POINTZERO: CONFINED

These activities are designed for 60-minute lessons. You may need to adapt the materials for use in longer or shorter lessons.

INTRODUCTION

In this activity, pupils are presented with a series of puzzles related to lifts that move according to specific mathematical rules. The aim in all cases is to get to the ground floor.

This activity is mainly ICT based. It has been designed for use with pupils in an ICT suite although it could be adapted for use in a maths classroom equipped with a data projector and whiteboard. It is suggested that pupils work together in pairs or small groups to encourage appropriate levels of participation and discussion.

The activity contains 3 options offering varying degrees of challenge. Different pupil pairs or groups within a class can work at different options. Alternatively, you may prefer to ensure each group has a mix of pupils. This will help to create appropriate conditions for peer support.

Completing an option unlocks a code which can be used when the user enters the PointZero building to reflect their progress. **Please note that these codes are not automatically saved if the user logs out**. Remind users to make a note of any codes they receive as they progress.

Each option is represented within the case study by a person in the lift who has solved how the lifts are working:

- **Option 1 (Tom's Solution)**: Lifts move up and down a specified number of floors only. This option is for pupils working at **level 4 of the National Curriculum**.
- **Option 2 (Alex's Solution)**: Lifts move up and down by a number of floors dictated by numbers in specific sequences. This option is for pupils working at **levels 4 and 5 of the National Curriculum**.
- **Option 3 (Mary's Solution):** Lifts stop only at specific floors dictated by a series of algebraic expressions. This option is for pupils working at **above level 5 of the National Curriculum**.

LEARNING OBJECTIVES

Option 1 (Tom's Solution)

By the end of the lesson pupils will:

- explore connections in mathematics to develop flexible approaches to increasingly demanding problems;
- select appropriate strategies to use for numerical or algebraic problems.

Option 2 (Alex's Solution)

By the end of the lesson pupils will:

- explore connections in mathematics to develop flexible approaches to increasingly demanding problems;
- select appropriate strategies to use for numerical or algebraic problems;
- generate common integer sequences (including sequences of odd or even integers, squared integers, prime numbers, triangular numbers).

Option 3 (Mary's Solution)

By the end of the lesson pupils will:

- explore connections in mathematics to develop flexible approaches to increasingly demanding problems;

- select appropriate strategies to use for numerical or algebraic problems;
- generate common integer sequences;
- generate terms of a sequence using position-to-term definitions of the sequence.

LEARNING OUTCOMES

Option 1 (Tom's Solution)

Most pupils will:
- use problem solving skills and directed number to solve a puzzle.

Option 2 (Alex's Solution)

Most pupils will:
- use problem solving skills and some special sequences to solve a puzzle.

Option 3 (Mary's Solution)

Most pupils will:
- use problem solving skills and sequences generated from an algebraic expression to solve a puzzle.

NATIONAL CURRICULUM OBJECTIVES

Ma2 Number and algebra

Using and applying number and algebra

1) Pupils should be taught to:
   a) explore connections in mathematics to develop flexible approaches to increasingly demanding problems; select appropriate strategies to use for numerical or algebraic problems.

Solving numerical problems

4) Pupils should be taught to:
   c) select appropriate operations, methods and strategies to solve number problems, including trial and improvement where a more efficient method to find the solution is not obvious.

Sequences, functions and graphs

6) Pupils should be taught to:
   a) generate common integer sequences (including sequences of odd or even integers, squared integers, powers of 2, powers of 10, triangular numbers)
   c) generate terms of a sequence using term-to-term and position-to-term definitions of the sequence; use linear expressions to describe the *n*th term of an arithmetic sequence, justifying its form by referring to the activity or context from which it was generated.

Links to the revised Programme of Study for introduction in 2008 include:

1 Key Concepts

Competence

c) Selecting appropriate mathematical tools and methods, including ICT.

Creativity

b) Using existing mathematical knowledge to create solutions to unfamiliar problems.

2 Key Processes

Analysing
Pupils should be able to:
d) identify and classify patterns
l) calculate accurately, selecting mental methods or calculating devices as appropriate
m) manipulate numbers, algebraic expressions and equations and apply routine algorithms.

3 Range and content

Number and algebra
The study of mathematics should include:
a) rational numbers, their properties and their different representations
f) linear equations, formulae, expressions and identities.

