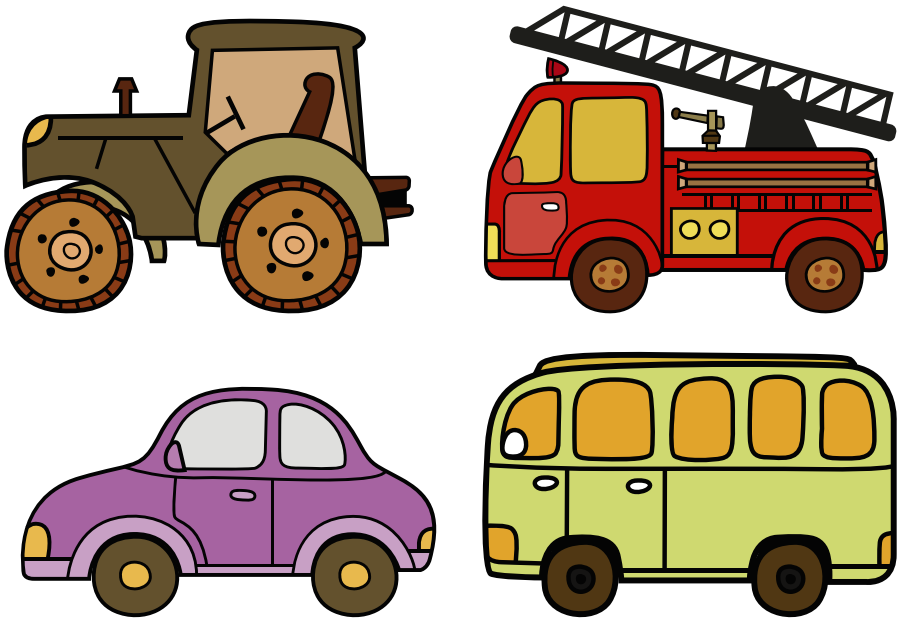
Reasoning in the classroom

Pictures for numbers

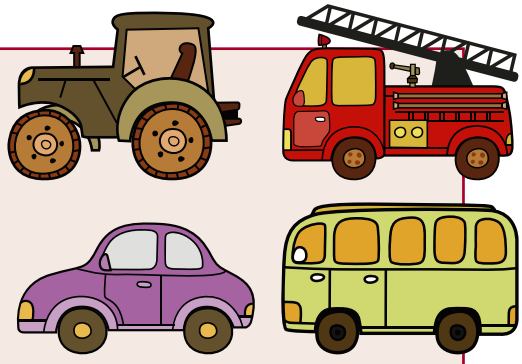


Support materials for teachers

Year 6

Llywodraeth Cymru
Welsh Government

Year 6 Reasoning in the classroom – Pictures for numbers



These Year 6 activities focus on pictorial representation. They start with an item that was included in the 2014 National Numeracy Tests (Reasoning) and continue with one linked activity.

Activity 1

Pictures for numbers
Learners solve a problem in which symbols stand for numbers.

Includes:

- Pictures for numbers question
- Markscheme

Activity 2

Mayan numbers
They explore pictures showing how the Mayans represented numbers. Then they create a video/poster to explain Mayan numbers and calculations.

Includes:

- Explain and question – instructions for teachers
- Resource sheet – Mayan numbers
- Teachers' sheet – More Mayan numbers
- Whiteboard – Mayan calculations

Reasoning skills required

Identify	Communicate	Review
Learners choose their own methods, making sense of pictorial information.	They explain their approach and articulate their thinking.	They review and use information.

Procedural skills

- **Four rules of number**
- **Place value**

Numerical language

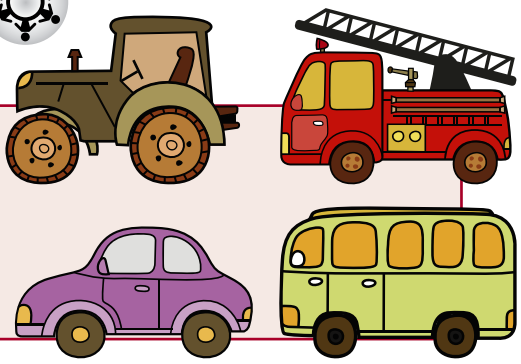
- **Total**
- **Represents**
- **Calculations**

