

Radioactive Dating Game

Name _____ Date _____ Period _____

phet.colorado.edu/en/simulation/legacy/radioactive-dating-game

A. Half Life

Click the “**Pause**” button at the bottom of the window. Click the “**Add 10**” button below the “**Bucket o’ Atoms**” repeatedly, until there are no more atoms left in the bucket.

1. There are now 100 carbon-14 atoms on the screen. The half-life of carbon-14 is about 5700 years. If you left those 100 carbon-14 atoms to sit around for 5700 years, how many would you expect to decay into Nitrogen-14 during that time? _____
2. Click the “**Play**” button at the bottom of the window. Watch the graph at the top of the window carefully. Was your prediction correct? _____ Was it close? _____
How close? _____

B. DECAY RATES

On the right side of the screen, click the button next to **Uranium-238**. On the **Bucket o’ Atoms**, there is a slider. Drag the **slider** all the way to the right and watch the graph at the bottom of the screen. Uranium-238 has a half-life of about 4.5 billion years. **Reset All Nuclei** and then pause at each half-life.

1. Use the graph to answer the questions below.
After one half-life (4.5 billion years), what percent of the original uranium remains?
After two half-lives (9 billion years), what percent of the original uranium remains?
After three half-lives (13.5 billion years), what percent of the original uranium remains?
After four half-lives (18 billion years), estimate the percentage of the original uranium atoms that would remain?

2. Suppose you found a rock, and through testing found out that it had just as much Lead-206 as Uranium-238 in it. How old would you conclude the rock to be? _____

C. MEASUREMENT

Click “**Plant Tree**” at the bottom of the screen. The tree will grow and live for about 1200 years, then die and begin to decay. Let the time run and watch the graph at the top of the screen.

1. According to the graph, what is the percent of C-14 in the tree while it is alive? _____
Why? _____
2. According to the graph, approximately how many years has the tree been dead when its C-14 percent is down to 25%? _____
3. According to the graph, approximately how many years has the tree been dead when its C-14 percent is down to about 12.5%? _____

Click “**Rock**” on the right side of the screen. Click “**Uranium-238**” underneath “**Probe Type**” in the upper left of the screen. To measure longer times, we need to use an element that decays more slowly than C-14.

4. Before you click anything, make some predictions.
How much uranium will be remaining when the rock is 4.5 billion years old? _____
How much will be remaining when the rock is 9 billion years old? _____
How much will be remaining when the rock is 13.5 billion years old? _____
5. Click “**Erupt Volcano**” to begin the process of creating an igneous rock. Watch the graph at the top of the screen. Check your predictions. Were they correct? _____
6. “**Reset**” and change the probe type to **Carbon-14**, then **Erupt Volcano**. Why doesn’t anything show up on the graph? _____

Radioactive Dating Game

Name _____ Date _____ Period ____

D. DATING GAME

Now that we understand radioactive decay and half-lives, we can use decaying elements to find the age of dead stuff, rocks and fossils. This probe can measure C-14, U-238 and several Custom Decay Elements. Use whichever works best for the item you are measuring. Slide the **green arrows** down the graph to help fill in the following table about the decay elements this probe can measure.

<i>Probe Decay Elements</i>	<i>Age at 1 Half-Life</i>	<i>Age at 2 Half-Lives</i>	<i>Age at 3 Half-Lives</i>
Carbon-14			17,250 years
Uranium-238		8.92 Billion Years	
Custom Half-Life = 100 ky	100,000 years		
Custom Half-Life = 1 my	1,000,000 years		
Custom Half-Life = 10 my	10,000,000 years		
Custom Half-Life = 100 my	100,000,000 years		

Drag the probe to different items on or below the surface of the earth. The probe will tell you how much of the original element is still in the rock or fossil. Use the graph to match the percent of element remaining, and then use the time shown to estimate the age of the rock or fossil. If you estimate a correct time, a green smiley face will appear. Find the age of all the items.

Hint: For the last four items on the list, neither C-14 or U-238 will work well. Select "Custom", and pick a half-life that gives you something other than 0.0% on the probe.

<i>Item</i>	<i>Biotic? (Check One)</i>	<i>Age (years)</i>	<i>Element Used</i>
Animal Skull	☐ Biotic ☐ Abiotic ☐ Fossil		
House (made of wood)	☐ Biotic ☐ Abiotic ☐ Fossil		
Living Tree	☐ Biotic ☐ Abiotic ☐ Fossil		
Distant Living Tree	☐ Biotic ☐ Abiotic ☐ Fossil		
Dead Tree	☐ Biotic ☐ Abiotic ☐ Fossil		
Bone	☐ Biotic ☐ Abiotic ☐ Fossil		
Wooden Cup	☐ Biotic ☐ Abiotic ☐ Fossil		
Larger Human Skull	☐ Biotic ☐ Abiotic ☐ Fossil		
Fish Bones	☐ Biotic ☐ Abiotic ☐ Fossil		
Rock 1	☐ Biotic ☐ Abiotic ☐ Fossil		
Rock 2	☐ Biotic ☐ Abiotic ☐ Fossil		
Rock 3	☐ Biotic ☐ Abiotic ☐ Fossil		
Rock 4	☐ Biotic ☐ Abiotic ☐ Fossil		
Rock 5	☐ Biotic ☐ Abiotic ☐ Fossil		
Fish Fossil	☐ Biotic ☐ Abiotic ☐ Fossil		
Dinosaur Skull	☐ Biotic ☐ Abiotic ☐ Fossil		
Trilobite	☐ Biotic ☐ Abiotic ☐ Fossil		
Smaller Human Skull	☐ Biotic ☐ Abiotic ☐ Fossil		

1. Why can Carbon-14 dating only be used on biotic things?

2. Why did the last 4 items in the table require using a **Custom Decay Element**?

Radioactive Dating Game

Name _____ Date _____ Period ____

MS-LS4-1	Score of 5	Score of 6-7	Score of 8-9	Score of 10
Science and Engineering Practices - Interpreting Data	-Dating Game: Few fossil ages are reasonable.	-Dating Game: Most fossil ages are reasonable.	-Dating Game: All fossil ages are reasonable.	Score of 3 in all three categories and all answers are accurate on the "Radiometric Dating Challenge Problems"
Disciplinary Core Ideas - LS4.A: Evidence of Common Ancestry and Diversity	-Your explanation of the connection between elements and fossil ages makes no sense.	-An explanation is attempted, but there are some errors or your explanation isn't entirely clear.	-A clear explanation is provided describing why certain elements are most useful for dating certain fossils.	
Crosscutting Concepts - Scientific Knowledge Assumes an Order and Consistency in Natural Systems	-Dating Game: few of the table of Probe Decay Elements is correct	-Dating Game: Most of the table of Probe Decay Elements is correct	-Dating Game: Correctly fill in the table of the Probe Decay Elements	