



**Advanced Mathematics  
Support Programme®**

# The Collatz Conjecture



- What's it all about?
- Let's start [here](#) with Alex Bellos and Numberphile

# Collatz-ish

- Try this out from NRICH and the UKMT

## Collatz-ish

Age 14 to 16 Short ★★

The first term of a sequence of positive integers is **6**. The other terms in the sequence follow these rules:

if a term is even then divide it by **2** to obtain the next term;  
if a term is odd then multiply it by **5** and subtract **1** to obtain the next term.

For which values of  $n$  is the  $n$ th term equal to  $n$ ?

# Finished?

- Check out your answer [here](#)

# Further thoughts

- Can you find any other starting numbers where there are values of  $n$  for which the  $n^{\text{th}}$  term is equal to  $n$ ? (Hint: try numbers from 2 to 15)
- As with the Collatz conjecture will this,  $5n - 1$ , always end with 4, 2, 1 for any starting number?

# More thoughts

- What happens if you still divide even numbers by 2 to obtain the next term but change the multiplier for odd terms to -3 and subtract 1 to obtain the next term i.e.  $-3n - 1$  ? (Hint: try start numbers  $<10$ )
- Why do you think this is what happens?
- What is the first start number where this doesn't happen?

# The Collatz Conjecture

- Does it still work for negative start numbers?

# Other things to do

- Why not colour your own ‘seaweed picture’?  
Find a blank copy at the end of this document
- Is it possible to do this using the four colour theorem? ([more on the four colour theorem](#))
- Why not draw your own ‘tree’ diagram as Alex Bellos did for the  $-3n - 1$  sequence for start numbers from 1 to 10?



# Want to know a bit more about the Collatz Conjecture?

- Professor David Eisenbud on the infamous Collatz Conjecture, a simple problem that mathematicians may not be "ready" to crack.
- Wikipedia – Collatz Conjecture
- The On-Line Encyclopedia of Integer Sequences® (OEIS®) as referenced by Professor David Eisenbud, list of starting values and number of steps here.

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