Activity 1

Pictures for numbers

Activity 1 – Pictures for numbers

or



Outline

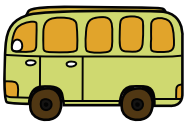
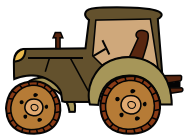
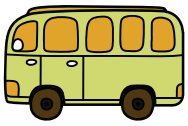
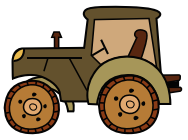
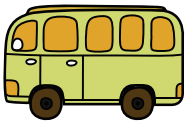
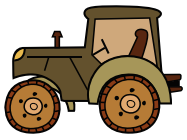
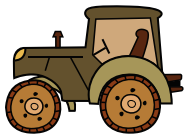
In this Year 6 activity, learners are given pictures of vehicles and shown how groups link to a given total. They use their numerical skills to reason the total for a different group.

You will need

Pictures for numbers question
One page for each learner

Markscheme

Each picture stands for a number.

				Total of the row
				20
				28
				**35**
				**46**
				**?**

What is the total of the last row?

3m

Activity 1 – Pictures for numbers – Markscheme

Marks	Answer
3m	**53**
Or 2m	Links the correct value to each vehicle, i.e. **5** **13** **12** **16** Or Shows the correct values for the last row, i.e. **13** **12** **16** **12** Or 5, **not 13**, but the answer is **66 – their value for** Or 5, 13, **not 12**, but the answer is **41 + their value for** Or 5, 13, 12, **not 16**, but the answer is **37 + their value for**
Or 1m	Shows = **13** Or Shows = **16**

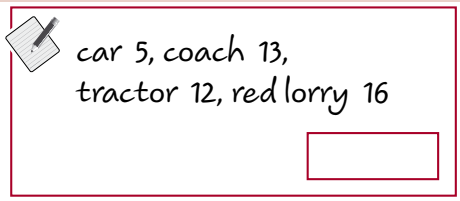
If you wish to see the relevance of 66, an explanation is provided after the learners' exemplars

If you wish to see the relevance of 41, an explanation is provided after the learners' exemplars

If you wish to see the relevance of 37, an explanation is provided after the learners' exemplars

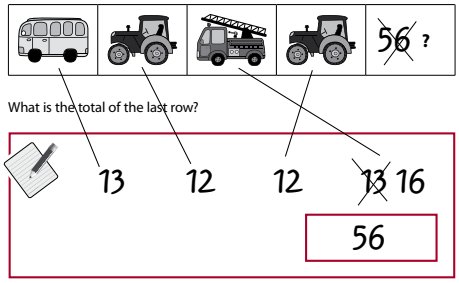
If **is wrong,** **must also be wrong so do not give 1m for** **= 12**

Activity 1 – Pictures for numbers – Exemplars



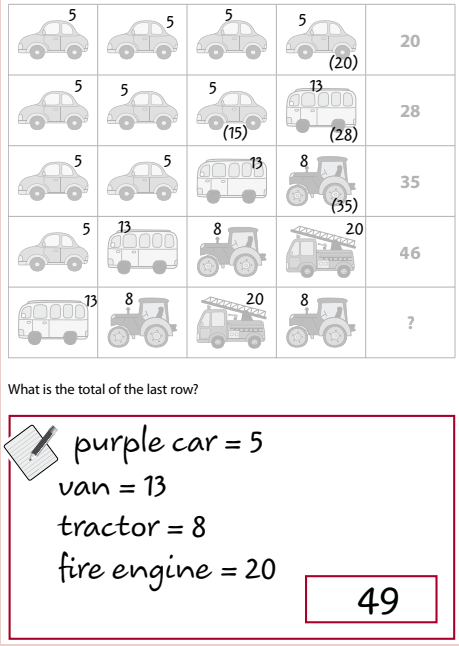
Correct values for each vehicle; **2 marks**

- The final step, working out the total of the last row, has been omitted.



