Name_____

Go To http://phet.colorado.edu/

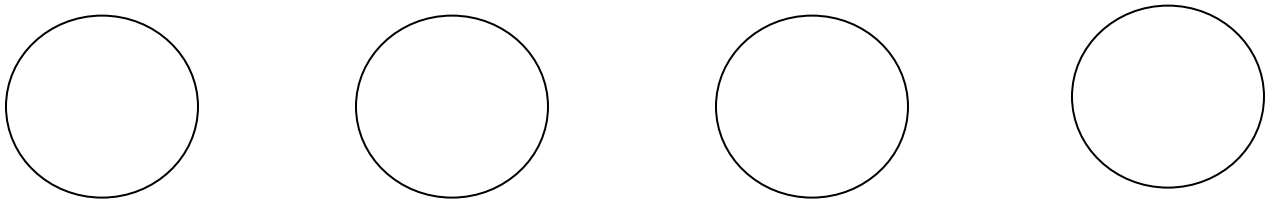
Part A: Alpha Decay

Click the magnifying glass search icon. Search "Alpha Decay", click on the simulation. Click on play sign in the middle of the image.

1. Observe the decay of Po-211. Write a nuclear equation for the alpha decay of Polonium-211.

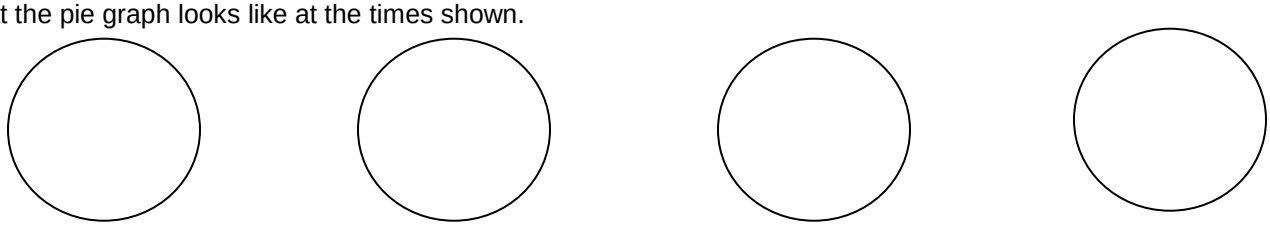
2. What has to happen within the nucleus in order for an atom of Polonium-211 to decay?

The half-life of Po-211 is approximately 500 ms (half a second). **Without using the PhET model**, sketch a pie graph indicating the number of **undecayed Po-211 atoms** for a reaction starting with 100 total atoms.



t= 0.5s t=1.0s t=1.5s t=2s

Now, simulate the decay of 100 Po-211 atoms by adding 100 atoms from the "Bucket o' Polonium". Sketch what the pie graph looks like at the times shown.



t= 0.5s t=1.0s t=1.5s t=2s

3. Compare your prediction to the results that you observed. How can you explain any discrepancies?

4. Is it reasonable to assume that if you start with 10 atoms of Polonium, that 0.5s later every time only 5 will remain undecayed? What if you start with 500 atoms? Explain.

Part B: Beta Decay

Go back to Phet home page and search "Beta Decay" Click on the simulation. Click on the play sign in the image. Make sure that you click on the "Single Atom" tab.

5. Observe the beta decay in the PhET model. Write an equation for the beta decay of C-14.

6. When an atom undergoes beta decay, where does the beta particle come from? What other particle is produced in this process?

Part C: Radioactive Dating Game

Search the "Radioactive Dating Game" PhET model.

7. On the **half life** tab, add 10 atoms. Describe what happens.

8. On the **Decay Rates** tab, move the slider over on the bucket of atoms. Describe what happens

9. On the **Measurement** tab, move the sensor around, you should get no reading. Click plant tree, put the sensor on the tree. What does the sensor read the whole time it is alive? Why?

10. What happens to the reading after the tree dies?

11. Switch the sensor to Uranium-238. Place the sensor on the tree. What happens? Why?

12. Change the object (on right) to rock. Click erupt volcano. Place the sensor (still on Uranium-238) on the rock. What happens? Why?

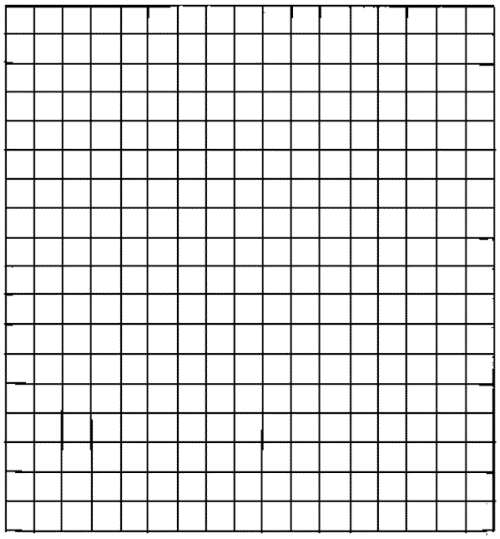
13. Predict what would happen if you switched it back to carbon-14 (write down your prediction). Test your hypothesis

Part D: Nuclear Fission

Search the "Nuclear Fission" PhET model. Make sure that you click on the "Fission: One Nucleus" tab.

14. Briefly describe the process by which Uranium-235 can be made unstable. Write a nuclear equation for the process.

15. Suppose that you have 100 atoms of Uranium-235 and you fire a neutron into a single atom. Sketch a qualitative graph of atoms that have undergone Fission of U-235 Atoms vs. Time.



Using the "Chain Reaction" tab within the model, validate your prediction from question 15.

16. Explain how the PhET model validates/invalidates your prediction made in question 15, citing specific observations.

17. Using the "Chain Reaction" tab, increase the U-235 and U-238 isotopes present. Explain what happens in high U-235 concentration, high U-238 concentration and equal amounts of both.

18. Explain why “weapons-grade” Uranium would not likely contain very much Uranium-238.

19. Explain why a reactor would not contain very much U-235.

20. Go to the Nuclear Reactor tab. Fire a few neutrons with the control rods up. What happens?

21. Fire a few neutrons with the control rods completely removed. What happens pay attention to the temperature?

22. Try to get the reaction to keep going to completion, but not get too hot (don’t let the red rise above the black box). What did you have to do with the control rods?

23. How do the control rods control the reaction?