

NUCLEAR CHEMISTRY PhET SIMULATION TASKS

TASK #2 – Radioactive Dating Game – STUDENT DIRECTED
<https://phet.colorado.edu/en/simulation/legacy/radioactive-dating-game>

Decay Rates - Follow the prompts and answer the questions.

Glue this section down!

- 1) Select *Carbon-14*. Using the graph, the estimated half-life for C-14 is _____ years.
- 2) Move the bucket slider all the way to the right. This will place 1000 C-14 atoms onto the screen.
 - a. Click on the *Start/Stop* to stop the C-14 decay. Click on *Reset All Nuclei*
 - b. Click on the *Start/Stop* to start the C-14 decay. Stop the decay as you get close to one half-life.
 - c. Use the *Step* button to stop decay at one half-life.
 - After 1 half-life, how many C-14 atoms of the 1000 original remain? _____
 - d. Use the *Start/Stop* and *Step* buttons to reach two half-lives. After two half-lives, how many C-14 atoms remain? _____
 - What fraction of C-14 atoms present at 1 half-life remain after 2 half-lives? _____
 - e. Use the *Start/Stop* and *Step* buttons to reach three half-lives. After three half-lives, how many C-14 atoms remain? _____
 - What fraction of C-14 atoms present at 2 half-life remain after 3 half-lives? _____
 - f. Repeat Steps (a) to (e) with uranium-238.
 - Estimated half-life for U-238 is _____ years.
 - After 1 half-life, how many U-238 atoms of the 1000 original remain? _____
 - What fraction of U-238 atoms present at 1 half-life remain after 2 half-lives? _____
 - What fraction of U-238 atoms present at 2 half-life remain after 3 half-lives? _____
 - g. Based on the results of 4a to 4f, explain the meaning of the word “*half-life*” in one sentence.

Measurement - Follow the prompts and answer the questions.

- 1) Under *Probe Type*, select *Uranium-238* and *Objects*. Under *Choose an Object*, select *Rock*.
- 2) Click on *Erupt Volcano*. Let the simulation run until you reach 1 half-life. What % of the original uranium remains? _____. How many years did this take? _____
- 3) Under *Probe Type*, select *Carbon-14* and *Objects*. Under *Choose an Object*, select *Tree*.
- 4) Click on *Plant Tree*. Let the simulation run until you reach 1 half-life. What % of the original carbon remains? _____. How many years did this take? _____
- 5) Explain why uranium-238 is used to measure the age of rocks while carbon-14 is used to measure the age of the tree trunk?

Dating Game - Follow the prompts and answer the questions. Fill out the data table.

- 1) Click on *Dating Game* tab. There are objects on the surface and in the five layers beneath the surface. There are both rocks and fossils in each layer.
- 2) Select the *Carbon-14* detector. Move the Geiger counter to each fossil and record the % of original in the table below
- 3) On the $\frac{1}{2}$ life graph, move the green arrow right or left until the % of original matches the reading on the detector. Record your estimated age for each fossil in the table
- 4) Repeat Steps 12 and 13 using the *Uranium-238* detector to estimate the rock ages. For fossils with no remaining C-14 signal, use the rock ages to estimate fossil ages in the same layer.
- 5) Summarize how C-14 and U-238 dating together can be used to determine fossil ages.

Table: - Radiometric Ages for Various Objects

Object	Measured using C-14 or U-238?	% of Original	Guessed Age	Measured Age
Animal Skull				
Living Tree				
Distant Living Tree				
House				
Dead Tree				
Bone				
Wooden Cup				
1 st human skull				
2 nd human skull				
Fish Bones				
Fish Fossil 1				
Rock 1				
Dinosaur Skull				
Rock 2				
Trilobite				
Rock 3				
Rock 4				
Rock 5				