Reasoning in the classroom

Dancing fountains

Support materials for teachers

Year 5

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Year 5 Reasoning in the classroom – Dancing fountains

These real-life and fantasy contexts encourage Year 5 learners to use and develop their knowledge of numbers and number patterns.

Activity 1

Dancing fountains

Learners work out the heights of jets of water.

Includes:

- Teachers' script
- PowerPoint presentation
- Dancing fountains questions
- Markscheme

Activity 2

Growing monsters

Then they use computers to create their own growing patterns, this time with a monster.

Includes:

- Explain and question – instructions for teachers
- Word file – Growing monsters.doc

Activity 3

Which way?

They investigate patterns on number grids.

Includes:

- Explain and question – instructions for teachers
- Whiteboard – Number square
- Whiteboard – Patterned number square

Reasoning skills required

Identify	Communicate	Review
Learners choose their own strategies when solving simple problems.	They use mathematical language to explain their findings.	They draw conclusions and predict outcomes.

Procedural skills

- **Addition and subtraction**
- **Multiplication and division, including multiplication tables**

Numerical language

- **Difference**
- **Height and width**
- **Patterns**
- **Multiples**
- **Area** *(Activity 2, extension only)*

Activity 1

Dancing fountains

Activity 1 – Dancing fountains

Outline

Learners engage with the stimulus presentation that shows choreographed water fountains.

They then complete questions relating to that context.

You will need

Teachers' script

PowerPoint presentation

Dancing fountains questions
Two pages for each learner, can be printed double-sided

Markscheme

TS

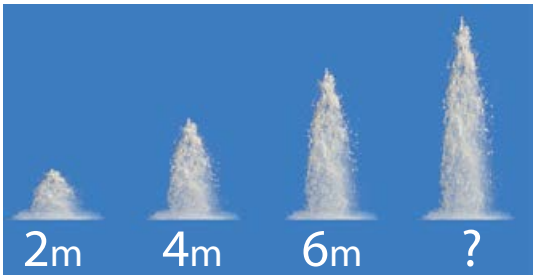
Presentation to be shown to learners before they work on Dancing fountains

The text in the right-hand boxes (but not italics) should be read to learners. You can use your own words, or provide additional explanation of contexts, if necessary. However, if you are using this as an assessment item, no help must be given with the numeracy that is to be assessed.

Slide 1		*(Keep this slide on the screen until you are ready to start the presentation.)*
Slide 2		Have any of you heard of a city in America called Las Vegas? It's in the middle of a desert yet millions of people go there each year for a holiday. There are huge hotels there, and one of them has a big lake in front of it. People stand by the lake waiting, and then every half an hour or so music starts and then . . .
Slide 3		. . . huge jets of water appear on the lake. Hidden under the lake are about twelve thousand jets. They shoot the water up in the air, but not all at the same time, so it looks as if the water is dancing in time to the music. Let's have a look at one of the dances . . .

Slide 4		*(Click and a black screen will appear. Click anywhere within the black screen and the video will play automatically.)* *(Click on Esc (top left) to exit the video.)* Isn't it clever? A team of people work together to create the dances. Working out which jets should be turned on at any one time, and how high they should be, is really difficult. It can take the team a whole week to work out just two minutes of dancing! And then the team has to program the jets of water. They use their numeracy skills to make sure that the heights are exactly right.
Slide 5		For example, the heights of these five jets make a pattern. The difference between the heights of the first and second jets *(point)* is the same as the difference between the second and third jets *(point)*, and so on. The heights go up by the same amount each time. Now you are going to see some jets of water of different heights. The heights are in a pattern. You are going to be a designer and work out the heights of some of the jets. Remember to show your working so that someone else can understand what you are doing and why. *(If you are using this item for assessment purposes, you may wish to limit the time available, e.g. 10 minutes.)*

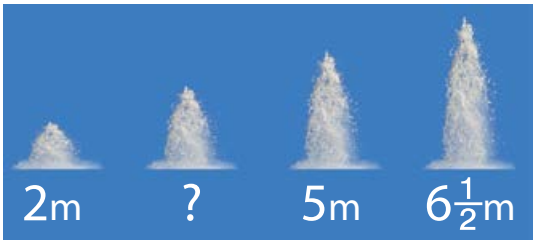
The first pattern starts like this:



The **4th** jet is ____ m high.

