Radioactive Nuclides & Earth's Age

Purpose: To discover what can be deduced about the Earth's age by comparing the half-life of known persistent nuclides with their presence or absence on Earth.

Background: Persistent nuclides are radioactive isotopes that are not produced continually by natural processes. This means that no new amounts of these materials have been produced since the beginning of Earth's formation.

Data:

Nuclide	Half-Life	Found in Nature?	Nuclide	Half-life	Found in Nature?
^{50}V	6.0×10^{15}	Y	^{40}K	1.25×10^{9}	Y
^{153}Dy	1.0×10^{6}	N	^{144}Nd	2.4×10^{15}	Y
^{235}U	7.04×10^{8}	Y	^{174}Hf	2.0×10^{15}	Y
^{98}Tc	2.4×10^{6}	N	^{93}Zr	1.5×10^{6}	N
^{244}Pu	8.2×10^{7}	Y	^{238}U	4.47×10^{9}	Y
^{146}Sm	7.0×10^{7}	N	^{232}Th	1.40×10^{10}	Y
^{192}Pt	1.0×10^{15}	Y	^{176}Lu	3.5×10^{10}	Y
^{150}Gd	2.1×10^{6}	N	^{205}Pb	3.0×10^{7}	N
^{115}In	6.0×10^{14}	Y	^{152}Gd	1.1×10^{15}	Y
^{97}Tc	2.6×10^{6}	N	^{247}Cm	1.6×10^{7}	N
^{187}Re	4.3×10^{10}	Y	^{123}Te	1.2×10^{13}	Y
^{135}Cs	3.0×10^{6}	N	^{182}Hf	9×10^{6}	N
^{190}Pt	6.9×10^{11}	Y	^{87}Rb	4.88×10^{11}	Y
^{138}La	1.12×10^{11}	Y	^{147}Sm	1.06×10^{11}	Y
^{107}Pb	7×10^{6}	N			

Procedures:

1. Place all of the persistent nuclides in order according to their half-life. List them from longest to shortest.
2. Describe the pattern you see.

Conclusions:

1. These data are an unbiased atomic sampling of our corner of the known universe. What do the presence or absence of nuclides tell you about the age of our solar system?

2. What happened to the persistent nuclides that are no longer found in our solar system?

3. Twenty half-lives should be enough to cause most nuclides to "disappear" from the universe. Look at your data and calculate the minimum age of our solar system. You can do this by determining the time it would take for twenty half-lives to occur for the persistent nuclide that has the longest half-live of those not found in nature.

References: I created this activity after reading Miller's book.

Miller, K.R. (1999). *Finding Darwin's God: A Scientist's Search for Common Ground Between God and Evolution*. New York: Harper Collins.