

EXPLORERS – MINING ENTERPRISES

The 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 invited to destroy several asteroids blocking the Orbital Highway using a selection of sonic charges. They must place their chosen charges on the correct lines or in the correct regions of a grid representing each asteroid's surface if they are to detonate as required.

Pupils will use linear equations, simple quadratic equations and regions to place their sonic charges in the correct places on the grid. There are three different asteroids to choose from with increasing levels of difficulty based on the complexity of the equations and inequalities used.

This activity is mainly ICT-based.

LEARNING OBJECTIVES

Pupils will:

- use mathematical problem solving skills in collaboration with each other
- use graphs of linear equations and simple quadratic curves
- represent the solution set of an inequality as a region of a graph.

LEARNING OUTCOMES

Most pupils will:

- collaborate within their groups to address the problem
- plot graphs of more complex linear equations and simple quadratic curves
- emerge having destroyed at least the first and second asteroids
- evaluate their strategies and report back to the class.

Pupils making slower progress will:

- collaborate within their groups to address the problem
- plot graphs of simple linear equations
- emerge having destroyed at least the first asteroid
- evaluate their strategies and report back to the class.

Pupils making faster progress will:

- collaborate within their groups to address the problem
- plot graphs of more complex linear equations and simple quadratic curves
- identify regions described by one or more inequalities
- emerge having destroyed all three asteroids
- evaluate their strategies and report back to the class.

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.

Equations, formulae and identities

5) Pupils should be taught to:

- i) solve simple linear inequalities in one variable and represent the solution set on a number line

Sequences, functions and graphs

6) Pupils should be taught to:

- e) use the conventions for coordinates in the plane; plot points in all four quadrants; recognise (when values are given for m and c) that equations of the form $y = mx + c$ correspond to straight-line graphs in the coordinate plane; plot graphs of functions in which y is given explicitly in terms of x (for example, $y = 2x + 3$), or implicitly (for example, $x + y = 7$).

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.

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:

- a) make connections within mathematics
- b) use knowledge of related problems
- d) identify and classify patterns
- 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**Number and algebra**

The study of mathematics should include:

- f) linear equations, formulae, expressions and identities.

Geometry and measures

The study of mathematics should include:

- f) points, lines and shapes in 2D coordinate systems.

4 Curriculum opportunities

The curriculum should provide opportunities for pupils to:

- a) develop confidence in an increasing range of methods and techniques
- 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
- f) work collaboratively as well as independently in a range of contexts.

LESSON PREPARATION

- Read the teacher notes and familiarise yourself with the other materials.
- Ensure that the activity is available to use on your teacher laptop or desktop computer.
- Ensure that the activity is available for pupils to use, e.g. via school network.
- Arrange for access to an ICT suite.
- Print off enough copies of the accompanying activity sheets.
- Decide which asteroid(s) pupils are going to use in the lesson.
- You may wish to create a certificate of achievement for pupils that perform well.

Vocabulary

Equation, function, inequality, region, greater than ($>$), less than ($<$), greater than or equal to (\geq), less than or equal to (\leq).

Materials required

You will need:

- Teacher laptop or desktop computer (to introduce activity)
- Data projector (to introduce activity)
- Access to an ICT suite with enough computers for pupils to work in small groups
- Printed copies of the accompanying activity sheets
 - Captain's Log Sheet
 - Mission Results Sheet

Prior knowledge and skills

Pupils should already:

- have some knowledge of drawing graphs of equations.

Health and Safety

All standard safety procedures with computers need to be in place.

Further information can be found at <http://schools.becta.org.uk>

LESSON DETAILS**Starter Activity**

Project the starter activity onto a whiteboard.

Ask pupils in their groups to consider the graphs displayed on each slide.

Project the first slide showing the lines $x = 2$ and $y = -3$.

Explain to your pupils that you want them to work out the equation of each line.

In each case, ask your pupils to:

- list the x and y coordinates of 5 points on each line
- identify what their chosen coordinates all have in common.

Using the information provided ask them to give the equation of each line.

Project the second slide showing the lines $y = x$ and $y = x + 2$.

Repeat the process described above.

If time allows, ask your pupils to draw other lines such as $y = x + 3$, $y = x - 1$ and so on.

Ask them to comment on the lines that they have drawn.

Project the third slide showing the lines $x = -2$ and $y = x$.

On the first graph, the yellow region is defined as $x > -2$ and the blue region is defined as $x < -2$.

On the second graph, the yellow region is defined as $y < x$ and the blue region is defined as $y > x$.

In each case, ask your pupils to:

- give the equation of each line as before
- list the x and y coordinates of 5 points in the yellow region
- identify what their chosen yellow coordinates all have in common
- list the x and y coordinates of 5 points in the blue region
- identify what their chosen blue coordinates all have in common.

Using the information provided ask them to define each region.

Annotate each graph on the whiteboard to record their findings.

Lead into the main activity (see below).