1m

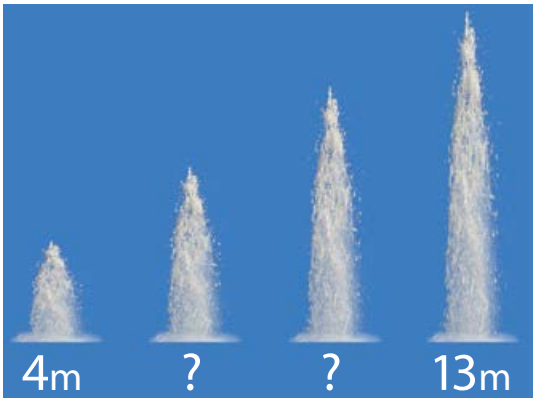
The next pattern starts like this:



The **2nd** jet is ____ m high.

1m

Another pattern starts like this:

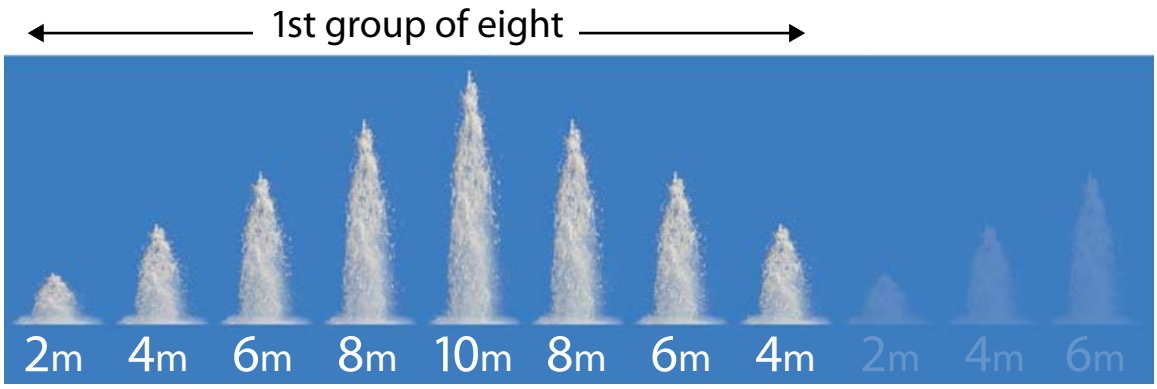


The **2nd** jet is ____ m high.

1m

The next pattern is different.

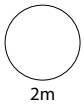
The heights repeat in groups of eight.



How high is the **200th** jet?

Show how you work it out.

m



Activity 1 – Dancing fountains – Markscheme

Q	Marks	Answer
i	1m	**8**m
ii	1m	**3$\frac{1}{2}$**m or equivalent
iii	1m	**7**m
iv	2m	Shows or implies that the height must be **4m** (accept units omitted) and justifies it by showing the value **25**, e.g. • 200 ÷ 8 = 25 so there are 25 groups so it is the last fountain in a group
	Or 1m	Shows or implies that the height must be **4m** (accept units omitted) Or Shows the value **25**

