***Go To:*** <http://phet.colorado.edu/en/simulation/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. (1pt) 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. (1pt) Click on the *Start/Stop* to stop the C-14 decay as you get close to one half-life. Use the *Step* button to advance the decay to one half-life.

*Step*

button

*Start/Stop*

button

* + - After 1 half-life, how many C-14 atoms of the 1000 original remain? *(use the simulator, don’t just write down half of the original)* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
	1. (1pt) Use the *Start/Stop* and *Step* buttons to reach two half-lives. After two half-lives, how many undecayed C-14 atoms remain?
		+ Calculate the percent of original undecayed C-14 atoms present after 2 half-lives?
	2. (1pt) Use the *Start/Stop* and *Step* buttons to reach three half-lives. After three half-lives, how many undecayed C-14 atoms remain?
		+ Calculate the percent of original undecayed C-14 atoms present after 3 half-lives?
	3. (2pts) Repeat Steps (a) to (d) 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?
		+ Calculate the percent of original undecayed C-14 atoms present after 2 half-lives?
		+ Calculate the percent of original undecayed C-14 atoms present after 3 half-lives?
	4. (1pt) Based on the results of *4a* to *4d*, 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. (1pt) 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. (1pt) 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. (2pts) 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 containing rocks and fossils beneath the surface.
2. Select the *Carbon-14* detector. Move the Geiger counter to each fossil and record the % of original in the table below
3. Based on the percent of original, make a guess as to the age of the object and record it.
4. On the ½ life graph, move the green arrow right or left until the % of original matches the reading on the detector. Record the estimated age for each fossil in the table.
5. Repeat Steps 12 and 13 using the Uranium-238 detector to estimate the rock ages. ***For objects with no remaining C-14 or U-238 radiation, use the custom setting to estimate ages. Select different half-lives until you reach the one with the least percent remaining.***
6. (2pts) Using what you have learned in this activity, summarize how you can use radioactive decay to determine the ages of objects.

***Table: Radiometric Ages for Various Objects (9pts)***

|  |  |  |  |
| --- | --- | --- | --- |
| **Object** | **Measured using C-14, U-238 or Custom Setting?** | **% of Original** | **Measured Age** |
| Animal Skull |  |  |  |
| Close 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 |  |  |  |

Room for improvement

**IMPROVEMENT**: This lab can be improved by:

When complete, upload to Focus. Ensure your filename is “FirstInitialLastNamePerXLabName”