How do they know?

Reasoning in the classroom

Support materials for teachers

Year 6

Llywodraeth Cymru
Welsh Government

Year 6 Reasoning in the classroom – How do they know?

These Year 6 activities focus on shape and space.

Activity 1

How do they know?
Learners consider how to estimate the size of crowds.

Includes:
- Teachers' script
- PowerPoint presentation
- How do they know? question
- Markscheme

Activity 2

Our space
They continue the theme of area and space by investigating space within the classroom.

Includes:
- Explain and question – instructions for teachers

Activity 3

Seating plan
They consider the number of tables needed for a wedding.

Includes:
- Explain and question – instructions for teachers
- Whiteboard – Tables 1
- Whiteboard – Tables 2

Reasoning skills required

Identify	Communicate	Review
Learners choose their own methods.	They decide for themselves what to record.	They consider different methods and adapt their approach.

Procedural skills

- Measuring
- Scale
- Area
- Rounding to the nearest 1000
- Simple construction
- Formulae in words

Numerical language

- Assume
- Round(ing)
- Area
- Investigate
- Solution
- Right angle
- Scale/scale drawing
- Rule (as in a formula in words)
- Perimeter

Activity 1

How do they know?

Activity 1 – How do they know?

or

Outline

In this Year 6 activity, learners engage with a real-life numerical problem – how to estimate the size of crowds.

This activity is demanding in that it brings together several different aspects of numeracy. As such, some learners may need more teacher support than usual.

You will need

TS

Teachers' script

PowerPoint presentation

Q

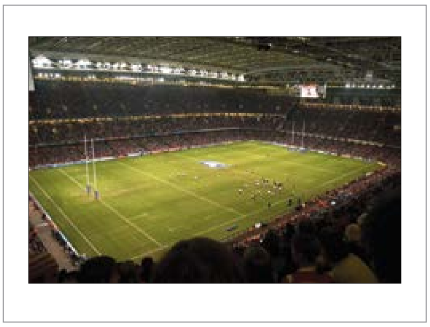
How do they know? question
Two pages for each learner, must not be printed double-sided.
As a scale drawing is included, make sure that the printer is set to print at 'actual size'

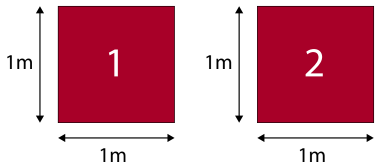
M

Markscheme

Presentation to be shown to learners before they work on How do they know?

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		Do you know where this photograph was taken? It's the Millennium Stadium in Cardiff. Newspaper reports said about eighty thousand people watched the match that is shown in the photograph. How would they know how many people were there? *(Discuss. Learners are likely to refer to tickets sold, entry gates, etc. Draw out that this allows the organisers to be able to know the exact number even though it has been rounded.)*
Slide 3		This photograph shows another crowd, but this time it was in Monmouth. The photograph shows people waiting to see the carnival procession. There were far too many people to count them individually, and there were no tickets sold, so we need to think about how to estimate the number of people in the crowd.

Slide 4	**77 000?** **150 000?**	Whenever you see an estimate of the number of people in a crowd you need to think about who has made the estimate. For example, there was a rally in Hong Kong remembering Chinese people who died. Here are two different estimates of the number of people who attended. One estimate was made by the people who organised the event. The other estimate was made by the police. Which do you think was made by the organisers of the event? *(Discuss, drawing out that organisers may overestimate to show how much support they have.)*
Slide 5		Estimating the number of people in a crowd is difficult and mathematicians and scientists have spent a long time trying to find the best method. One way is to think about how much space people take up. For light crowds – that means crowds where people are not too jammed together – they estimate that each person takes up about this amount of space, a square that is one metre by one metre *(point to the left-hand square)*. But when the crowds are more tightly packed together, they estimate that two people will fit in the same space. So for each square that is one metre by one metre, they estimate there will be two people.
Slide 6		You are going to use that information to estimate the size of a crowd that stood along a wide road in London called The Mall. They were standing there in front of Buckingham Palace for the royal wedding of Prince William and Kate Middleton in 2011. 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.)*

Estimate the number of people standing on The Mall for the Royal Wedding.

Assume:

- two people for each square, 1 metre by 1 metre
- the Mall is 30 metres wide.

Use the map on the opposite page and explain each step of your reasoning.

Give your answer to the nearest **thousand** people.