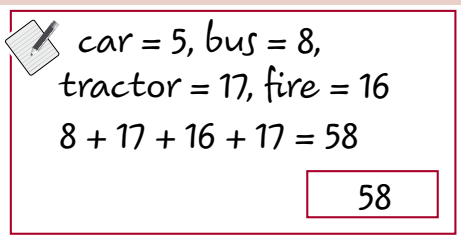
Correct values for the last row; **2 marks**

- The values are correct but they have been added incorrectly.



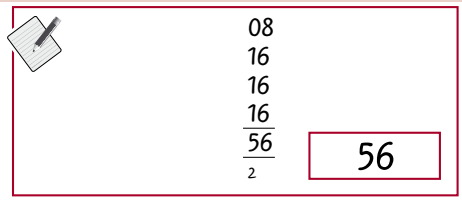
5 ✓, 13 ✓, 8 (not 12), answer 41 + 8 = 49; **2 marks**

- This learner has made only one mistake, but has continued with a correct method to their solution (this is called follow-through). When you see the first incorrect value, check their total to see if you can give 2 marks.



5 ✓, 8 (not 13), answer 66 – 8 = 58; **2 marks**

Common error This error is from thinking that the second row has 4 cars not 3



No values are linked to vehicles; **0 marks**

- Because no working is shown, we can't disentangle this learner's reasoning. However, if the answer had been 53, they would have scored all 3 marks.

Activity 1 – Pictures for numbers – Explanation (for interest only)

Let = C, = B, = T and = F

The first row shows that C = 5 (this is not worth 1 mark as it is such an easy calculation).

What happens if their only error is in finding C?

If every subsequent step is correct, the answer 53 will also be correct because the final row does not involve C. If learners slip up on this first easy stage, it is most unlikely that they will be able to complete every other stage correctly, so for ease of marking we accept 53 without further checks.

What happens if their only error is in finding B?

The third row shows that 10 + B + T = 35, which simplifies to B + T = 25
So if their B is wrong, their T must be wrong because they must add to 25

The fourth row shows that 5 + B + T + F = 46
But because B + T = 25 we have 5 + 25 + F = 46
This simplifies to F = 16, which is the correct value for F.

The final row is B + T + F + T
Because B + T = 25, we know that T = 25 – B
We also know that F = 16, so

$$\begin{aligned} B + T + F + T &= B + (25 - B) + 16 + (25 - B) \\ &= 25 + 25 + 16 + B - B - B \\ &= 66 - B \end{aligned}$$

So if their only error is in finding B, their answer must be 66 – B

What happens if their only error is in finding T?

The fourth row shows that 5 + 13 + T + F = 46, which simplifies to T + F = 28
So this time, if the value for T is wrong, the value for F must be wrong.
The final row is B + T + F + T
We know that B = 13 and T + F = 28, so

$$\begin{aligned} B + T + F + T &= 13 + 28 + T \\ &= 41 + T \end{aligned}$$

So if their only error is in finding T, their answer must be 41 + T

What happens if their only error is in finding F?

The final row is B + T + F + T
We know that B = 13 and T = 12, so

$$\begin{aligned} B + T + F + T &= 13 + 12 + F + 12 \\ &= 37 + F \end{aligned}$$

So if their only error is in finding F, their answer must be 37 + F

Activity 2

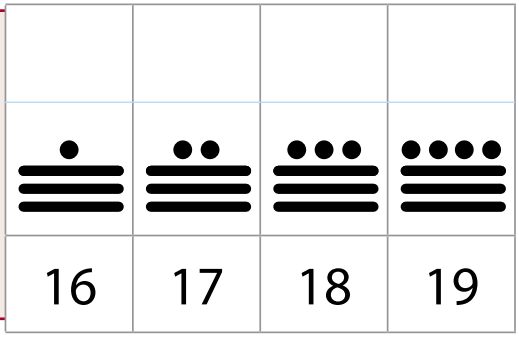
Mayan numbers

Activity 2 – Mayan numbers

or

Outline

This activity focuses on the ancient system of counting used by the Mayans. Their number system was based on counting in 20's rather than in 10's, so learners explore place value while considering how numbers were represented. Then they create a video/poster that explains Mayan numbers and includes Mayan calculations.