Activity 1 – Dancing fountains – Exemplars

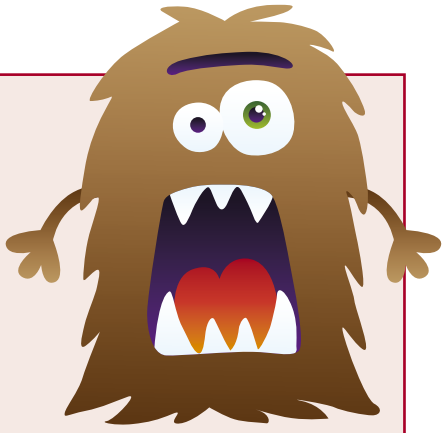
Part iv

I did 200 ÷ 8 = 25 and that is how many groups of 8 there are but then I had to think where in the group it was but it is the last one because they are full groups. 4 m	Correct; **2 marks** • This learner shows good insight into the problem.
Every group of 8 is the same. 200 ÷ 8 = 25 so therefore 200 = 4 m	Correct; **2 marks** • Although the numerical communication could be improved, the answer 4 is clearly shown in the working and 25 gives sufficient justification.
4 m	Answer 4m; **1 mark** Common error No evidence is given as to why the height is 4m. This learner needs support to understand the importance of 'Show how you work it out'.
2 4 6 8 10 8 6 4 8 2 4 6 8 10 8 6 4 16 2 4 6 8 10 8 6 4 24 2 4 6 8 10 8 6 4 32 2 4 6 8 10 8 6 4 40 2 4 6 8 10 8 6 4 48 2 4 6 8 10 8 6 4 56 2 4 6 8 10 8 6 4 64 2 4 6 8 10 8 6 4 72 2 4 6 8 10 8 6 4 80 2 4 6 8 10 8 6 4 88 2 4 6 8 10 8 6 4 96 m	Incomplete; **0 marks** Common error Counting on is an inefficient strategy and this learner has run out of time and/or energy.
100 = 8m so 200 = 8m 8 m	Incorrect; **0 marks** Common error This learner has worked out, correctly, that the 100th fountain is 8m high. However, they have then assumed that because the 100th fountain is 8m high, the 200th fountain will also be 8m high. This is a common misconception.

Activity 2

Growing monsters

Activity 2 – Growing monsters



Outline

This activity is designed to carry on from **Activity 1 – Dancing fountains** and is computer-based.

Learners choose a monster then create their own pattern by enlarging or reducing.

They then predict how their pattern will continue.

Their results – the rule and the ensuing pattern – can be printed out and displayed in the classroom.

You will need

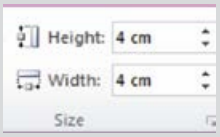
Computer access (Word) for each group/pair

Learner access to one or more of the electronic monsters

Computer skills needed by learners

- **Copy and paste**
- **Changing dimensions** – see below

Click on a monster, and at the top right of the screen you will see its height and width, e.g.



Clicking on the up or down arrow to the right of 'Height' will change the height; the width should change at the same time. If not, click on the small arrow to the right of 'Size', and tick the box that says 'Lock aspect ratio'.

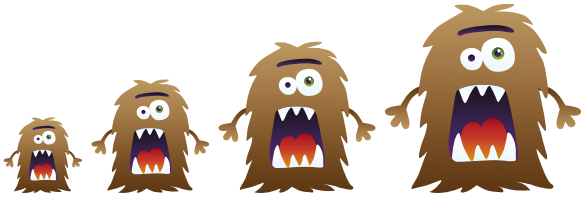
Note that the above applies to later versions of Word. This may need adapting if you have an older version of Word or are working on an Apple Mac.

Activity 2 – Growing monsters

Explain

Show learners **Growing monsters.doc** on the whiteboard and tell them they are going to choose a monster and decide on a rule to make it grow. They will then cut and paste their monster into Word, and use their rule to repeatedly enlarge (or reduce) their image on screen.

For example, if their rule is add 0.5cm each time the pattern would be:



Can they work out what the height of the 10th monster in their pattern would be? The 25th? The 100th?

Learners can then repeat this exercise, choosing a rule that gives a very different pattern.

Question

- What is your rule? Why did you choose that one?
- How could you change your rule to make your monster grow more quickly . . . or less quickly?
- How are you working out the heights of different monsters?
- Why isn't adding on an efficient way of finding the height of the 100th monster? Can you think of a better way?

Extension

- What happens to the area of the monster when the rule is 'double the height'? *(Drawing rectangles around the shapes can support an investigation into how the area changes. If monster B is twice the height of monster A, the area of monster B is 4 times the area of monster A because $2^2 = 4$.)*

Word document Growing monsters.doc available for download from the Learning Wales website

Activity 3

Which way?

Activity 3 – Which way?

Outline

This activity can carry on from **Activity 2 – Growing monsters**, or from **Activity 1 – Dancing fountains**.

Learners consider the patterns made by shading multiples of 3 on a 10 by 10 number grid.

