HALF-LIFE LAB   NAME: DUE:

In any sample of a radioactive isotope, the individual atoms are decaying in a random fashion. It is impossible to predict which atom is the next to decay, yet statistically you can predict how many atoms will decay within a certain time period. Scientists measure how much time elapses while half of the atoms of a given radioactive sample decay. That time is called the half-life, or $t_{1/2}$. Half-lives of radioactive isotopes vary greatly, from much less than a second to billions of years. In this experiment, you will use pennies to represent radioactive isotopes. A heads-up penny will represent the parent nuclide, HEADSIUM. The tails-up penny will represent the daughter nuclide, TAILSIUM. Shaking the pennies for **5 seconds** will represent one half-life period. During this period, some headsium nuclides will decay to form tailsium nuclides.

PROCEDURE

1. Each group needs a cup, and 100 pennies. Count them out to make sure you have exactly 100.

2. Place the pennies in the cup. Cover the cup with your hand, and shake the pennies for 5 seconds. Dump the pennies onto the table, and spread them out so you can see whether each penny is heads-up or tails-up.

3. Remove all of the TAILSIUM nuclides (tails-up pennies). *Carefully* count these nuclides and record the number in the data table. DO NOT PUT THESE PENNIES BACK IN THE CUP. Determine the number of HEADSIUM pennies remaining in the box and record it in a data table below.

4. Repeat steps 2 and 3 until either one penny remains or no pennies remain.

5. Return all pennies to the cup, and complete the Analysis and Conclusions in your lab notebook.

DATA AND OBSERVATIONS – Recopy neatly on a separate sheet of paper to turn in.

NUMBER OF HALF-LIVES	NUMBER OF TAILSIUM NUCLIDES	NUMBER OF HEADSIUM NUCLIDES	TIME ELAPSED (S)
0	0	100	0
1			
2			
...			

ANALYSIS

1. Fill in the time elapsed column of your data table based on the fact that the half-life of HEADSIUM is 5 seconds.

2. Prepare a graph by plotting "Number of Headsium Nuclides" on the y-axis and "Time Elapsed in Seconds" on the x-axis. Remember to maximize the graph area. Draw a best-fit line or curve that shows the general trend of your data points. DO NOT SIMPLY CONNECT THE DOTS. Make this graph as neat and accurate as possible, as it will be a major part of your lab grade.

1. Describe the shape of your graph. How does the number of HEADSIUM nuclides change over time? Be specific.

2. Calculate what the average percentage of nuclides decayed (turned tails-up) after each half-life (shake)? Is this percentage consistent with the half-life concept? Hint: nuclides turning to tails, divided by the total number of nuclides will give you the percentage. Explain why or why not your average is consistent with the half-life concept.

3. The half-life of headsium was 5 seconds. What would the expected time be to get down to one or zero nuclide atoms? How long did it take your sample to get there? Explain why or why not your results were the same as expected.

4. The half-life of iodine-125 is 60 days. The half-life of iodine-131 is 8 days. Radioactive iodine is used to diagnose and treat diseases of the thyroid gland. Keeping in mind that overexposure to radiation is harmful, which of these isotopes would be the best to use? Explain your answer.

GRADING RUBRIC

Graph – Data points are all neatly plotted, scale is appropriate to use the entire graph, axes are labeled accurately with correct units, best-fit line is drawn in (not connecting dots), appropriate title, neat and reflects effort. You may also use excel if you prefer.

40 points: _____

Data Table – Rewritten or typed neatly on a separate sheet of paper, Set up with a grid and correct column labels (with units), all data is entered into the correct columns, and corresponds to the data that was graphed, appropriate title, neat and reflects effort.

20 points: _____

Conclusion Questions – Rewritten or typed neatly on a separate sheet of paper (below your data table would be fine), in complete sentences, answering all parts of the question, referencing numbers and showing calculations when appropriate, appropriate title, neat and reflects effort.

40 points: _____

Final Grade: _____