

Topical Applications of Mathematics

Darts

TEACHER INFORMATION

Key Stage KS3

Target Mainstream Year 7/8

MEP references Year 7, Unit 12

Teaching notes

The Rules of Darts and technical information about the game are given at the website

<http://www.mastersgames.com/rules/darts-rules.htm>

Further information on the origin of darts and the numbering on a darts board can be found at

http://web.ukonline.co.uk/patrick.chaplin/Darts_History/why_are_the_numbers_on_a_dartboard.htm

Details of the game '501' are given at

<http://www.thedartshop.co.uk/how-to-play-darts-501>

On page 6 of the website

http://www.sde.ct.gov/sde/lib/sde/PDF/Curriculum/mcaptrel/mathcapt_rel00.pdf

you will find probability questions relating to a different style of 'darts', which might be useful as extension work in this topic.

Solutions and Notes for material in the Pupil Text

Activity 1

a) 180 b) 3

Activity 2

54, 57, 60

Activity 3

23

Activity 4

163

Solutions continued on next page.

Activity 5

Score	Dart	Dart	Dart
161	60	51	50
162	60	51	51
164	60	54	50
165	60	54	51
167	60	50	57
168	60	57	51
170	60	60	50
171	60	57	54
174	60	57	57
177	60	60	57

Other possible combinations of scores are also possible as alternative solutions.

Activity 6

There are, we think, 133 distinct ways of obtaining 15. For example, with 'D' representing DOUBLE and 'T' TRIPLE, the combination $9 + 4 + D1$ can also be obtained in these ways:

$4 + 9 + D1$
 $9 + D2 + D1$
 $D2 + 9 + D1$
 $4 + T3 + D1$
 $T3 + 4 + D1$
 $T3 + D2 + D1$
 $D2 + T3 + D1$

So there are 8 ways possible with the $9 + 4 + D1$ combination.

Activity 7

The least number of darts is 9. For example,
 $60 + 60 + 60 + 60 + 60 + 60 + 60 + 57 + 24$ (D12).

Activity 8

The sector with the highest total is $16 + 7 + 19 + 3 + 17 = 62$.

Activity 9

If the aim of the design is to maximise the effect of errors when missing the number aimed at, then you could consider summing all the possible differences between adjacent numbers; this has to be as high as possible (e.g. for the conventional darts board, the differences are

$19 + 17 + 14 + 9 + 7 + 4 + 5 + 13 + 15 + 14 + 16 + 12 + 9 + 8 + 3 + 3 + 5 + 3 + 7 + 15 = 198$).

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SAMPLE LESSON PLAN

Activity		Notes
		T: Teacher P: Pupil
1	<p>Background</p> <p>T: I expect you've all seen a darts board – but do you know why the numbers are arranged as they are? <i>(Ps suggest reasons)</i></p> <p>T: It's to cut down on the number of 'lucky shots' and to encourage accuracy. So if you aim for a 20 but are not accurate, you'll be likely to score a low score, 5 or 1.</p> <p>T: We'll look at some possible scores.</p> <p>T: With 3 darts, and assuming that every dart scores, what is the highest score possible? what is the lowest score possible?</p> <p>P: Highest: 180, lowest: 3</p> <p>T: With just one dart you can score 50 if you hit the bullseye or 51 with the treble 17. What other scores between 50 and 60 can you score with just one dart? Work in pairs as quickly as you can.</p> <p>T: What are the numbers and how are they scored?</p> <p>P: 54 (18×3), 57 (19×3) and 60 (20×3)</p> <p>T: Still in your pairs, find the lowest score it's impossible to obtain with just one dart. I'll give you a couple of minutes for this.</p> <p>P: 23</p> <p>T: Well done. Now, using up to 3 darts, what is the lowest score it is impossible to get?</p> <p>T: Who has an answer?</p> <p>P: 163</p> <p style="text-align: center;"><i>15 mins</i></p>	<p>It would be useful to have a darts board at the front of the class. Otherwise, show <i>Data Sheet 1</i> on OHP.</p> <p>Ps will probably reach this conclusion – with guidance from T, if necessary!</p> <p>Straightforward questions which can be answered verbally. Praise for quick, correct responses.</p> <p>Ps work together in pairs. Aim to keep them working at a quick pace.</p> <p>Allow few minutes to complete this and then ask for volunteers to give their answers.</p> <p>Make sure that all Ps understand what is needed here. Volunteer P gives answer – others agree/disagree.</p> <p>Again, Ps can work in pairs.</p>
2	<p>Game '501'</p> <p>T: If you need to score 15 to finish your game of 501, how many ways are there to do this? You can count, for example, '1, 2 double 6' and '2, 1, double 6' as different ways. It will take you a few minutes to decide on an answer!</p> <p>P: It has been calculated that there are 133 ways!</p> <p style="text-align: center;"><i>30 mins</i></p>	<p>Introduce the game of '501': Ps will probably already be familiar with it. Stress that the final dart thrown must land on a section of the double ring (a 'double').</p> <p>You might prefer to set this as homework as it might take some time! Praise Ps who reach the correct answer.</p>

<i>Activity</i>		<i>Notes</i>
<p>3</p>	<p>Design of darts board</p> <p>T: There are 20 sectors on the board. Any 5 adjacent sectors make up one quarter of the board.</p> <p>T: Which quarter of the board gives the <i>highest</i> total when the numbers around its outside edge are added up? Work in your pairs again to answer this question.</p> <p>P: $16 + 7 + 19 + 3 + 17 = 62$</p> <p>T: Does anyone have another suggestion?</p> <p>T: With 3 darts you can score 180 ($60 + 60 + 60$); you can also score 160 ($60 + 60 + 40$). There are 10 other scores between 160 and 180 which you can obtain with 3 darts. Find as many as you can; write your solutions on <i>Data Sheet 2</i>.</p> <p style="text-align: center;"><i>45 minutes</i></p>	<p>It will be helpful if each P has a copy of <i>Data Sheet 1</i>.</p> <p>T monitors Ps' work and then chooses P to show solution by shading sectors on <i>Data Sheet 1</i> on OHP.</p> <p>Other Ps agree/disagree. Class discussion if necessary.</p> <p>Praise for Ps who have made good attempts.</p> <p>Hand a copy of <i>Data Sheet 2</i> to each pair of Ps.</p> <p>Review answers with the class.</p>
	<p>Extension</p> <p>If you are not an expert darts player and want to 'play safe', should you aim for the left-hand or the right-hand side of the darts board to be more likely to get a high score? Why?</p>	