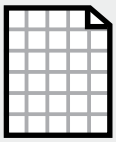
Then they consider the patterns made by shading multiples of 3 on different sizes of square number grids, predicting whether the pattern will be sloping from right to left ↖ or left to right ↗ or in straight vertical lines.

91	92	93	94	95	96	97	98	99	100
81	82	83	84	85	86	87	88	89	90
71	72	73	74	75	76	77	78	79	80
61	62	63	64	65	66	67	68	69	70
51	52	53	54	55	56	57	58	59	60
41	42	43	44	45	46	47	48	49	50
31	32	33	34	35	36	37	38	39	40
21	22	23	24	25	26	27	28	29	30
11	12	13	14	15	16	17	18	19	20
1	2	3	4	5	6	7	8	9	10

You will need

Whiteboard – Number square

Whiteboard – Patterned number square



Squared paper

Colouring pencils

Activity 3 – Which way?

Explain

Use the whiteboard to show **Number square**. Ask learners what they would see if you coloured all multiples of 3 red (remind them what a multiple is, if needed).

Allow discussion and then show **Patterned number square**.

Ask learners to describe the pattern of lines made by the red squares, e.g. that they are sloping this way ↖, from right to left.

Learners then create different-sized number grids, e.g. 3 by 3, then 4 by 4, and so on, starting numbering from the bottom left. They shade all multiples of 3 and investigate the different patterns that are made.

91	92	93	94	95	96	97	98	99	100
81	82	83	84	85	86	87	88	89	90
71	72	73	74	75	76	77	78	79	80
61	62	63	64	65	66	67	68	69	70
51	52	53	54	55	56	57	58	59	60
41	42	43	44	45	46	47	48	49	50
31	32	33	34	35	36	37	38	39	40
21	22	23	24	25	26	27	28	29	30
11	12	13	14	15	16	17	18	19	20
1	2	3	4	5	6	7	8	9	10

Or

Provide learners with the different-sized square grids, numbered for them.

Question

- What patterns have you found so far?
- Which sizes of square grids have red vertical lines? *(3 by 3, or 6 by 6, or 9 by 9, etc.)* What do these grids have in common? *(The grid size is a multiple of 3.)*
- Is 72 a multiple of 3? How can you tell without dividing? *(If the number is a multiple of 3 the sum of its digits is a multiple of 3, so as 7 + 2 = 9 and 9 is a multiple of 3, 72 is a multiple of 3.)*
- Which sizes of square grids have red lines that slope from right to left? *(4 by 4, or 7 by 7, or 10 by 10, etc.)* What do these grids have in common? (*The grid size is 1 more than a multiple of 3.)* Would a 19 by 19 square grid have red lines that slope from right to left? How do you know?
- Which sizes of square grids have red lines that slope from left to right? *(5 by 5, or 8 by 8, or 11 by 11, etc.)* What do these grids have in common? *(The grid size is 1 less, or 2 more, than a multiple of 3.)*

Extension

- Think about multiples of different numbers. Which ones would give red vertical line(s) on a 10 by 10 square grid? *(Assuming 1 is not included, multiples of 5 and 10.)* Which sizes of square grids would give red vertical lines for multiples of 7? *(7 by 7, 14 by 14, and so on)*

WB

91	92	93	94	95	96	97	98	99	100
81	82	83	84	85	86	87	88	89	90
71	72	73	74	75	76	77	78	79	80
61	62	63	64	65	66	67	68	69	70
51	52	53	54	55	56	57	58	59	60
41	42	43	44	45	46	47	48	49	50
31	32	33	34	35	36	37	38	39	40
21	22	23	24	25	26	27	28	29	30
11	12	13	14	15	16	17	18	19	20
1	2	3	4	5	6	7	8	9	10

WB

91	92	93	94	95	96	97	98	99	100
81	82	83	84	85	86	87	88	89	90
71	72	73	74	75	76	77	78	79	80
61	62	63	64	65	66	67	68	69	70
51	52	53	54	55	56	57	58	59	60
41	42	43	44	45	46	47	48	49	50
31	32	33	34	35	36	37	38	39	40
21	22	23	24	25	26	27	28	29	30
11	12	13	14	15	16	17	18	19	20
1	2	3	4	5	6	7	8	9	10