Teacher's Notes : Activity 3

National Curriculum

This activity and the accompanying worksheets are aimed at Key Stage 3, level 5/6 and focus mainly on:

Ma3 *Space, Shape and Measures*

Using and applying shape, space and measures:

Problem solving

1.b select and combine known facts and problem-solving strategies to solve complex problems

1.c identify what further information is needed to solve a problem; break complex problems down into a series of tasks

Reasoning

1.i explain and justify inferences and deductions using mathematical reasoning

1.j explore connections in geometry; pose conditional constraints of the type 'If … then …'; and ask questions 'What if …?' or 'Why?'

Geometrical reasoning:

Angles

2.a recall and use properties of angles at a point, angles on a straight line (including right angles), perpendicular lines, and opposite angles at a vertex

2.b distinguish between acute, obtuse, reflex and right angles; estimate the size of an angle in degrees

Transformations and coordinates:

Coordinates

3.e understand that one coordinate identifies a point on a number line, two coordinates identify a point in a plane and three coordinates identify a point in space, using the terms '1-D', '2-D' and '3-D'; use axes and coordinates to specify points in all four quadrants; locate points with given coordinates; find the coordinates of points identified by geometrical information [for example, find the coordinates of the fourth vertex of a parallelogram with vertices at (2, 1) (-7, 3) and (5, 6)]; find the coordinates of the midpoint of the line segment AB, given points A and B, then calculate the length AB.

Measures and construction:

Measures

4.a interpret scales on a range of measuring instruments, including those for time and mass; know that measurements using real numbers depend on the choice of unit; recognise that measurements given to the nearest whole unit may be inaccurate by up to one half in either direction; convert measurements from one unit to another; know rough metric equivalents of pounds, feet, miles, pints and gallons; make sensible estimates of a range of measures in everyday settings

4.b understand angle measure, using the associated language [for example, use bearings to specify direction]

Construction

4.d measure and draw lines to the nearest millimetre, and angles to the nearest degree; draw triangles and other 2-D shapes using a ruler and protractor, given information about their side lengths and

angles; understand, from their experience of constructing them, that triangles satisfying SSS, SAS, ASA and RHS are unique, but SSA triangles are not; construct cubes, regular tetrahedra, square-based pyramids and other 3-D shapes from given information

Brief

In order to successfully complete this activity, Students must locate different minerals and resources on Mars. They may position up to three radar stations on the grid and, from the information given, they must locate the relevant resource.

To complete the activity the student needs to be able to:

- plot coordinates from a map, in the first quadrant.
- locate coordinates based on information given about how far away it is from other points.
- find the coordinates of a point by using the bearings from other points.
- find the coordinates of a point using scales and given the distances from other points.

Details of activity

There are 5 resources to find in this activity.

Stage one is the easiest and is used once. Students are given up to three radar stations to position on the grid, and each radar station then reports its distance from the resource in question. Once all stations have been deployed, students can use the three sets of feedback to work out the coordinates that satisfy all three stations. The distance is give as lengths of the square, so this stage requires counting sections of the square's perimeter.

For example, if the first radar station is located at (2,5) and the resource is located at (3,3), the information will say:

Station 1 is 3 square lengths away from (resource)

More able students should notice that the distance can be calculated from $|x_1-x_2|+|y_1-y_2|$. You may want to do an investigation on this before or after using Settlers. Logical reasoning for finding the position of the resource would take into account relative positions of the radar stations and making statement such as:

Station 1 is below station 2. The liquid water is 3 square lengths from Station 1 and 5 square lengths from Station 2, so it must be below Station 1, etc.

Stage two is based on bearings, and is used twice. Students are once again given up to three radar stations to position on the grid, and each radar station then reports its bearing to the resource in question. Once all stations have been deployed, Students can use the three sets of feedback to work out the co-ordinates that satisfy all three stations. There is a circular protractor available to help with this. It is not always necessary to use all three stations to locate the resource.

For example, if the station is placed on (1,0) and the information says:

Station 1 has found iron at bearing 090°

Clearly, the iron is at (0,0). Students can use the protractor as they add each station, if they want, but they should also be encouraged to estimate the bearing. You may find it is helpful to use 'figther pilot' language, such as "Bandits at 8 o'clock", and convert clock positions to bearings, as well as using cardinal directions such as North, South, etc. The circular protractor is only marked at 0, 90, 180 and 270, with 10° divisions and a tick mark on the fives. Students will have to estimate a bearing such as 282°.

Stage three is based on distance, as with stage one, but this time the distance is in a straight line and is given on a scale of 1 square = 100km. Students are once again given up to three radar stations to position on the grid, and each radar station then reports its distance from the resource in km. Once all stations have been deployed, Students can use the three sets of feedback to work out the coordinates that satisfy all three stations. There is a circular ruler available to help with this. Again, it may not always be necessary to use all three stations to find the resource.

Stage three may feedback decimal measurements, such as 538.52km, so students will have to use estimating skills to determine where this is located on the grid. This may be challenging for larger distances, since the circular ruler only extends to 500km.

For all questions, the pupil must enter the correct coordinates into the X and Y boxes before clicking on the submit button. The quicker the Students complete the activity and the higher their success rate, the more points they receive and the better their position on the leaderboard.

Sometimes, students will be lucky and manage to place the radar station on resource itself. In this case the information will say:

Station 2 is at the target location.

There are blue markers which can be moved onto the grid to show candidate points. Placing too many can cause confusion, so you may need to monitor this or check with students who seem to be 'going overboard' with marking out positions.

Worksheets

There are worksheets available for each stage of this activity if you want to introduce the concepts or review them later.

Worksheet A3S1 sets up stage one by using the example of zigzag bridges in a Japanese garden. You could also introduce the example of building a skyscraper, where construction workers have to walk along girders when they are adding a new floor at the top of the building. It is a very simple counting activity.

Worksheet A3S2 sets up stage two by using the example of being shipwrecked on a island with a compass, but no way of measuring distances accurately. Students will need to use a protractor and ruler to determine bearings of various landmarks, and to find the location of buried emergency supplies. You might want to provide some students with an adjustable directional compass with a lubber's line on a baseplate. http://mapzone.ordnancesurvey.co.uk/mapzone/PagesHomeworkHelp/docs/mapabilitycompassbearings.pdf provides a worksheet/guidance if required.

Worksheet A3S3 sets up stage three by using the example of try to guarantee access to a phone signal. Students will need to use a pair of compasses and a ruler to construct intersecting circles and determine the best place to build a new home. It also introduces the idea of working from a scale. Here, 1cm = 2 km.

PowerPoint slides

There are sets of PowerPoint slides available for each stage of this activity if you want to introduce the concepts or review them later.

A3S1 – distances (lengths) uses the idea of simple droids with limited movement.
A3S2 – bearings uses the idea of trying to find a civilian who has gone missing.
A3S3 – distances uses the idea of overlapping circles to identify a signal source.