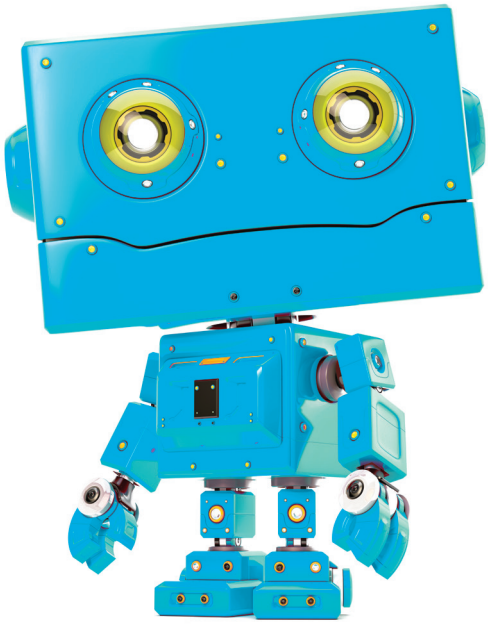
Reasoning in the classroom

Robots



Support materials for teachers

Year 3

Llywodraeth Cymru
Welsh Government

Year 3 Reasoning in the classroom – Robots

These Year 3 activities require learners to solve a range of problems using basic computational and reasoning skills. The first activity was included in the 2015 National Numeracy Tests (Reasoning). This is followed by one further activity set in a competitive game context designed to encourage strategic thinking.

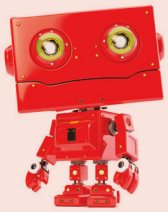
Activity 1

Robots

Learners work out combinations of robots to meet different conditions then use their reasoning skills to solve simple problems about robots standing on blocks.

Includes:

- Teachers' script
- PowerPoint presentation
- Robots questions
- Markscheme



Activity 2

Number robots

Learners use the numbers from three dice to arrive at target numbers set by other teams, in order to win robots.

Includes:

- Explain and question – instructions for teachers
- Whiteboard – Winning a robot
- Resource sheet – Red robots' game board
- Resource sheet – Blue robots' game board
- Whiteboard – Robot rules

Reasoning skills required

Identify	Communicate	Review
Learners select appropriate mathematics and techniques to use in order to reach a solution and win a game.	They work together to set challenging number targets before discussing strategies and options for finding solutions.	They review their work and decide on whether to amend their strategies.

Procedural skills

- 2-times table, 3-times table, 4-times table
- Subtraction
- Addition
- Multiplication and division

Numerical language

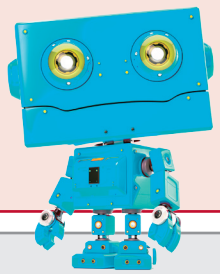
- Altogether
- Weigh
- High
- Addition/subtraction
- Multiplication and division

Activity 1

Robots

Activity 1 – Robots

Outline



This Year 3 activity focuses on robots of differing heights and masses.

Learners use their number skills to solve a wide range of problems.

You will need

Teachers' script

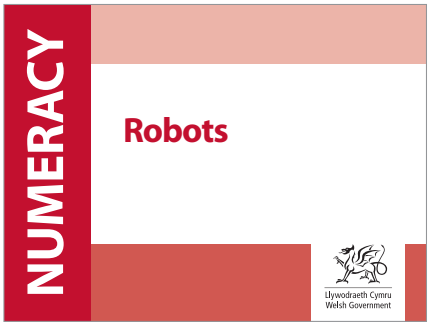
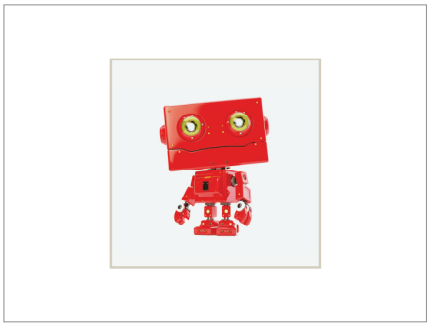
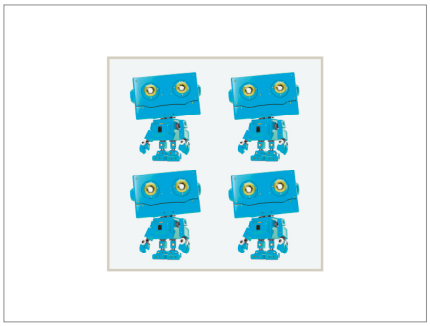
PowerPoint presentation

