

POINTZERO: LOST

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 required to decipher two or three codes which will describe loci that they are asked to draw on a map. The loci will enable them to find a particular station on the map provided. A starter activity introduces pupils to loci with practical activities.

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 the name of a tube line:

- **Option 1 (Penny Line):** Pupils need to solve two clues based on the same type of code. This option is for pupils working at **levels 5 and 6 of the National Curriculum**.
- **Option 2 (Bank Line):** Pupils need to solve three clues based on different types of code. This option is for pupils working at **levels 6 and 7 of the National Curriculum**.
- **Option 3 (Pound Line):** Pupils need to solve three clues based on different types of code. This option is for pupils working at **levels 7 and 8 of the National Curriculum**.

LEARNING OBJECTIVES**Penny Line**

By the end of the lesson, pupils will:

- decipher at least 2 codes;
- find simple loci to produce paths.

Bank Line

By the end of the lesson, pupils will

- decipher at least 3 codes;
- find simple loci to produce paths;
- construct the perpendicular bisector of a line.

Pound Line

By the end of the lesson, pupils will:

- decipher at least 3 codes;
- find the locus of a point that moves according to a simple rule;
- construct the perpendicular bisector of a line;
- construct an angle bisector.

LEARNING OUTCOMES**Penny Line**

Most pupils will:

- use given information to solve a problem;
- find simple loci by reasoning.

Bank Line

Most pupils will:

- use given information to solve a problem;
- find simple loci by reasoning;
- construct the perpendicular bisector of a line;
- understand locus as a set of points that satisfy a given set of conditions.

Pound Line

Most pupils will:

- use given information to solve a problem;
- find loci by reasoning;
- construct the perpendicular bisector of a line and the bisector of an angle;
- understand locus as a set of points that satisfy a given set of conditions.

NATIONAL CURRICULUM OBJECTIVES**Ma3 Shape, Space and Measures****Using and applying shape, space and measures**

- 1) Pupils should be taught to:
 - a) select problem-solving strategies and resources, including ICT, to use in geometrical work, and monitor their effectiveness.

Measures and Construction

- 4) Pupils should be taught to:
 - e) use straight edge and compasses to do standard constructions, including an equilateral triangle with a given side, the midpoint and perpendicular bisector of a line segment, the perpendicular from a point to a line, the perpendicular from a point on a line, and the bisector of an angle
 - j) find loci, both by reasoning and by using ICT to produce shapes and paths (for example, equilateral triangles).

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

1 Key concepts**Competence**

- a) Applying suitable mathematics accurately within the classroom and beyond.

Creativity

- a) Combining understanding, experiences, imagination and reasoning to construct new knowledge.

Applications and implications of mathematics

- b) Understanding that mathematics is used as a tool in a wide range of contexts.

2 Key processes**Representing**

Pupils should be able to:

- a) identify the mathematical aspects of a situation or problem.

Analysing

Pupils should be able to:

- g) take account of feedback and learn from mistakes
k) make accurate mathematical diagrams, graphs and constructions on paper and on screen.

Communicating and reflecting

Pupils should be able to:

- a) communicate findings effectively
b) engage in mathematical discussion of results.

3 Range and content**Geometry and measures**

The study of mathematics should include:

- b) constructions, loci and bearings
e). similarity, including the use of scale.

4 Curriculum opportunities

The curriculum should provide opportunities for pupils to:

- a) develop confidence in an increasing range of methods and techniques
d) work on problems that arise in other subjects and in contexts beyond the school
f) work collaboratively as well as independently in a range of contexts.

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. A teacher answer sheet accompanies this activity.
- If available, arrange for pupil access to computer facilities for the main part of the activity. Pupils should work in pairs or small groups at a computer or the activity can be projected on to a whiteboard for use with the whole class. Ensure the PointZero case study is available on each computer.
- Print out sufficient copies of the map and code information sheets. Note that when printing the map sheet you will need to ensure that it is printed to scale. In the print menu select 'none' where it says 'page scaling' – this will ensure that the dimensions of the maps you print are correct.
- If you are using the homework sheets provided, ensure you print sufficient copies.
- You may wish to create a certificate of achievement to award to pupils that perform well in the activity.