4 Curriculum opportunities

The curriculum should provide opportunities for pupils to:
b) work on sequences of tasks that involve using the same mathematics in increasingly difficult or unfamiliar contexts, or increasingly demanding mathematics in similar contexts
e) work on tasks that bring together different aspects of concepts, processes and mathematical content
f) work collaboratively as well as independently in a range of contexts
g) become familiar with a range of resources, including ICT, so that they can select appropriately.

LESSON PREPARATION

- If this is the first time you have accessed the case study, familiarise yourself with the story of PointZero.
- Go through the 3 options available in order to ascertain the correct one for your pupils.
- Download the starter and plenary activities from the 'Support Material' section and arrange for them to be displayed to the whole class, either using a data projector or an overhead projector. To successfully display coloured images using an overhead projector, print the images onto the transparency paper recommended for your colour printer.
- Arrange for pupil access to computer facilities for the main part of the activity.
- You may wish to create a certificate of achievement to award to pupils that perform well in the activity.

Vocabulary

Sequence, expression, substitute, integer, triangular numbers, square numbers, prime numbers, factor, multiple, positive, negative, value.

Materials required

Starter
- Either mini-whiteboards, pens and erasers OR a set of number cards
- Teacher access to computer and projector or overhead projector and transparencies OR write the numbers on the board
- Microsoft PowerPoint

Main
- Access to computers and the PointZero case study – either in pairs or small groups.

Plenary
- Mini-whiteboards (optional), pens and erasers

- Teacher access to computer and projector or overhead projector and transparencies
- Microsoft PowerPoint

Classroom set-up

- Pupils should work individually for the starter activity and either with a partner of similar ability or individually once they begin the main activity on computers.
- If the computers are in a separate room to the normal classroom, then either the starter and plenary activity can be carried out in the usual classroom and the pupils taken to the computer room for the main activity, or the entire lesson can be conducted in the computer room, with pupils working away from the computers for the starter and plenary sessions.

Prior knowledge and skills

Option 1 (Tom's Solution) tasks:
- Pupils should be able to identify simple number sequences.

Option 2 (Alex's Solution) tasks:
- Pupils should be able to identify simple number sequences and recognise some special ones.

Option 3 (Mary's Solution) tasks:
- Pupils should be able to substitute integer values into algebraic expressions to generate sequences.

LESSON DETAILS

Starter

Aims:
Option 1 (Tom's Solution)
to generate sequences and remind pupils about some special sequences.

Option 2 (Alex's Solution)
to generate sequences and remind pupils about some special sequences.

Option 3 (Mary's Solution)
to remind pupils how to substitute values into an expression.

Pupils should have a mini-whiteboard each OR a set of number cards.

Option 1 (Tom's Solution) and Option 2 (Alex's Solution)
- Display the presentation to the whole class and show the first set of numbers.
- Pupils are asked (on the slide) to choose 4 numbers to make a sequence
- Ask pupils to display their responses
- Select a few responses and ask pupils to explain their answers. A few possible answers (there are many more!):

2, 3, 4, 5	1, 3, 5, 7	3, 6, 9, 12	5, 9, 13, 17
4, 8, 12, 16	1, 3, 6, 10 (triangle numbers)	1, 4, 9, 16 (square numbers)	2, 3, 5, 7 (prime numbers)

- For Option 2 (Alex's Solution) only, ensure that attention is drawn to the last 2 sets of special numbers. If pupils do not come up with them then write them out and discuss further. Pupils will need to use square and prime numbers during the task.

- Show pupils the second set of numbers. This time pupils are told that a sequence begins 1, 2 … and they have to choose 2 numbers to continue the sequence. They are asked to find as many different ones as they can. There are 2 question marks on the slide to allow pupils complete freedom.
- Pupils could be asked to find at least 3 possibilities.
- Ask pupils to display and share their answers.
- How many different possibilities can the class find between them?
- Some possible answers:

1, 2, 3, 4	1, 2, 4, 7	1, 2, 4, 8	1, 2, 5, 10
1, 2, 3, 5	1, 2, 6, 13	1, 2, 6, 24	

Option 3 (Mary's Solution)

- The first slide shows 5 expressions and 5 sequences. Pupils have to match the expressions to the sequences.
- Note that only 4 of the expressions and sequences will match
- Ask your pupils to identify the odd ones out.
- Show their responses on a mini-whiteboard when they have done so.
- Go through the expressions and ask the class which sequence it matches with. Ask pupils to explain how they worked them out, particularly for the quadratic expressions. Answers:
  1 - C
  2 - B
  3 - D
  4 - No match (3, 8, 13, 18)
  5 - A

  E – No match (4x - 3)
- The second slide shows an expression and asks pupils to substitute positive and negative integers into an expression.
  Possible: -10 (x = -2), 20 (x = 8), -16 (x = -4), 8 (x = 3), 29 (x = 11)
  Not possible: 4, 24, -6

Main

Before moving to the computers:

- If this is the first time pupils have seen PointZero go through the story on the first screen and ask pupils what they think may happen. On the next screen, ask pupils to select the activity **'Confined'**.
- It may be useful to show the pupils the screens they can expect to see and showing them how to choose the level appropriate for them.