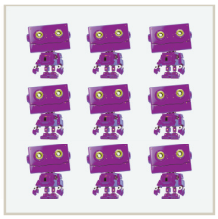
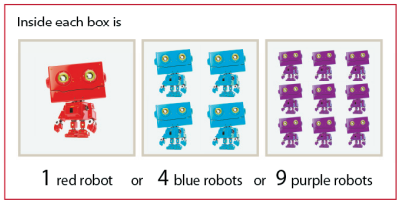
Robots questions
Three pages for each learner, can be printed double-sided

Markscheme

Presentation to be shown to learners before they work on Robots

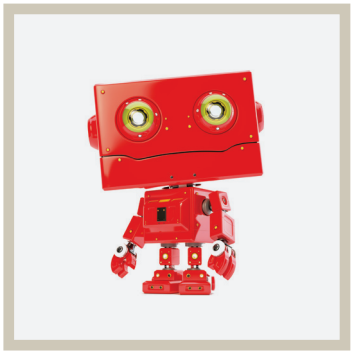
The text in the right-hand boxes (but not italics) should be read to learners. You can use your own words, or provide additional explanation of contexts, if necessary. However, if you are using this as an assessment item, no help must be given with the numeracy that is to be assessed.

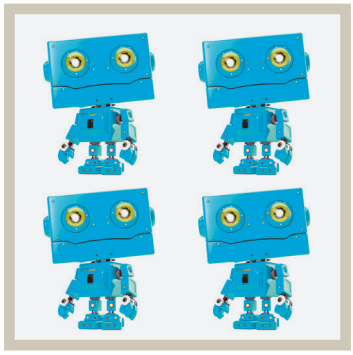
Slide 1		*(Keep this slide on the screen until you are ready to start the presentation.)*
Slide 2		You can see lots of boxes in this picture. Some of the boxes are inside the lorry and some *(point)* are waiting to be moved. Each box is the same size. Let's find out what's inside one of the boxes . . .
Slide 3		. . . it's a big red robot. But not all of the boxes have a big red robot inside. Some of the boxes have . . .
Slide 4		. . . four medium-sized blue robots. And some of the boxes have . . .

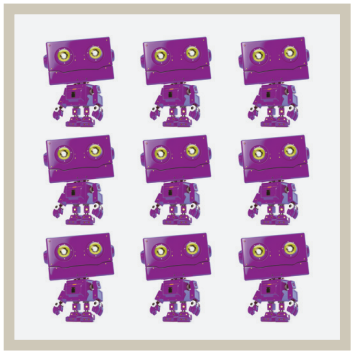
Slide 5		. . . nine small purple robots. Let's have a look at all the different boxes together.
Slide 6		So, inside each box is one red robot *(point)* or four blue robots *(point)* or nine purple robots *(point)*. When people want to buy some of these robots, they say how many of each colour they want. Then the correct boxes are sent to them. If I want eight blue robots, how many boxes will I get? That's right, two boxes – four blue robots in one box, and another four blue robots in the second box. If I want three red robots and nine purple robots, how many boxes will I get? *(Allow discussion, using the whiteboard if necessary to explain why four boxes are needed.)* Now you are going to answer some questions about these robots. Remember to set our your work clearly 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. 15 minutes.)*

1

Inside each box is







1 red robot or 4 blue robots or 9 purple robots

Tom wants 1 red, 12 blue and 9 purple robots.

How many **boxes** does he get altogether?

boxes

2m

Jen wants 2 red, some blue and 0 purple robots.

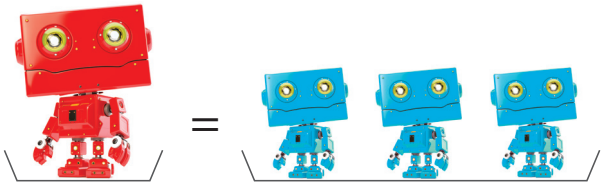
She gets 8 boxes.

How many **blue robots** does she get altogether?