You will need

R **Resource sheet – Mayan numbers**

T **Teachers' sheet – More Mayan numbers**

WB **Whiteboard – Mayan calculations**

Activity 2 – Mayan numbers

Explain

Ask learners if they know of any ancient civilisations, e.g. the Romans. Ask where Central America is and explain that the Mayans were a civilisation that lived there until about AD900. Our counting system is based on the number 10. The Mayans' counting system was based on the number 20 – probably because they used both their hands and feet when counting.

Give each group/pair a copy of the resource sheet **Mayan numbers**. Say that their first task is to work out how the Mayans wrote numbers.

Encourage groups to explore the resource sheet independently, and use the questions below to support their thinking. Then ask learners to choose numbers *(between 60 and 99)* and show how the Mayans would have written them. *(For ease of reference, the teachers' sheet* **More Mayan numbers** *shows the numbers from 60 to 119. Numbers greater than 99 are included as the extension activity uses them.)*

When learners are confident, show **Mayan calculations** on the whiteboard. Ask learners to work out the answers. *(The first represents 15 – 12 so* ●●● *is the answer. The second represents 15 + 12 so* *is the answer.)*

Finally, ask learners to create posters and/or a video explaining the Mayan system of counting, including their own calculations.

Question

- Look at the numbers 1 and 6, then 2 and 7, then 3 and 8, then 4 and 9. What do you notice? *(The pattern of dots is the same in each pair, but there is an additional line in the numbers 6, 7, 8 and 9 – this represents 5. So 6 is 5 + 1, 7 is 5 + 2, etc.)*
- In the numbers 5 to 9, what does each line represent? *(5)* So what do two lines represent? *(10)* And three lines? *(15)* So why is 17 three lines and two dots? *(17 = 3 × 5 + 2)*
- Now look at the next row. What numbers are shown? *(20 to 39)* Each number has two parts to it – what do you notice about the lower part? *(Same as the numbers 0 to 19)* What about the top part? *(They all show one dot.)* So what does that tell you? *(The top dot represents 20, so the number 30, for example, is 20, shown by one dot in the top part, + 10, shown by two lines in the bottom part.)*
- Why do the numbers 40 to 59 have two dots in the top part? *(The two dots represent 20 + 20 = 40, then the numbers in the bottom part are 0 to 19 again.)*
- What do you think the numbers 60 to 79 will be and why? *(As above, but using three dots in the top part to represent 60)* What about 80 to 99? *(As above, using four dots in the top part)*
- How will you explain the Mayan system of counting to other people? What calculations are you going to do, and why?

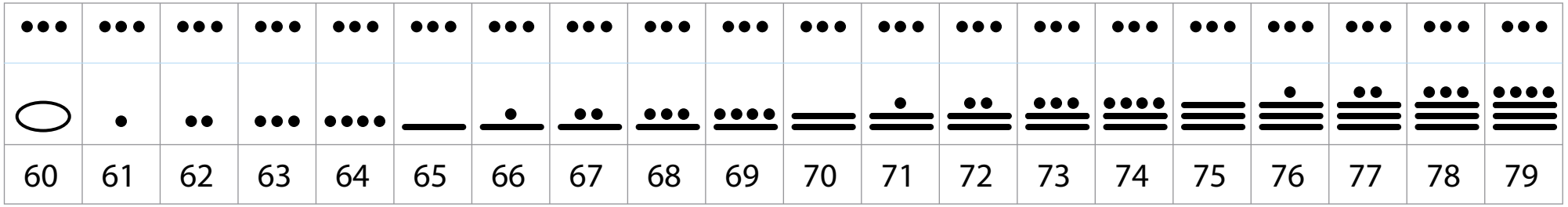
Extension

- How did the Mayans count beyond 99? A useful website is gwydir.demon.co.uk/jo/numbers/maya/ in which learners can enter a number from 1 to 99 999 and see the Mayan representation. The program also includes 'step counts' in which the number increases by 1 each time.