4m


Buckingham Palace
W
THE MALL
100m

Activity 1 – How do they know? – Markscheme

Marks	Answer
4m	Shows or implies all four of the following steps, or equivalent. 1. Measures and uses the scale to convert to metres (accept 920m to 940m) 2. Multiplies by 30 to find the area of the Mall (accept 27 600m^2 to 28 200m^2 inclusive) 3. Doubles to find the number of people (accept 55 200 to 56 400 inclusive) 4. Rounds correctly to the nearest thousand, giving an answer of 56 000 or 55 000, as appropriate e.g. • 18.6cm is 930m $930 \times 30 = 27\,900m^2$ 2 people per m^2 so 55 800 Answer 56 000 people
Or 3m	Shows a value between 54 000 and 57 000 inclusive Or Doubles their (incorrect length $\times$ 30) then rounds to the nearest thousand
Or 2m	Shows a value between 27 600 and 28 200 inclusive Or Doubles their (incorrect length $\times$ 30)
Or 1m	Shows a value between 920 and 940 inclusive Or Multiplies their incorrect length in metres by 30

Throughout, condone units that are incorrect or omitted

Activity 1 – How do they know? – Exemplars

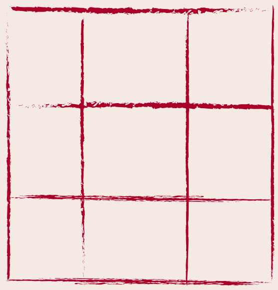
The length = 18.5cm 2cm = 100m so 18.5cm = 925m Number of people = 925 × 30 × 2 = 55500 56000	Correct; **4 marks** • The method is clear and concise.
I know the Mall is 30 metres wide so 60 people can stand side by side, because 2 × 30 = 60. Then I measured the road and used the scale so I think the Mall is 920 metres long so the people altogether is 55,200 because 920 × 60 = 55,200. But then I had to give the answer to the nearest thousand which is 1000 so that is how I got my answer. 55,000	Correct; **4 marks** • This learner uses an equivalent method to the one shown in the markscheme, by finding the number of people per metre width of the Mall. All values are correct and their answer is correctly rounded down.
I used the scale to find 100m then I marked them on the map and there were $9\frac{1}{2}$ of them. So $9\frac{1}{2}$ × 100 = 950m and then I wanted the area so I did 950 × 30 = 28500 squares. 2 people fit in each one so there are 57000 people altogether which is a lot. 57000	Shows 57 000; **3 marks** • This learner explains their method clearly, but has worked with $9\frac{1}{2}$ rather than $9\frac{1}{4}$ lots of 100m for the length of the Mall.
The road is 18 cm wich = 9 100 m wich = 900 m. So I did × 30 to get 27000 and then I no to do times 2 = 54000	Doubles their (incorrect length × 30); **2 marks** • This learner measures incorrectly, possibly by measuring from the end of the ruler. The next step, × by 30, is correct, but because their answer is already to the nearest thousand, no evidence of correct rounding is shown.
60,000	Incomplete; **0 marks** • As no working is shown we do not know how this answer has been found. This learner needs support to understand the importance of showing working.

Activity 2

Our space

Activity 2 – Our space

Outline

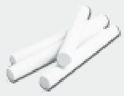


This activity follows on from **Activity 1 – How do they know?** It uses the definition of crowds presented in that activity to encourage an open-ended investigation into personal space within the classroom.

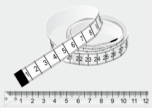
Learners should be encouraged to take their own decisions on what to investigate and how to record their work and their findings.

You will need

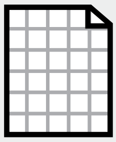
Each group (preferably of six) will need:



Chalk



Metre ruler/tape



Squared paper

Activity 2 – Our space

Explain

Give each group chalk and a metre ruler and ask them to create a grid of squares, e.g. 2m by 3m, with each square 1m by 1m.

Ask one learner to stand in each square. Remind them that this is the definition of a 'light crowd' in **Activity 1 – How do they know?**

Discuss how comfortable they feel *(this allows for the possibility of discussing the issue of personal space and research on the distances people generally feel comfortable with – information can be found on many websites, such as www.livescience.com/20801-personal-space.html)*. Increase the number of learners in each square. Now how do they feel? Support their understanding that different situations require different distances.

Tell learners that they are now going to explore the space they have in the classroom. They can choose what to investigate. *(If necessary, suggest some ideas, such as investigating how many people could stand in the classroom, as a 'light crowd', or a 'packed crowd', or exploring how much space each learner – and the teacher – has.)*

Give them squared paper and ask them to record their work and their findings so they can be displayed in the classroom.

Support their decisions and investigations, then when complete, bring the class together so that groups can present their work and findings to other groups.