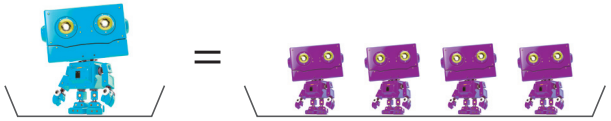
blue robots

2m

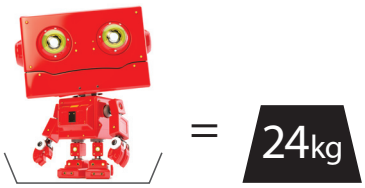
2 1 **red** robot weighs the same as 3 **blue** robots.



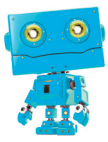
1 **blue** robot weighs the same as 4 **purple** robots.



1 **red** robot weighs 24kg.



Work out what a **blue** robot and a **purple** robot weigh.



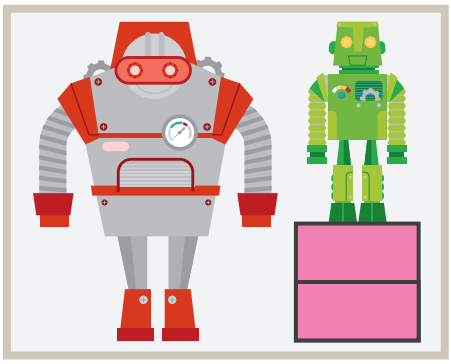
kg

kg

2m

3 The **big robot** is 60cm tall.

Each **pink block** is 11cm high.



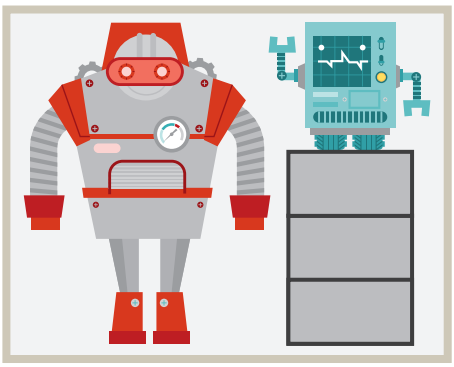
How tall is the **green robot**?

cm tall

2m

The **big robot** is 60cm tall.

The **blue robot** is 24cm tall.



How high is each **grey block**?

cm high

2m

Activity 1 – Robots – Markscheme

Q	Marks	Answer
1i	2m	**5** boxes
	Or 1m	Shows or implies that the blue robots need **3** boxes, e.g. • 1 red, 3 blue, 1 purple • 12 = 4 + 4 + 4
1ii	2m	**24** blue robots
	Or 1m	Shows **6 × 4** (or 4 + 4 + 4 + 4 + 4 + 4) Or Gives the answer **32** blue robots Or Gives the answer **6** blue robots
2	2m	Both correct, i.e. blue **8**kg purple **2**kg
	Or 1m	Blue 8kg, even if purple is incorrect or omitted Or Their purple is **quarter** of their blue, e.g. • Blue 10kg purple $2\frac{1}{2}$kg

Has done 8 × 4, forgetting that 2 of the boxes contain red robots

Common error

Has forgotten that each of the 6 boxes contains 4 blue robots

Activity 1 – Robots – Markscheme (continued)

Q	Marks	Answer
3i	2m	**38**cm tall
	Or 1m	Shows **22** Or Shows a method that would lead to 38cm if calculated correctly, with not more than one numerical error, e.g. • 11 + 11 = 32 (error) 60 – 32 = 28 • 60 – 11 = 49 49 – 11 = 28 (error)

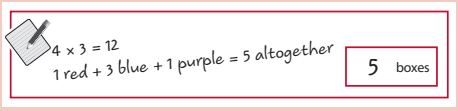
The height of two pink blocks

3ii	2m	**12**cm high
	Or 1m	Shows **36** (or 6 and 30) Or Shows a method that would lead to 12cm if calculated correctly, even if there is more than one numerical error, e.g. • 60 – 24, then a clear attempt to find the number of 3's in their answer

Difference in height between the two robots

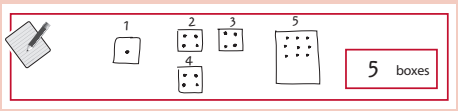
Activity 1 – Robots – Exemplars

Question 1i



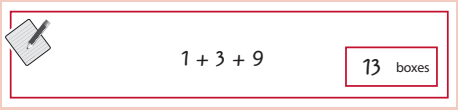
Correct; **2 marks**

- This learner shows very clear numerical communication.