Whilst pupils are working on the computer tasks:

- Some pupils may wish to use paper and pencil methods to help them solve the tasks. This can be encouraged or discouraged depending on the level of challenge required.
- For each task the aim is to get to the ground floor in as few moves as possible but the 3 tasks all have different rules.
- Pupils could begin on level 1 or 2 and then move on to level 2 or 3 but will need to realise that the tasks are similar but not identical.
- Pupils should be discouraged from using trial and error to complete the activity. You should remind them that they are penalised for having a high number of attempts. This penalty is specified in the code that is awarded to them at the end of the activity.

Option 1 (Tom's Solution)

- Lift A will only move up 3 floors at a time.
- Lift B will only move down 5 floors at a time.

- Each pupil begins on a randomly assigned floor.
- They will need to choose either lift A or lift B and tell the lift which floor they wish to go to.
- If it is a permitted move then the lift will take them to that floor.
- Pupils can get out at any floor they arrive at and change lifts at any time.

Option 2 (Alex's Solution)

- Lift A will only move up by any prime number of floors at a time.
- Lift B will only move down by any square number of floors at a time.
- Each pupil begins on a randomly assigned floor.
- They will need to choose either lift A or lift B and tell the lift which floor they wish to go to.
- If it is a permitted move then the lift will take them to that floor.
- Pupils can get out at any floor they arrive at and change lifts at any time.
- To really challenge pupils, do not allow them to write out a list of prime numbers and a list of square numbers.
- Conversely, if pupils are struggling, allow them to or suggest that they write out a list of prime numbers and a list of square numbers.

Option 3 (Mary's Solution)

- There are 5 lifts.
- Each lift is labelled with an algebraic expression.
- Lifts will only stop at floors that can be generated by substituting a positive or negative integer into its expression. **(This is different from levels 1 and 2).**
- **Only certain lifts are available at each floor, dictated by their expression.**
- Each pupil begins on a randomly assigned floor.
- They will need to choose an available lift and decide which floor they wish to go to.
- If it is a permitted move then the lift will take them to that floor.
- Pupils can get out at any floor they arrive at and change lifts at any time…if another lift is available at that floor.
- To really challenge pupils, do not allow them to write out lists of which floor each lift goes to.
- Conversely, if pupils are struggling, allow them to or suggest that they write out lists.

Plenary

Option 1 (Tom's Solution) and Option 2 (Alex's Solution)
Show the pupils the final slide and ask them to pick out numbers that fulfil specific criteria.

Examples:

i) find a number that is a triangle number and a multiple of 3
ii) find a number that is a prime number and a multiple of 5

Option 3 (Mary's Solution)
Show the pupils the final slide and ask them to work out what the expressions are that generate the given sequences.

Homework

- Homework sheets which build on the lift puzzle tasks are provided for pupils.
- The sheets relate directly to the levels within the computer task.

TECHNICAL SUPPORT

Throughout all the activities and support notes you will be asked to open various files in Flash or in Adobe PDF. To use these, you will need to have the minimum specification installed. This recommendations list can be found below.

The latest **Adobe Flash Player** (previously know as the Macromedia Flash Player) can be downloaded free from the Adobe website. Support and Help can also be found on this site.

http://www.adobe.com/shockwave/download/download.cgi?P1_Prod_Version=ShockwaveFlash

You will be using a version of **Adobe Reader** or Distiller to view these Teacher Notes. If you would like help or to download a newer version, you can find information at Adobe's website:

http://www.adobe.com/products/reader/

Minimum Machine and Software Specifications

PC

P3 800MHz; 128MB RAM; Windows 2000
Screen resolution 1024x768
Browser: Microsoft Internet Explorer 5.5; Firefox 1; Netscape 7; or Opera 7
Macromedia Flash Player 7
Adobe Reader 7

Mac

G3 500MHz; 128MB RAM; OS X 10.2
Browser: Safari 1; Firefox 1; Netscape 7; or Opera 6.2
Screen resolution 1024x768
Macromedia Flash Player 7
Adobe Reader 7