Vocabulary

Locus, loci, construction, equidistant, perpendicular bisector, angle bisector

Materials required

- Copies of the Codes Information sheet
- Printed copies of the tube map
- Copies of the appropriate homework sheet (for Option 2 and Option 3)
- Rulers
- Compasses
- Protractors
- Sharp pencils

Prior knowledge and skills

Pupils should have some experience of working with codes before completing the activity.

Pupils working at Option 2 and Option 3 should have some experience in constructing perpendicular bisectors of a line and angle bisectors.

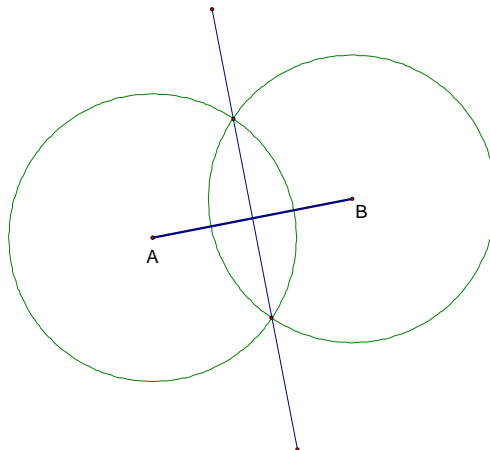
LESSON DETAILS**Starter**

The same task for each option (whole class activity)

- Place 2 chairs about 3m apart anywhere in the room.
- Ask a pupil to stand so that they are the same distance from each chair.
- Ask a second then a third pupil to do the same.
- Introduce the word *equidistant*.
- Ask the rest of the class to sketch what they would see if 10 pupils were standing so that they were equidistant from the chairs.
- Ask 7 more pupils to find positions equidistant from the chairs.
- Get the 10 pupils to sit down again, then ask a different pupil to walk so that they are always equidistant from the chairs.

For Option 2 and Option 3 pupils only

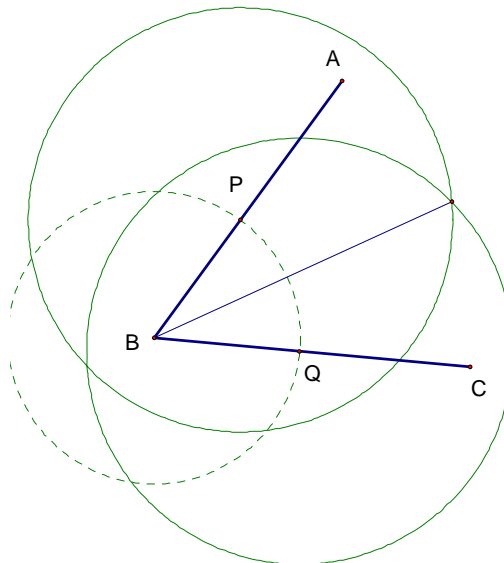
- Ask pupils to describe the path taken by the pupil (perpendicular bisector of the line joining the 2 chairs).
- Remind pupils how they can draw the path accurately using just straight edge and compasses.



- With centre A, and radius greater than half AB, draw a circle.
 - With centre B and same radius as before, draw another circle.
 - Join the points of intersection of the circles to get the perpendicular bisector of AB.
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- Now place a chair anywhere in the room.
 - Ask 2 pupils to stand so that they are both 2 m from the chair.
 - Ask the class to sketch what they would see if 10 pupils were standing 2 m from the chair.
 - Ask another 8 pupils to find a position 2 m from the chair.
 - Ask them to sit down then get another pupil to walk so that they are always 2m from the chair.
 - What path has been walked? (a circle radius 2 m)
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- Now have a pupil stand in one corner of the room.
 - Ask him/her to walk so that s/he is always the same distance from each of the adjacent walls.
 - Ask the class to sketch the path that will be walked.
 - Ask what angle the path makes with one wall (45°).
 - Explain that in mathematics a path like this is called a **locus** (plural: **loci**) and is a set of points that satisfy a given set of conditions. The three activities each illustrate a different locus. The word comes from the Latin for place.