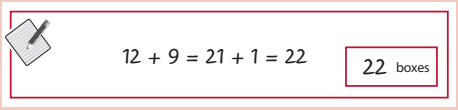
Correct; **2 marks**

- Drawing the contents and numbering the boxes is an effective method, albeit time-consuming.



Blue robots need 3 boxes; **1 mark**

- This learner is listing the number of boxes, but has become confused when working with the purple robots.



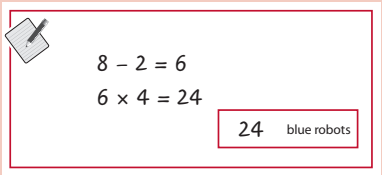
Incorrect; **0 marks**

- This learner has added the number of robots. As there is no evidence of 3 boxes for the blue robots, no marks can be given.

Incorrect; **0 marks**

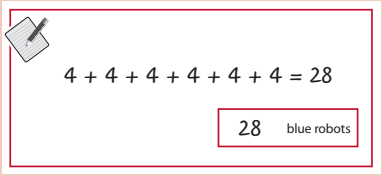
- As there are 3 sets of robots, we cannot assume that 3 refers to the blue robots. No marks can be given.

Question 1ii



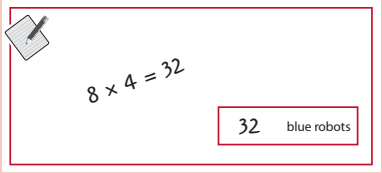
Correct; **2 marks**

- The method is clear and succinct.



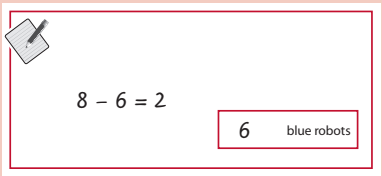
Shows 4 + 4 + 4 + 4 + 4 + 4; **1 mark**

- The method is correct, but there is a numerical error.



Answer 32; **1 mark**

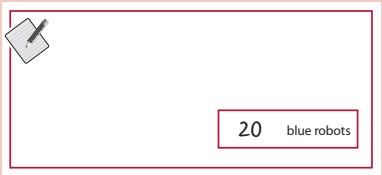
- The answer 32 would be correct if all the boxes contained blue robots.



Answer 6; **1 mark**

Common error

This is a common error. The learner has confused boxes and numbers of robots.

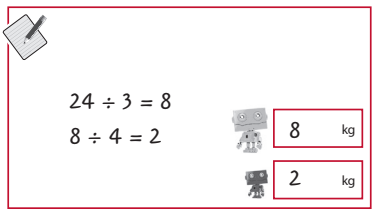


Incorrect; **0 marks**

- The learner may have worked out 6 lots of 4 incorrectly but as we cannot be sure, no marks can be given.

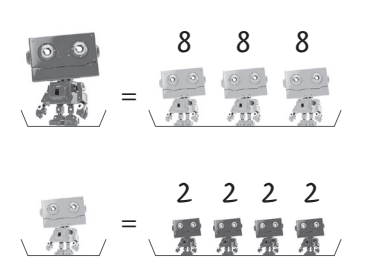
Activity 1 – Robots – Exemplars (continued)

Question 2



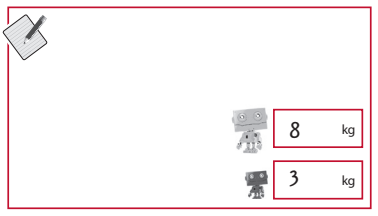
Correct; **2 marks**

- The method is very clear, showing good numerical communication.



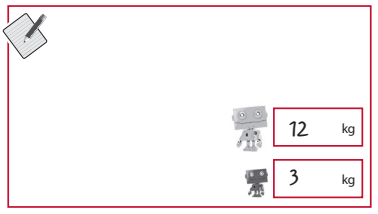
Correct; **2 marks**

- Although the answer boxes were left blank, the learner shows the correct answers on the diagrams.



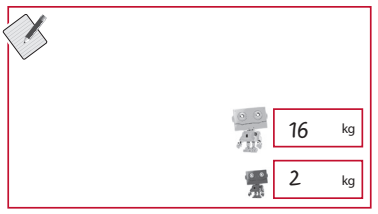
Blue robot 8kg; **1 mark**

- The value for purple is incorrect.



