***Radioactive Dating Game Lab***

[*http://phet.colorado.edu/simulations/sims.php?sim=Radioactive\_Dating\_Game*](http://phet.colorado.edu/simulations/sims.php?sim=Radioactive_Dating_Game)

**Purpose:** You will use the radioactive decay rate and original-daughter element ratios of carbon-14 and uranium-238 to determine the ages of different objects.

**Procedure:**

1. Load PhET *Radioactive Dating Game*
2. Click on tab for *Decay Rates*
3. Select *Carbon-14*. Using the graph, the estimated half-life for C-14 is \_\_\_\_\_\_\_\_\_ years.

*Bucket Slider*

1. Move the bucket slider all the way to the right. This will place 1000 C-14 atoms onto the screen.
	1. Click on the *Start/Stop* to stop the C-14 decay. Click on *Reset All Nuclei*

*Step*

button

*Start/Stop*

button

* 1. Click on the *Start/Stop* to start the C-14 decay. Stop the decay as you get close to one half-life.
	2. 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? \_\_\_\_\_\_\_
	3. 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? \_\_\_\_\_\_\_
	4. 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? \_\_\_\_\_\_\_
	5. 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? \_\_\_\_\_\_\_
	6. Based on the results of *4a* to *4f*, explain the meaning of the word “*half-life*” in one sentence.
1.  Click on the *Measurement* tab.
2. Under *Probe Type*, select *Uranium-238* and *Objects*. Under *Choose an Object*, select *Rock*.
3. 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? \_\_\_\_\_\_\_\_\_\_\_\_
4. Under *Probe Type*, select *Carbon-14* and *Objects*. Under *Choose an Object*, select *Tree*.
5. 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? \_\_\_\_\_\_\_\_\_\_\_\_
6. 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?



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 ½ 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 Uranium2-38 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 |  |  |  |  |
| 1st human skull |  |  |  |  |
| 2nd human skull |  |  |  |  |
| Fish Bones |  |  |  |  |
| Fish Fossil 1 |  |  |  |  |
| Rock 1 |  |  |  |  |
| Dinosaur Skull |  |  |  |  |
| Rock 2 |  |  |  |  |
| Trilobite |  |  |  |  |
| Rock 3 |  |  |  |  |
| Rock 4 |  |  |  |  |
| Rock 5 |  |  |  |  |