For Option 3 pupils only

- Ask the class to describe the path that the pupil will walk (the angle bisector of the corner of the room).
- Remind pupils how they can construct an angle bisector using straight edge and compasses.



- With centre B and any radius, draw a circle to cut AB and BC at P and Q
- With centre P and any radius greater than half the distance from P to Q, draw a circle
- With centre Q and same radius as before, draw a circle

- Join B to the point of intersection of the circles to get the angle bisector

Main

- Pupils should work in pairs or small groups at a computer or the activity can be projected on to a whiteboard for use with the whole class.
- Distribute the Codes Information sheet and copies of the Tube map.
- Pupils will see a mobile phone on screen with a coded message displayed. Clues can be accessed to help them to decide which code is being used.
- They should decipher the message then draw the locus described in it on their own copy of the map.
- Remind pupils that 'edge' refers to an edge of the map.
- 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

- Pupils get a second coded message to decipher with a second locus to draw. The intersection of the two loci will give the position of the station. This can then be entered on screen.
- There are three sets of messages pinpointing three different stations. These are generated at random giving pupils additional practice if necessary.

Option 2

- Pupils should be encouraged to use the construction for the perpendicular bisector of a line when appropriate.
- They then get a second coded message to decipher with a second locus to draw, and then a third coded message with a third locus
- All three loci will need to be drawn to find the position of the station. This can then be entered on screen.
- There are three sets of messages pinpointing three different stations. These are generated at random giving pupils additional practice if necessary.

Option 3

- Pupils should be encouraged to use the construction for the perpendicular bisector of a line or the construction for the angle bisector when appropriate
- They then get a second coded message to decipher with a second locus to draw, and then a third coded message with a third locus
- All three loci will need to be drawn to find the position of the station. This can then be entered on screen.
- There are three sets of messages pinpointing three different stations. These are generated at random giving pupils additional practice if necessary.

Plenary

Option 1

- Project a copy of the tube map on to the whiteboard.
- Select one of the stations.
- Ask individual pupils to describe a locus that relates to the chosen station.
- How many different loci can they think of for the chosen station?
- Accept answers such as:
 - nearer to x than to y
 - the same distance from x as from y

- to the North of x
- x metres from y

Option 2

- Ask pupils to visualise the following paths and to trace them in the air with a finger:
 - The path of a ball dropped from a height.
 - The path of a ball being bounced by someone standing still.
 - The path of a ball being bounced by someone walking.
 - The path of a ball thrown against a wall.
 - The path of a white dot on the heel of the right shoe of someone walking along a straight line.
 - The path of a white dot on a bicycle wheel being ridden in a straight line.
 - The path of your head when you are on a teacup ride at the fairground.
- Which do they find easy to visualise? Which are harder?

Option 3

- Ask pupils to visualise the following and to describe the shapes they would see
 - A rectangle of card being spun horizontally very fast.
 - The same rectangle spun vertically very fast.
 - An equilateral triangle of card with horizontal base spun horizontally.
 - The same triangle spun vertically.
 - A right angled triangle with horizontal base being spun horizontally.
 - The same triangle spun vertically.
 - A conker is hanging motionless on its string. Imagine that your fingertip moves so that it is always 10 cm from the conker. What is the locus of your fingertip?
 - You hold a pencil in your left hand. You move a right-hand fingertip so that it is always 10 cm from the pencil. What is the locus of your fingertip?
 - You hold a 10 cm square of card in your left hand. You move a right-hand fingertip so that it is always 10 cm from the square. What is the locus of your fingertip?
- Which do pupils find easy to visualise? Which are harder?

Homework

Option 1

- If part of a lesson is given for other pupils to decipher the codes and find the requisite station then the homework is self-marking.
- The homework sheet asks pupils to choose a station from the tube map. They are then asked to write down 2 clues to help someone to find their station and to put the clues into code. They are asked to write the codes on to a sheet of paper which will be displayed in the classroom.

Option 2 and Option 3

- As for Option 1 but with 3 clues asked for. Although a homework sheet is provided, the task could be given verbally to these pupils

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