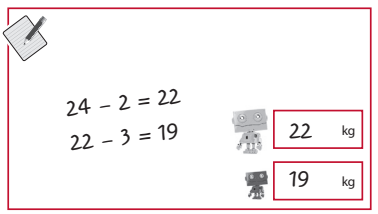
Their purple is quarter of their blue; **1 mark**

- This learner has made an error when finding what the blue robot weighs but has followed through correctly by doing 12 ÷ 4



Incorrect; **0 marks**

- As their blue is 16kg, their purple should be 16 ÷ 4 = 4kg. No marks can be given.



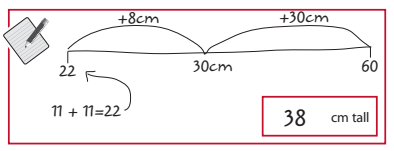
Incorrect; **0 marks**

Common error

There are two more blue robots than red robots on the first diagram, which is why this learner subtracts 2 from 24, then subtracts 3 from 22 for the second answer. This shows a lack of understanding of simple proportion.

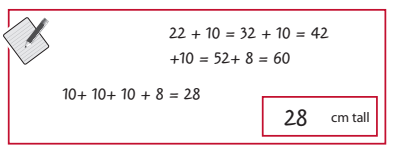
Activity 1 – Robots – Exemplars (continued)

Question 3i



Correct; **2 marks**

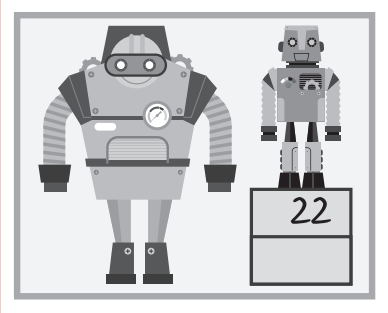
- The method is very clear.



Shows 22; **1 mark**

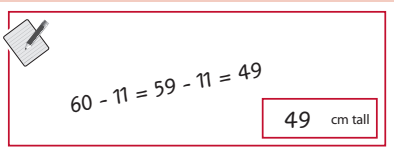
Common error

22 is shown, but the result of counting on to 60 is incorrect.



Shows 22; **1 mark**

- Although this learner left the answer space blank, 22 is clearly shown on the diagram.



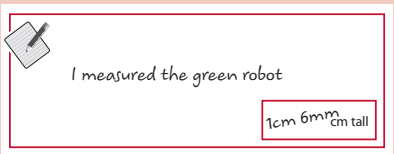
Incorrect; **0 marks**

- This learner shows a correct method but there are two numerical errors. No marks can be given.

Incorrect; **0 marks**

Common error

This learner may have subtracted 22 from 60 in their head incorrectly, but we cannot be sure so no marks can be given.



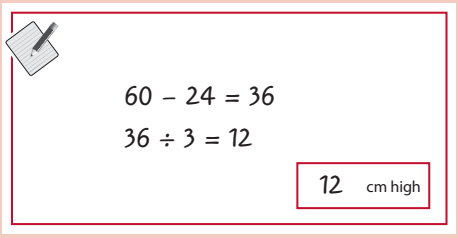
Incorrect; **0 marks**

Common error

Understanding the importance of using the numbers given, rather than measuring, is an essential part of becoming numerate.

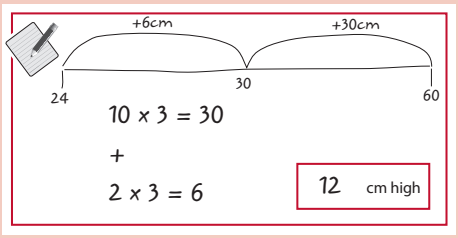
Activity 1 – Robots – Exemplars (continued)

Question 3ii



Correct; **2 marks**

- This learner works efficiently to solve the problem.

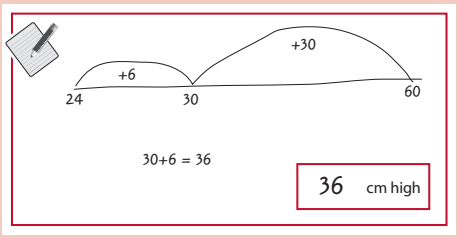


Correct; **2 marks**

- Having counted on to find 6 and 30, this learner then uses their knowledge of the 2- and 10-times tables to work out that the block must be 2 + 10 = 12cm high.

