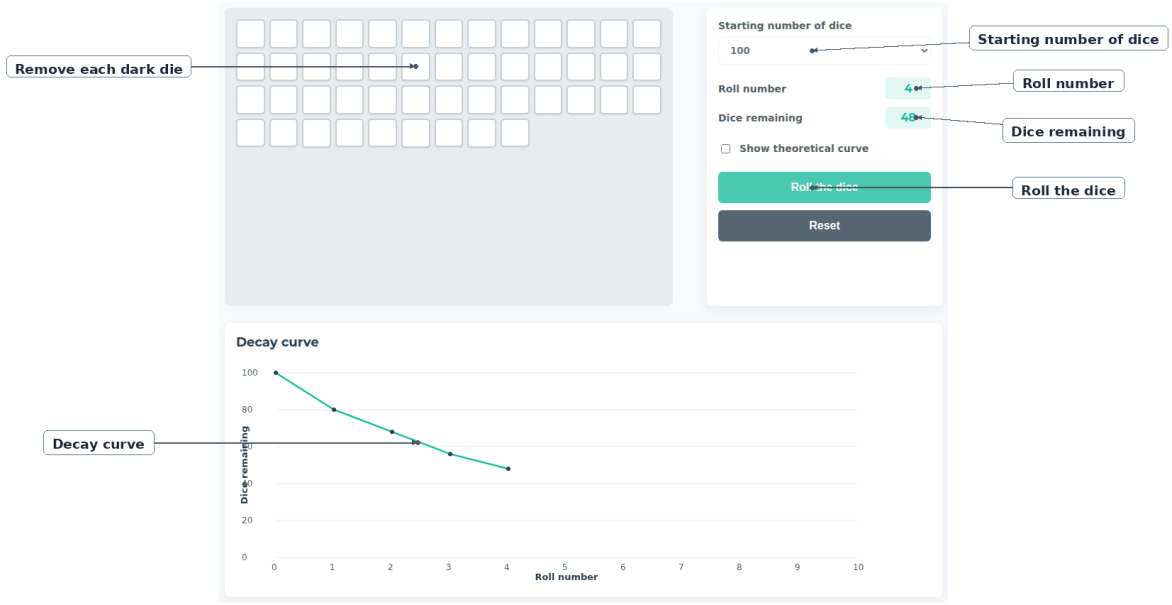
Investigating Radioactive Decay

The Dice Model of Half-Life

Aim:

You are investigating how the number of dice remaining changes as you roll and remove them again and again, and using this to estimate a half-life for the simulation.



Prediction:

Starting from 100 dice, predict how many rolls it will take for the number remaining to fall from 100 to 50. Then predict how many further rolls it will take to fall from 50 to 25.

Rolls from 100 to 50: ..... Rolls from 50 to 25: .....

Test both predictions in the simulation.

Method:

1. Choose a starting number of dice from the Starting number of dice dropdown (100 is a good default) and click Roll the dice.
2. Every die that has landed on its dark face has "decayed" — click each one to remove it from the tray.
3. Count how many dice are left, type the number into the box, and click Record result.
4. Click Roll the dice again and repeat steps 2 and 3.
5. Keep rolling, removing, counting and recording until only a few dice remain. Add extra rows to your results table if you need them.

Results:

Roll	Dice remaining	Dice decayed this roll

Analysis:

Use your graph to estimate how many rolls it took for the number of dice to fall from your starting number to half that number. This is your first estimate of the half-life, measured in rolls.

Find a second half-life later in the same run, for example from 50 dice down to 25 (or from whatever count you reached down to half of it). Is it close to the same number of rolls as your first estimate?

What does your answer to the question above tell you about whether the half-life depends on how many dice are left in the tray?

Tick Show theoretical curve to overlay the smooth prediction on your graph. How well does your rolled data follow it, and why might the two differ more once only a few dice remain?

Explaining why:

Why is the dark face on a die a good model for radioactive decay, even though real nuclei do not roll dice?

Is the number of rolls needed to halve the count always exactly the same each time you run the simulation? Why not?

How would using 20 dice instead of 200 change how smooth or how ragged your decay curve looks? Explain why.

What single change to the dice themselves (not the starting number) would make the half-life of the model shorter? Explain your reasoning.