Barefoot

Recommended for
ages 9-10

Logical Number Sequences Activity

Activity Duration: **45 minutes**

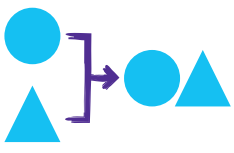
This resource can be adapted for other years

Principal partners

BT

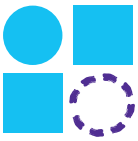
Computing at School

Concepts and approaches covered



Algorithms

Logic



Patterns

Persevering

Collaborating

Overview

In this activity pupils explain the rule for a number sequence and predict which number(s) comes next. In doing so, they extend their knowledge of simple rule based algorithms. They also use logical reasoning as they work out and explain their algorithms.

Pupil objectives

- ☑ **I can use logical reasoning to explain how some simple algorithms work**

Introduction (5 mins)

- Write the word algorithm on the board and ask the children to recap what an **algorithm** is (a sequence of instructions, or a set of rules for performing a specific task) and share their own examples of algorithms, perhaps from previous work
- Explain that in this activity they will be examining (or analysing if they can understand this term) rule based algorithms and explaining how they work
- To do this they will be using logical reasoning (write this key term on the board)
- If appropriate for your class, you could find out if anyone can deduce what logical reasoning means at this stage from their existing knowledge of the words 'logic' and 'reason' – this in itself is logical reasoning!

Introduction to algorithms (10 mins)

- Explain that you will be using number sequences for this activity and they will be working out the rules for the sequences
- Write a number sequence on the board with at least one missing entry, such as the one given here, but appropriately challenging for your class' age and ability. 8, 16, 32, 64, __
- Using a think-pair-share activity, ask the pupils to:
  - work out and explain the rule for the sequence
  - predict what number comes next in the sequence
  - write the rule on the board – i.e. "double the last number" and add in the next number in the sequence (128)
- Highlight that this is the rule for solving the problem, and therefore a simple rule based algorithm
- Using a think-pair-share activity, ask the pupils to consider how they worked out the rule
- Invite pupils to share their ideas. Hopefully they will offer that they have looked at the numbers already in the sequence, identified if they could spot a pattern by working out the relationship between the given numbers, and then predict what number came next (or lead them to this point)
- Tell them they have been using **logical reasoning**
- Stress that logical reasoning is concerned with how a problem is solved rather than simply 'knowing' the right answer. It is the journey, rather than the destination that is important
- They have analysed the problem by using their prior knowledge (of maths) and the existing information (the numbers that were given to them). They then used this to identify the rule and predict what the correct number could be. They then tested their rule and the number by working through the sequence again, using the rule with their new number to check it produces the next number in the sequence. If it didn't, then they worked through the process again
- This is an example of using logical reasoning

Main task (20 mins)

- Pair up the pupils and give out the number sequence sheets you have prepared prior to the lesson
- Explain they now need to use their logical reasoning skills to be able to explain the rule (the algorithm) and the missing number
- Tell the pupils that you will be asking them:
  - how they worked out the answer
  - the rule for the number sequence (the algorithm)
  - the missing number
- Highlight that the missing number is actually not the most important thing in this task – you are most interested in how they worked their answer out, followed by the rule and then finally what the answer actually is

- Explain that some of the sequences are deliberately tricky and they might not be able to work out the rule, but that they should note down how they tried to spot the pattern and work it out, as this is the most important thing (if you intend to assess their work, you could give them points for this element)
- Throughout the process pupils will be developing important skills. They will be collaborating and persevering as they work together to try to explain the rules and find the missing numbers
- When you feel pupils have made good progress, bring the task to a close. Not all may be able to explain all their sequences but do ensure they all write down how they have tried to work the rule out

Extension

- Pupils could think up their own sequence for others to explain
- Stretch & challenge extension: Invite pupils to visit and explore the website **https://oeis.org**
  They can explore their favourite number sequences and enter different sequences to find out where they are used

Class discussion (5 mins)

- As a class discuss the rules and missing numbers for the sequences, focusing on the rules and how they worked them out
- A pattern will hopefully emerge around how they have found the rules and missing numbers. You should be able to draw out that they have been using their skills of analysis (examining the existing information) and prediction (using what they already know to explain the pattern within the sequence and identify the missing numbers)

Plenary – crack the safe (5 mins)

- Write the sequence you have prepared for the plenary on the board
- Explain that they have been given the sequence for the combination lock that will open the school safe (or another suitable scenario)
- Explain they have also given 3 numbers that could be the correct answer.

  Write these on the board.
  E.g. Sequence: 16, 35, 73, 149, ___
  Possible answers: 303, 302, 304, 301
- Using a think-pair-share activity, ask the pupils to work out what the rule for the sequence is and predict which of the numbers comes next in the sequence (in this case the rule used is multiply by two and add three and the missing number is 301)
- Use this as an opportunity to ensure they all have a common understanding and have met the learning objective

Differentiation

- You may wish to create differentiated sequences for your class, so all pupils have some challenge to their sequences at an appropriate level for them. The extension activity is also suitable for stretching and challenging more able pupils
- Pupils requiring more support may benefit from sequences which increase slightly in difficulty as they progress to build their confidence. They may also benefit from adult support to help them to work through the logical reasoning process

Assessment opportunities

- Informal teacher assessment of pupils' progress during main task, class discussion and plenary (focussing on asking pupils to explain the rule for a sequence and how they worked out the rule)
- Assessment of sequence sheets if wished

Teaching notes

Preparing the sequences

In order to prompt your pupils to use their logical reasoning skills, the sequences you prepare for the main task need to be challenging for them. This is so they cannot simply look at the numbers and 'know' what the answer is. You may wish to ease them in fairly gently, then increase the difficulty - this is up to you. However the emphasis should be on the how they tried to, or were able to, work out the rule. The example sequences in the activity resources can be used as a starting point.