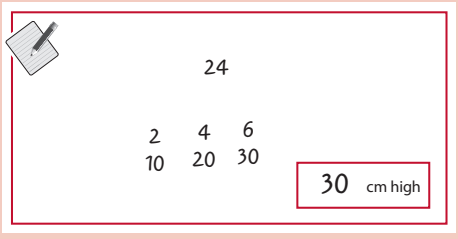
Correct; **2 marks**

- This learner needs support to understand why showing working is important. However, the answer is correct and scores 2 marks.



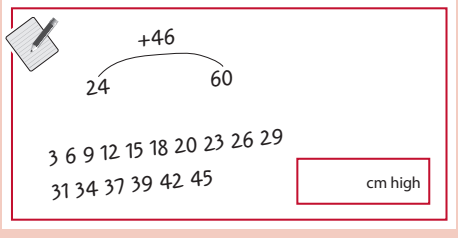
Shows 36; **1 mark**

- This learner shows a correct first step, using counting on to find the correct answer to 60 – 24



Shows 6 and 30; **1 mark**

- Many learners find it easier to divide 36 by 3 in two steps (6 ÷ 3 and 30 ÷ 3). Although 2 and 10 are shown, the learner has become confused and the answer is incorrect.



Correct method; **1 mark**

- Although there are several numerical errors, this learner shows a correct method – finding the difference of 24 and 60, then counting in 3's.

Activity 2

Number robots

Activity 2 – Number robots

Outline

This Year 3 activity continues the theme of robots with pairs of learners competing against each other to be the first to win nine robots.

To win a robot, learners throw three dice and use a combination of addition and subtraction to achieve a target number set by the opposing team.

You will need

Whiteboard – Winning a robot

Whiteboard – Robot rules

Resource sheet – Red robots' game board (laminated if possible)
One for each two pairs (playing together)

Resource sheet – Blue robots' game board (laminated if possible)
One for each two pairs (playing together)

Each two pairs (playing together) will need:

- **two pads of sticky notes** (one for each pair)
- **paper and pencil/pen**
- **a calculator** (optional)
- **three dice**

Activity 2 – Number robots

Explain

Put learners into sets of two pairs. Name one pair the 'red team' and the other the 'blue team'. Tell them that each team will have nine robots and that the aim of the game is to be the first to take all nine of the other team's robots. They take a robot by throwing three dice and adding or subtracting the numbers on the dice to achieve a target number that has been set for that robot by the other team.

Demonstrate by showing **Winning a robot** on the whiteboard. Ask how they can achieve the target of 11 *(6 + 3 + 2)*. Write this on the whiteboard, on the 'sticky note' under '11'. Could they use the same three dice to reach any other target numbers? *(Assuming positive targets: 1 or 5 or 7)*

The game starts with each pair setting the target numbers for the other pair. Give the red team a copy of **Red robots' game board** and the blue team a copy of **Blue robots' game board**. They choose any *(whole)* number from 0 to 18, write it on the top part of a sticky note and put it on any one of their robots. They continue doing this until each robot has been given a target number for the opposing pair to aim for *(so every robot has a sticky note detailing a target number)*.

When the targets have been set, teams swap game boards and play commences with each team taking turns to throw the dice. When they have a solution for any of the targets on the board, they write their calculation *(e.g. 6 + 3 + 2 = 11)* on the bottom part of the relevant sticky note *(so their opponents and you can check for accuracy)* and take the robot *(sticky note)*. Play then passes to the other team.

Make sure they understand that they have to get exactly the target number from their three dice *(all dice must count)* to take a robot. If they can't get exactly the target number of any of the robots left on the board, play moves on to the other team. Show **Robot rules** throughout the activity to remind them of the rules and process. At the end of the game, review the play using the questions below as a guide. Finally, ask learners to repeat the game, thinking carefully about any changes to their strategy that would help them.

