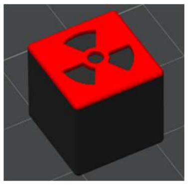
“Radioactive” Dice – Half Life Lab

Background

All radioactive elements have a property called half-life. **Half-life** can be defined as the amount of time it takes for one-half of the original sample to decay and this time varies based on the element.



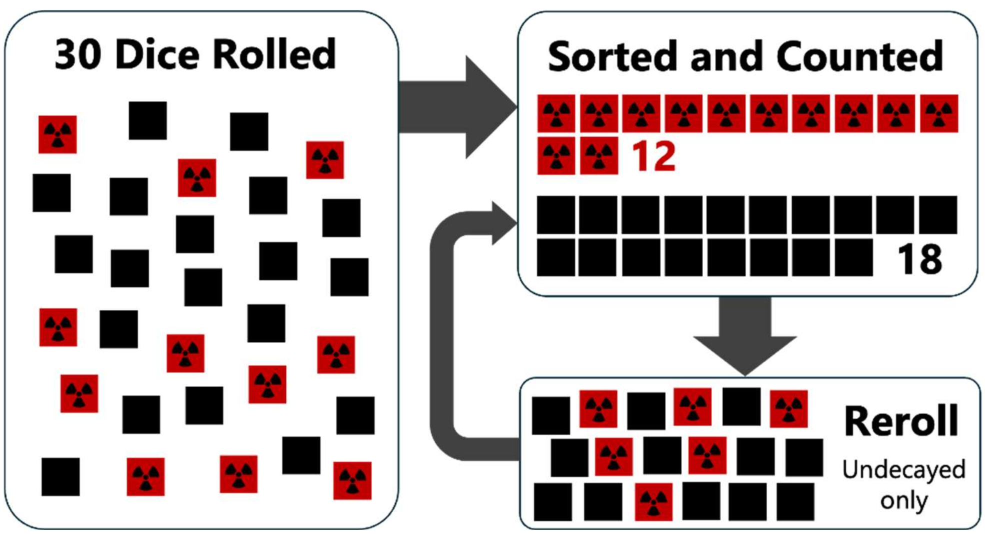
Materials

To represent our radioactive atoms, we will be using dice that have one colored face. When one of these “atoms” is rolled with the colored face up, we say that it has decayed into one of its daughter elements.

Procedure

1. Place all 100 “radioactive” dice into a cup and roll them out into a box lid to prevent losing them off the table.
2. Carefully count the number of dice that are showing their colored side face-up and remove these from the sample.
3. After removing these “decayed atoms” from the sample, place all remaining dice back in the cup and roll again.
4. Repeat steps 2 and 3 until there are no more dice remaining.

The diagram/table below shows this process if you started with 30 dice



# of Rolls	Total Undecayed	Newly Decayed ☢	Total Decayed ☢
	Black side up this roll	Colored side up this roll	Total in the “colored side up” pile after this roll
0	30	0	0
1	18	12	0 + 12 = 12
2	12	6	12 + 6 = 18

