Anchor Activity

7-2A Modelling Rates of Radioactive Decay

Find Out ACTIVITY

Radioactive elements contain at least one unstable isotope. Each radioisotope decays at a unique rate. However, graphs showing the rate at which isotopes decay show striking similarities. The rate at which a sample of a radioisotope decays can be modelled by tossing pennies and letting them land randomly. In this activity, you will use coin tosses to generate data for a graph.

Safety

- Wash your hands after completing this activity.

Materials

- 100 pennies or other two-sided objects
- container for shaking the pennies
- graph paper

What to Do

1. Create a data table like the following. Give your data table a title.

Number of Tosses Completed	Number of Pennies Remaining	Total Number of Pennies Removed Since the Start
0	100	0
1		
2		
etc.		
Last toss (record the number)	0	100

2. Working in pairs or small groups, count out 100 pennies.
3. Shake the pennies in the container and let them fall on a surface where they can be examined. Count all pennies that landed "heads" up and put them back into the shaker. You will shake them again because they represent atoms that did not yet decay. Record this number of pennies in the column "Number of Pennies Remaining."
4. Count the number of pennies that landed "tails" up. These represent atoms that decayed, so you will not shake them again. Add this number of pennies to the previous total number of pennies removed so you have a running total of all the pennies removed. Record this number of pennies in the third column.
5. Repeat steps 3 and 4 until there are no pennies left.
6. You will plot two smooth curves on the same piece of graph paper.
   - The first curve will show the number of pennies remaining after each toss. This will represent the number of nuclei of the parent isotope remaining in the sample after each decay.
   - The second curve will show the number of pennies removed since the start. This will represent the number of daughter isotopes produced during the decay.

   Your graph should have the following features.
   - Give your graph a title.
   - The *x*-axis (horizontal) will be the number of tosses. The *x*-axis should increase left to right from 0 tosses to how many you needed in the activity.
   - The *y*-axis will plot the number of pennies. The *y*-axis should extend from 0 to 100.
   - Join the dots on each curve with a smooth line.
   - Label the falling curve as parent isotopes and the rising curve as daughter isotopes.

What Did You Find Out?

1. (a) Could you use your graph to estimate how many pennies would be present after four tosses if you had already done three tosses but not the fourth? Explain.

   (b) Does your data suggest you could predict exactly how many pennies would be present after four tosses if you had already done three tosses but not the fourth? Explain why or why not.

   (c) Does your data permit you to predict which particular pennies will land heads up? Explain.

   (d) Obviously there is no such thing as "half a toss" of the pennies. However, does your data suggest that you could estimate the number of pennies remaining after $2\frac{1}{2}$ tosses? Explain.

Decay Activity:
How Radioactivity Changes over Time

Name:
Date:

Purpose: to demonstrate how radioactive decay decreases over time.

Materials:

- Container
- 100 2-sided coins or chips

Procedure:

1. Place 100 chips all with one side facing up into the container
2. Shake the container. This represents 1 unit of time.
3. Remove all chips that have the opposite side facing up (these represent the decayed nuclei). Count and record the amount in the table.
4. Count the remaining chips still with the original side up (these represent the un-decayed nuclei). Record this amount in the table.
5. Repeat steps 2-4 until all chips have been removed. Add more space to your table if you need it.
6. Graph your results in two curved lines on the graph. The number of shakes/time should be on the x-axis and the number of chips on the y-axis. Make sure to title your graph.

Results:

Table 1: The Number of "Decayed" and "Un-decayed" nuclei.

Time (shakes)	Number of Decayed Nuclei	Number of Un-decayed Nuclei
0	0	100