

# Lesson plan: MATHS KS3 **NUMBER SNAKES**

Working out which sequences of operations give integer answers helps students to consolidate their numerical fluency, says Colin Foster

In this lesson students explore 'number snakes', which are sequences of operations performed successively, beginning with a specific starting number. First, students explore a given number snake to find out which starting numbers lead to integer answers. They then create and vary their own number snakes, and try to control when the final answer will be an integer and when it won't. Playing around with numbers and operations like this is a great way to develop students' numerical fluency.

language.)

# **STARTER ACTIVITY**





These snakes can be challenging, because it will take just one error to mess up everything that follows. Some students may realise that they are going wrong, because the answers along the way become too awkward (non-integer) to do without a calculator.

The final answer should be 6.



answers at the end. **KEY CURRICULUM** LINKS Make connections between

number relationships

DOWNLOAD

a FREE lesson plan that will

help your students develop an

understanding of prime numbers

and what makes them special

teachwire.net/ primenumbers

WHY

**TEACH THIS?** This lesson helps students develop their number sense

by inventing sequences of operations that lead to integer

 Make and test conjectures about patterns and relationships

### **KEY OUESTION**

What happens when we put different numbers into different 'number snakes'?



## MAIN ACTIVITY

Q What other numbers could you put in at the top, instead of 26, that would give you an integer answer at the bottom?

Students may realise that the critical steps where things could go noninteger are the squarerooting step and the dividing-by-3 step. This may lead them to choose starting numbers which, like 26, are 1 bigger than a square number.



However, on average only one in three of these will work. In general, starting numbers like 5, 65 and 122, which are of the form  $(3n - 1)^2 + 1$ , will work, but other numbers won't.

Q Make up your own number snake with 5 steps like this example; decide which numbers will give integer answers and which won't, and work out why.

Additional challenges you could set here might include

- Include a 'cube root' at one of the steps
- Include two 'divides'
- Include '15% of' as one of the steps

• Make one which gives an integer answer at the end, but **not** after all of the intermediate steps

• make one which gives a number over 100 after one of the steps

· make one which is guaranteed to go into negative numbers

somewhere • make one which gives an integer answer only for one unique starting number make one which always gives the **same** answer (e.g.  $\pi$ ), regardless of the

starting number make one which always gives a final answer which is the same as the starting number make one which always gives a final answer which is twice the starting number



## DISCUSSION

Q Let's have a look at your snakes!

What does your snake do with different starting numbers?

Which numbers did you tru?

Can you reason about what must happen for other numbers?

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There is lots for students to explore, and ample opportunity for them to get really creative with their ideas. It may be preferable to not allow calculators, if vou want the students to be developing their mental number work.

Alternatively, the use of calculators might allow the

focus to be placed on the process, rather than the calculations. Pupils who know about them might find ways of using functions such as sin. cos and tan.

For some snakes. it may be possible to express what is going on with algebra, using n for the starting number. In other cases, this may not help so much, depending on whether the steps involve things that are easy to express algebraically. This is a useful lesson for helping students appreciate when algebra is the ideal tool for the job - as well as those occasions when it may not be.



**GET INFORMED** 

The Association of Teachers of Mathematics has announced that its upcoming 2021 conference will take place online. Running from 6th - 8th April, the event will be made available via a managed event app and nclude a series of plenary speakers, ATM workshop sessions, a guiz and the organisation's AGM. All tems will be recorded, and there will be access to an exhibitor room, networking rooms and a lunchtime chat room throughout. For more details, visit atm.org. uk/2021-conference



#### ADDITIONAL RESOURCE

A selection of similar activities can be downloaded via bit.ly/ts98-nsnakes



#### **GOING DEEPER**

Confident students could explore number snakes with more than 5 steps They could also include more complex functions, such as powers and roots. and perhaps rounding to specified numbers of significant figures.



#### **ABOUT OUR EXPERT**

Colin Foster is a <u>Reader in</u> Mathematics Education at the Mathematics Education Centre at Loughborough University. He has written many books and articles for mathematics teachers.

> His website is foster77.co.uk. and on Twitter he is @colinfoster77