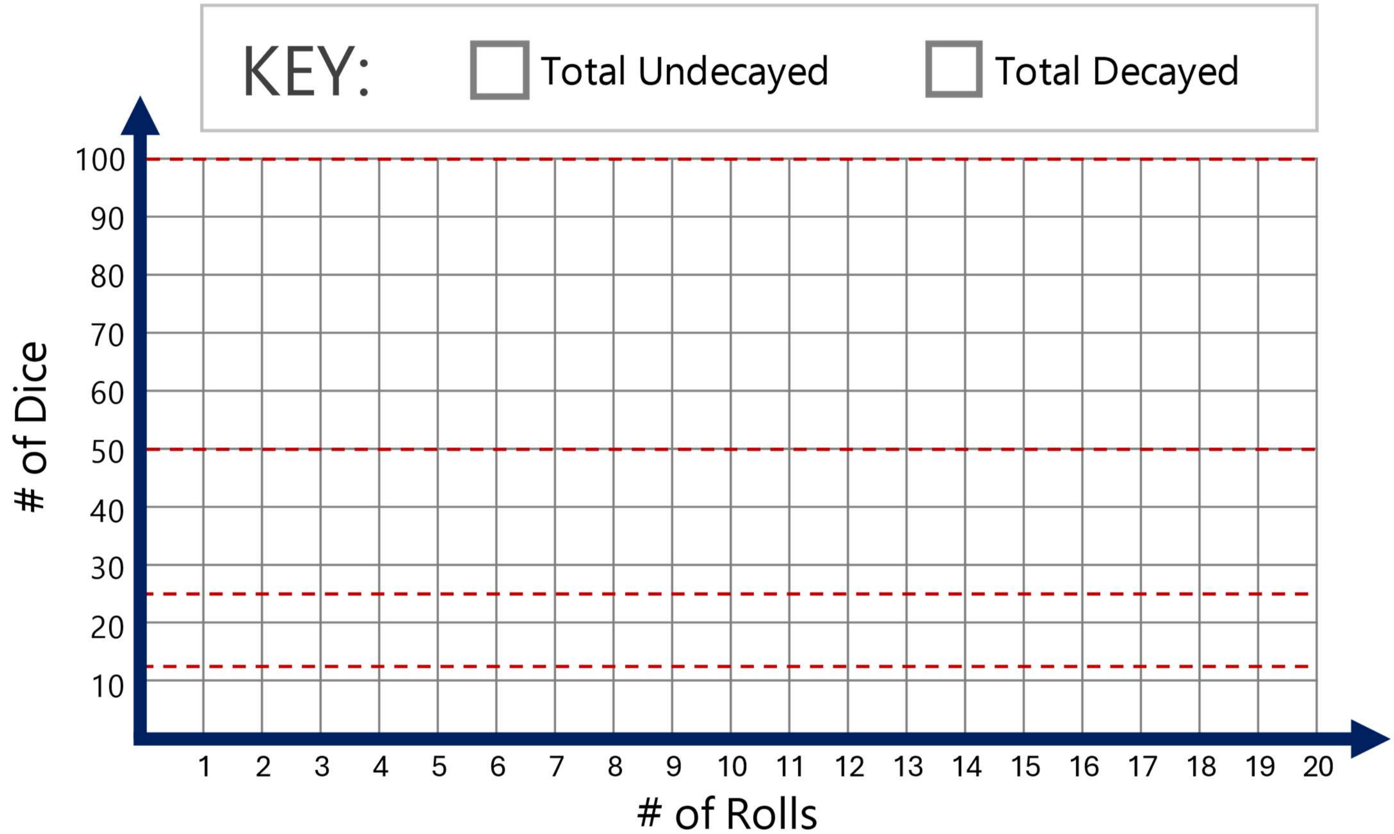
Data

Record the results of your rolls when following the procedure on the last page

# of Rolls	Total Undecayed	Newly Decayed ☢	Total Decayed ☢
	Black side up this roll	Colored side up this roll	Total in the "colored side up" pile after this roll
0	100	0	0
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Graph

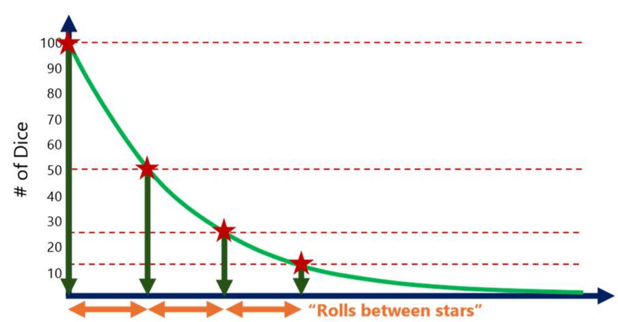
1. In the axes below, **graph in the number of dice** that remain **undecayed** after each roll in one color and the total number of dice that have **decayed** (colored side up) in another color.
2. **Color in the boxes** in the “KEY” for easy interpretation of the graph.
3. **Draw a curve** for each color that best represents the general shape of the graph



Analysis

1. On the graph above for the undecayed atoms draw a star (★) on the line where it crosses 50, 25, and 12.5 (as marked by the dotted lines). Estimate the location with 1 decimal place for each of the stars and subtract to calculate the rolls between stars.

Total Undecayed	100	50	25	12.5
# of Rolls	0			
Rolls between stars				



2. Looking at the average spacing for the stars listed above, how many rolls do you estimate is the “half life” for your particular radioactive sample? (average the three “Rolls between stars” above)

Average “Half Life” of Sample	

3. Describe the relationship between the “Total Undecayed” and “Total Decayed” values. What do these two values always add up to?

Questions

1. Complete the following table

# of Half Lives	0	1	2	3	4	5	6
% remaining	100%	50%					

2. If you started with 1,200 dice, how many would you expect to have after 4 half-lives have elapsed?

3. Based on your estimated half-life for these dice, how many rolls would that take? (4 half-lives)

4. If these dice had 2 radioactive faces instead of 1, how would that affect the number of rolls it would for half of the sample to decay? Why?

5. Since actual radioactive elements are not dice, we measure half-life in seconds, minutes, days or years. For example, the half-life of Carbon-14 is 5,730 years.

   If you have a 40 g sample of that is 17,190 years old:

   a. How many **half-lives** have elapsed? (how many times can 5,730 go into 17,190?)

   b. What **percentage** of the sample is still undecayed Carbon-14?

   c. **How many grams** of Carbon-14 remain undecayed?

   d. Carbon-14 becomes Nitrogen-14 through beta decay. Assuming all decayed atoms are now Nitrogen-14, **how many grams of Nitrogen-14** are in the sample?