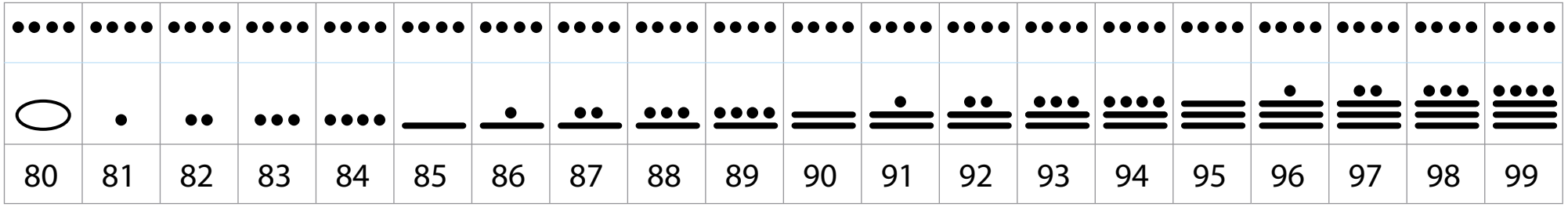
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39

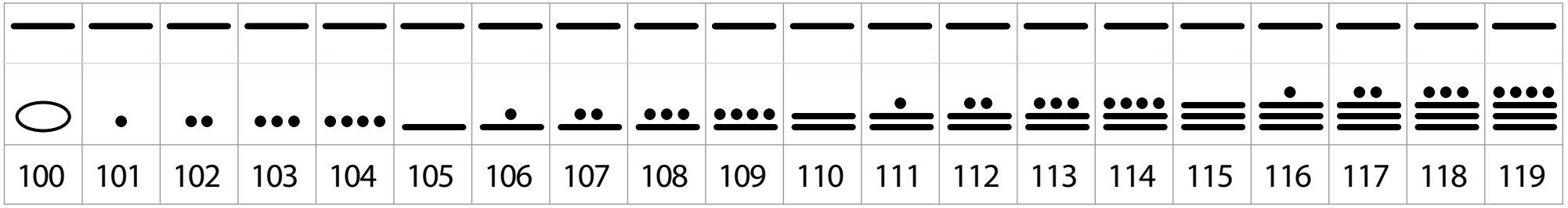
40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59

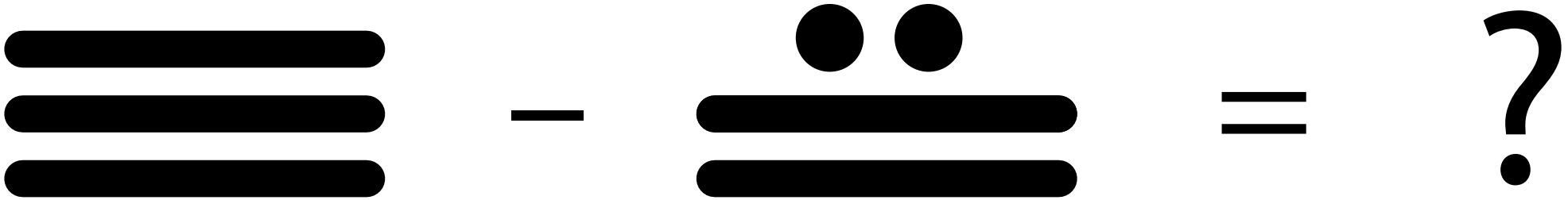
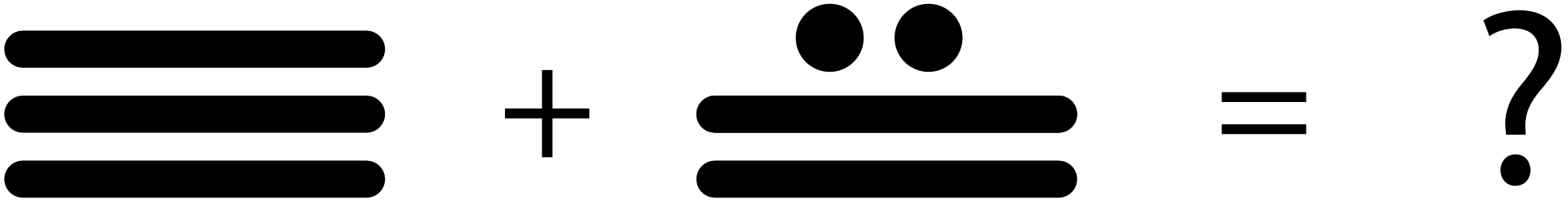


60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79



80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99



100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119

WB