(The outcomes of this activity are less important than the opportunities it provides for learners to make their own decisions as they explore the concept of area.)

Question

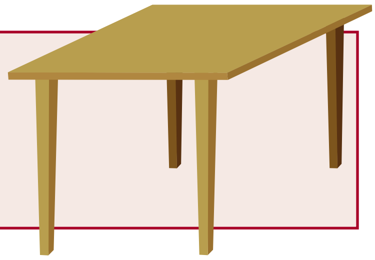
- How are you sure that the squares in your grid are accurate? How are you sure that the lines are at right angles?
- Why might it feel okay to be very close to people in a crowd (e.g. watching a rugby match) but not in another situation (e.g. in the classroom)?
- How are you going to choose what to investigate? Have you all agreed? If you don't agree, what will you do?
- How are you going to record your work and your findings so someone else can make sense of them?
- In your calculations, have you taken account of the fact that there is furniture in the classroom, and other things that take up space? How can you record/draw that?
- Are you using scale drawings? What is your scale?
- Do your findings/conclusions make sense? Are they what you would expect?
- When you present your work to the other groups, who is going to do what? And how will you make sure your presentation is interesting?

Activity 3

Seating plan

Activity 3 – Seating plan

or



Outline

This activity follows on from **Activity 1 – How do they know?**
Learners explore seating arrangements, using the context of a wedding.

You will need

WB	**Whiteboard – Tables 1**
WB	**Whiteboard – Tables 2**

Activity 3 – Seating plan

Explain

Tell the class that at the royal wedding in 2011, 600 people were invited to the lunch that followed. Most weddings have fewer people! Tell learners that they are going to plan how to seat 80 people around different arrangements of tables.

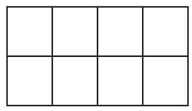
Show **Tables 1** on the whiteboard. Four people can sit around each table, one at each side. How many people can sit around six of these tables? *(24)* How many tables do you need for 80 people? *(20, because 80 ÷ 4 = 20)*

Now show **Tables 2** and say that the tables are side by side in a long line. How many people can sit around these six tables? Encourage discussion then help learners to realise that 14 people can be seated, because one person sits at each end and six people can sit along each side, so we have 1 + 1 + 6 + 6 = 14.

What happens if we change the number of tables, but still keep them side by side in a long line? How many tables would we need for 80 people? Encourage learners to find their own methods, and remind them that they will need to show their reasoning so that someone else can understand what they have done.

(Solution – there will always be one person at each end of the long table, and an equal number of people on each of the other sides, so (80 – 2) ÷ 2 = 39 people on each side, therefore we need 39 tables.)

Now tell them that there is so much food to go on the tables that there will always be two tables side by side in a long line. Now how many tables do you need for 80 people?



(Solution – this time there will be two people at each end of the long table, so there will be (80 – 4) ÷ 2 = 38 people on each side, but each one has a table, so 38 × 2 = 76 tables.)

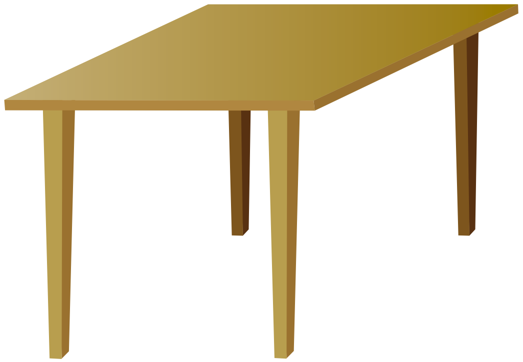
Question

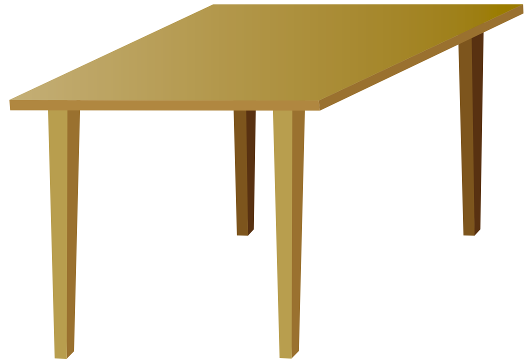
- How are you approaching the task? And how are you recording your findings?
- Have you checked your work? How?
- Can you write a rule that works out how many tables you need for any number of people?
- How does this link to perimeter?
- How can you use what you learned in the first part of this activity to help you with the second part?

Extension

- In real life, what length of table do people need, on average, when they are eating? How will you decide? And how will this change your answers to the numbers of tables needed?
- Explore seating patterns for other shapes, such as triangles.

WB






WB