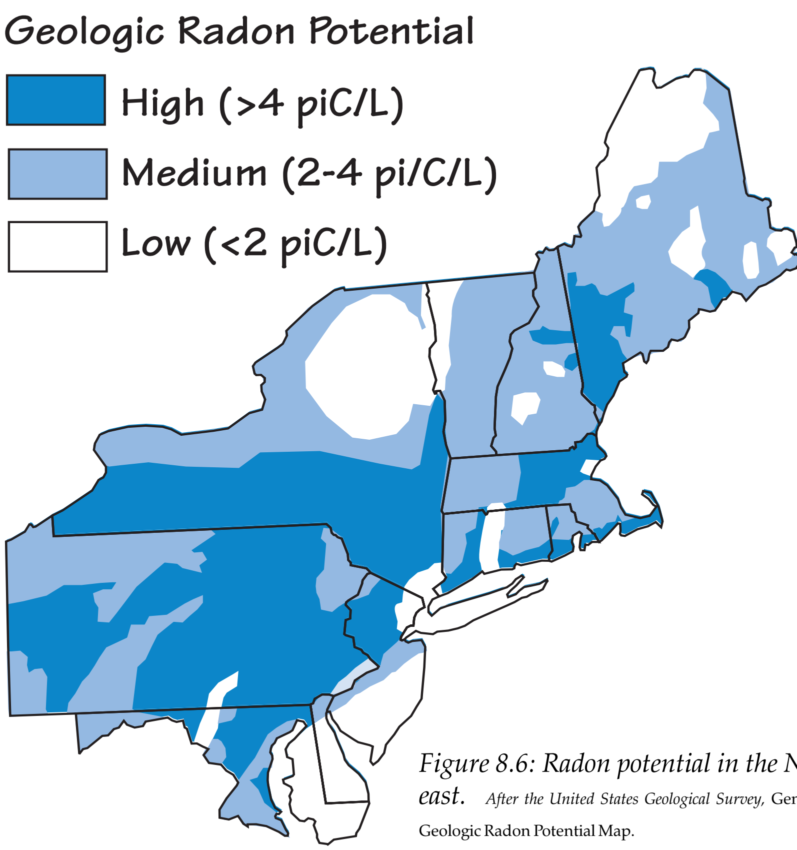


Figure 8.6: Radon potential in the Northeast. *After the United States Geological Survey,* Generalized Geologic Radon Potential Map.