Main Activity

The aim of this activity is to destroy the asteroids blocking the Orbital Highway.

This can be achieved by correctly placing sonic charges on each asteroid's surface.

Once placed, the sonic charges can be detonated.

Upon detonation, a certain amount of valuable asteroid ore will be left behind.

The amount of asteroid ore that can be collected will depend on:

- the types of charges used
- the number of charges placed correctly.

Pupils will receive 'special recognition' if they can:

- find a way to collect the maximum amount of ore for each asteroid.

This activity is based around an open problem with a complexity of potential interpretations.

Opportunities for discussion and group presentations have been incorporated into the activity.

Pupils should be arranged in small groups at a computer.

With mixed ability classes, try to ensure that each group has an appropriate mix of pupils.

This will help to create appropriate conditions for peer support.

Each group should be given:

- a copy of the 'Activity 3 - Captain's Log' sheet
- a copy of the 'Activity 3 - Mission Results' sheet.

Introduce the activity by projecting it onto a whiteboard.

Set the scene using the introductory narrative and the Captain's Log sheet to help.

Note that there are a number of different asteroids to choose from:

- Andromeda 364
- Betelgeuse 721
- Capricorn 918.

Andromeda 364

- based on simple linear equations
- hazard rating - low
- maximum ore value - low (5000 Credits).

Betelgeuse 721

- based on more complex linear equations and simple quadratic equations
- hazard rating - medium
- maximum ore value - medium (7500 Credits).

Capricorn 918

- based on inequalities and regions
- hazard rating - high
- maximum ore value - high (10000 Credits).

Specify clearly which asteroid(s) you want your pupils to attempt.

Refer pupils to the 'Getting Started' section on the Captain's Log sheet.

This fleshes out the narrative a little more and provides an introduction to the activity interface.

Allow time for pupils to experiment with the activity as directed.

Once ready, refer pupils to the 'Discussion Time' section on the Captain's Log sheet.

Ask pupils to consider the questions listed.

Allow time for pupils to discuss their thoughts and define their strategies.

Try to circulate between groups listening to discussion and asking questions as required.

Encourage pupils to pursue their strategies and to develop the mathematics involved.

Take care, however, not to overly direct the pupils.

Once ready, refer pupils to the 'Recording Your Results' section on the Captain's Log sheet.

Pupils should drag and drop their chosen charges onto the asteroid's surface.

Once the set number of charges has been placed, the 'Detonate' button becomes active.

Once clicked, the sonic charges will explode.

Pupils will then receive feedback relating to:

- the number of their charges that have detonated correctly
- whether the asteroid was destroyed or not
- the income they have received from the asteroid ore.

Ensure that pupils record their results in the table on the Mission Results sheet.

Pupils are asked to calculate what % of the maximum ore amount they have collected each time.

Pupils should repeat the process until the relevant sections of the table are complete.

Pupils can then determine if they are deserving of the 'special recognition' award.

Ask pupils to review their results and consider the questions listed.

Allow time for pupils to discuss their results and record their responses in the space provided.

Once ready, refer pupils to the 'Finishing Off' section on the Captain's Log sheet.

Ask pupils to consider the questions listed.

Allow some time for pupils to discuss their thoughts and reflect on their performance.

If time allows, ask pupils to repeat the process, refining their original strategies.

Lead into the plenary activity (see below).

Plenary

Draw the class together and ask pupils to reflect on the activity.

Ask each group to report back on their progress, specifically:

- whether they were able to destroy their chosen asteroid(s)
- the average income they received from the asteroid ore.

Ask selected groups to describe and evaluate the strategies they used.

In particular, ask them to identify what they would do differently next time.

If time allows, ask pupils some follow-up questions such as:

- What was the key to success in this activity?
- How would it be possible to gain the maximum amount of ore from each asteroid?

Finally, ask the class to consider the maths that they have used during the activity.

Ask the class to identify real-life contexts where people may use similar maths.

Homework Suggestions

Ask pupils to complete their Captain's Log reflecting on their results and evaluating their performance during the activity.

Additionally, pupils could be invited to complete the accompanying homework task sheet. The sheet is divided into different sections relating to the equations and inequalities used in the main activity and gives further practice in the use of linear equations, quadratic curves and regions.

TECHNICAL SUPPORT

This activity makes use of Flash and Adobe PDF files. To access all the resources that are provided, you will need the minimum machine and software specifications as listed below.

Adobe Flash Player (previously known as Macromedia Flash Player) is required to launch the activity. The latest version of Flash and guidance on how to use it can be downloaded from:

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

Adobe Reader or Distiller is required to view these notes. The latest version of Reader and guidance on how to use it can be downloaded from:

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

Minimum Machine and Software Specifications

PC

P3 800MHz
128MB RAM
Windows 2000
Screen resolution 1024 x 768
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
Screen resolution: 1024 x 768
Safari 1, Firefox 1, Netscape 7, or Opera 6.2
Macromedia Flash Player 7
Adobe Reader 7