Concepts and approaches

Algorithms

Algorithms are the sets of rules for solving the number sequences. These can be very simple - such as double the previous number each time, or more complex, depending on the level of your class and the sequences you have developed. Algorithms can also be thought of as a set of steps, eg 'take the previous number, double and add three' as a two step algorithm for generating a sequence of numbers.

Logic

Logic is used throughout the activity as pupils use their existing knowledge of arithmetic and the information they are given (the numbers) to work out the rule for the sequences. They predict what number comes next based on the numbers given to them in the sequence. Pupils will look at the existing numbers and work out relationships between them by using their existing knowledge of maths. Once they think they have worked out the rule, they will predict the next number and test it out by going through the whole sequence, using their rule to check it produces the number they have predicted. If it doesn't, they will repeat the process, once again looking at the relationships between the numbers and trying to spot a pattern until they are able to work out the rule and the next number(s) in the sequence.

Patterns

Pupils spot and use similarities throughout this activity as they see relationships between the numbers within the sequences and similarities in how they go about finding the rules and missing numbers.

Persevering

Persevering is an important skill throughout this activity as pupils need to keep going despite the fact that they may find some of the sequences tricky.

Collaborating

Collaborating as an approach is used as pupils work in pairs throughout the activity, working together to find the rules and missing numbers in the sequences.

Curriculum links

Computing

- Use logical reasoning to explain how some simple algorithms work

Maths

- 5 – 7 years: recognise and describe linear number sequences

Note: the sequences in this activity go beyond the requirements of the maths programme of study as it is likely you will include non-linear sequences too (as per the examples given).

Prior knowledge

This activity assumes your pupils are familiar with what algorithms are, perhaps having worked through the **introduction to algorithms activities**.

Taking this further

Spreadsheet programs can be used to explore number sequences. An example spreadsheet that can be used to create a sequence is included in the activity resources. Pupils could play (or adapt) the Scratch number sequence game at **http://scratch.mit.edu/projects/23731318/**

Further reading

NRICH activities on number sequences at **http://nrich.maths.org/8941**

Online encyclopedia of integer sequences **https://oeis.org/**

Wolfram Alpha for continuing number sequences e.g.
http://www.wolframalpha.com/input/?i=continue+2%2C+5%2C+8%2C+11

Related actvities

KS2 2D shape algorithms
KS2 Logical Reasoning Unplugged Activity

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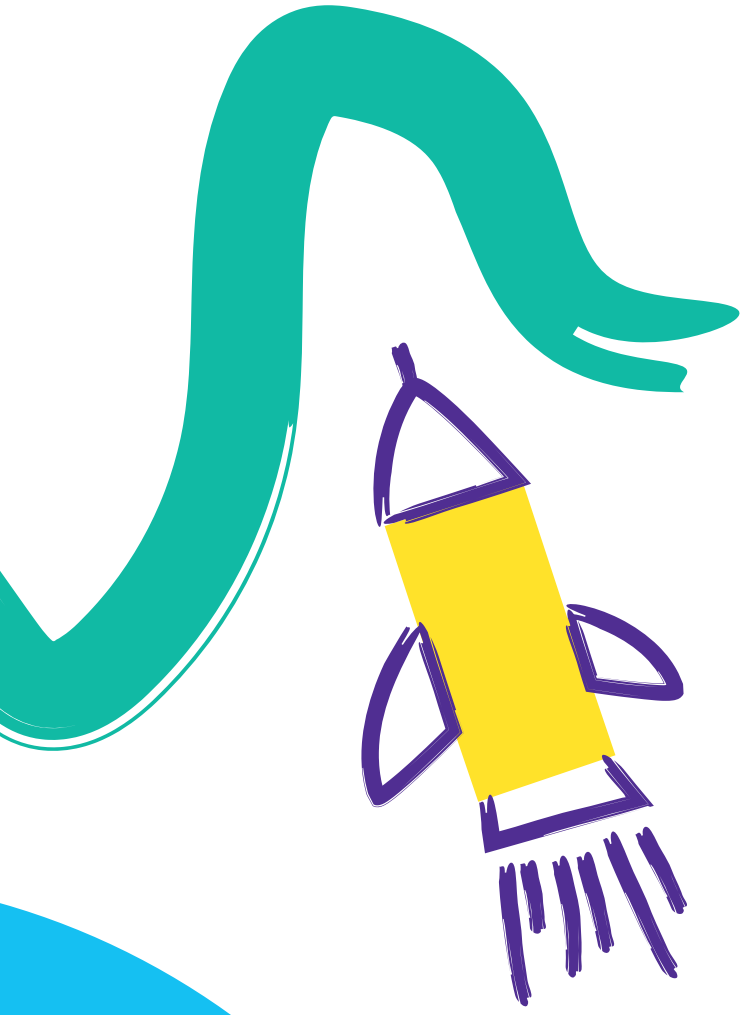

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Principal partners

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