

4. Count the number of pennies remaining in the box. Record this number in the 10 s row of the “Unchanged atoms” column. Count the number of changed atoms (the pennies that you removed from the box), and record the number table in the 10 s row.
5. Each lab partner should predict how many times steps 2–4 will need to be repeated until only one unchanged atom remains. Record the time that each lab partner predicted. Remember that each shaking period is counted as 10 s, so four shaking periods would be recorded as 40 s.
6. Repeat steps 2–4 by counting and recording each time until only 1 (or 0) penny with the head side up remains.

Part B: Simulating decay with paper

7. Draw an y -axis and x -axis on the poster board so that they are about 5 cm from the left side and the bottom edge respectively. Label the x -axis as “Time” and the y -axis as “Amount of material.”
8. Along the x -axis, draw marks every 10 cm from the y -axis line. Label the first mark “0” and the next mark “1,” and so on. Each mark represents 1 minute.
9. Place one of the colored strips vertically with its lower edge centered on the 0 mark of the x -axis. Tape the strip in place.
10. Fold the other colored strip in half, and cut it in the middle. Place one-half of the strip so that it is centered on the next mark, and tape the strip in place.
11. Fold the remaining piece of the strip in half, and cut it exactly in the middle.
12. Place one of the pieces so that it is centered on the next mark, and tape the piece in place.
13. Repeat steps 11 and 12, and each time, tape the first piece vertically at the next x -axis mark. Continue until you have at least 8 strips taped along the x -axis.
14. Use the string to join the tops of each strip of paper to make a continuous curve.

CLEANUP AND DISPOSAL

15. Return the pennies and box to your teacher. Dispose of the poster board, strips, and string as instructed by your teacher. Clean up your lab station.



ANALYSIS AND INTERPRETATION

Part A

1. **Predicting Outcomes:** How long did it take to have only 1 penny (0 pennies) left in the box? How close was your prediction in step 5?
2. **Analyzing Data:** Make a graph of your data on a piece of graph paper. Label the x -axis “Time” and the y -axis “Unchanged atoms.” Plot the number of unchanged atoms versus time. Draw a smooth curve through the data points.
3. **Analyzing Results:** Each trial was comparable to a 10 s period of time. How long did it take for half of your pennies to be removed from the box? What is the half-life of the process?
4. **Interpreting Graphics:** Use your graph to determine the time it takes to have only 25% of the unchanged atoms remaining. In your experiment, how many pennies remained in the box at that time?

Part B

5. **Analyzing Results:** How many half lives have passed after 4 minutes?
6. **Interpreting Graphics:** Using the string plot, determine how many minutes it took until only 20% of the original material remained.

CONCLUSIONS

1. **Inferring Conclusions:** If you started with a paper strip that was twice as long, would the half-life change?
2. **Inferring Conclusions:** Is there a relationship between the graph from Part A and the string plot from Part B?