Question

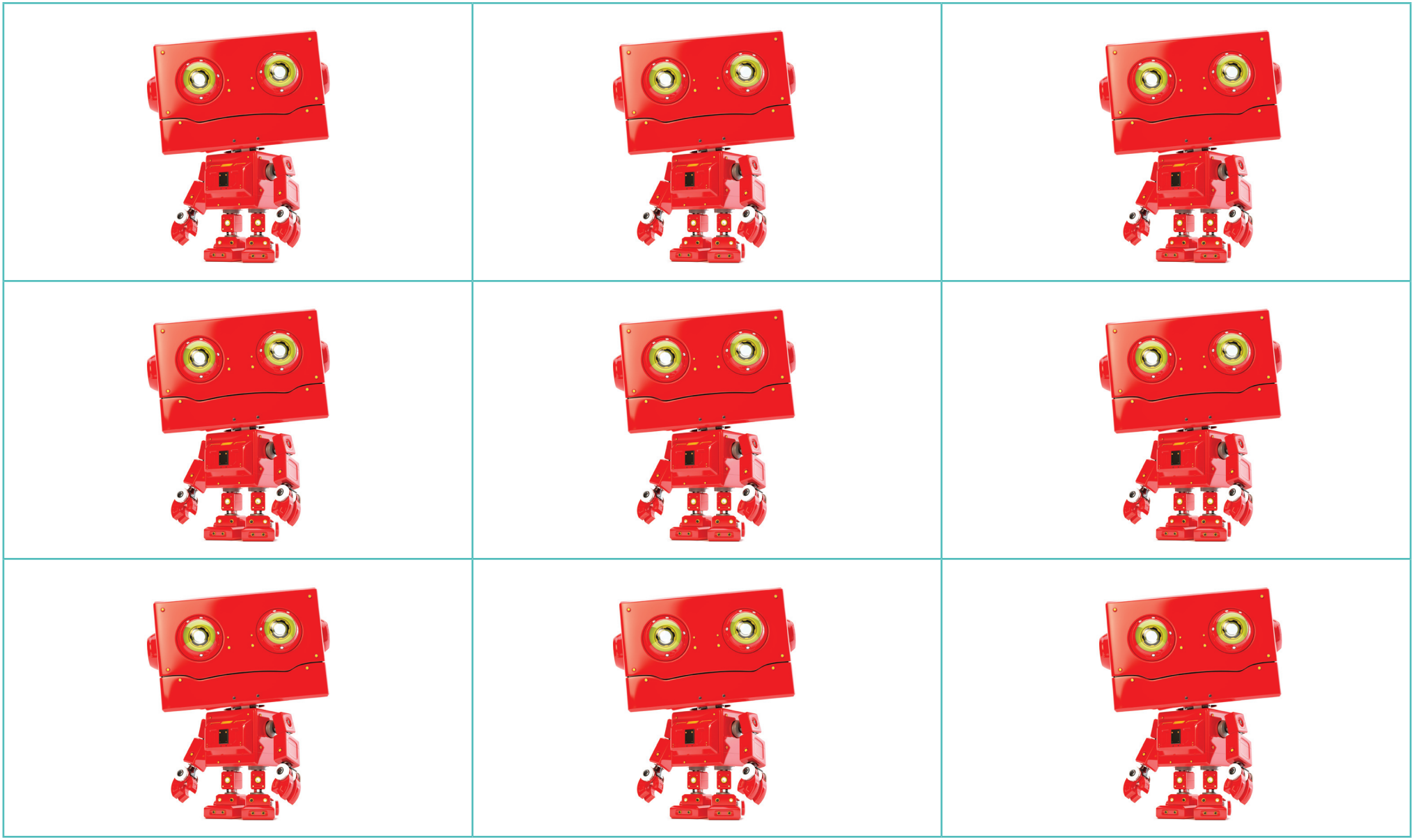
- What is the smallest number you can get with three dice, using just addition? *(3)*
- Why is 18 the highest number you can set as a target? *(The maximum score in any one go)*
- Using all three dice, how can you reach a target number of 1? Can you find another way? *(Subtraction: e.g. 6 – 4 – 1; addition and subtraction: e.g. 3 + 2 – 4)*
- How did you decide which target numbers to choose? Were they 'good' targets to set? Why/why not? Would you change any of them? Why/why not?
- Were there target numbers that were harder to achieve? Why were they harder?
- What would you do differently next time?

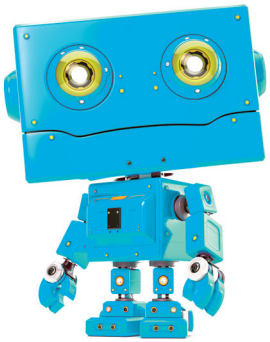
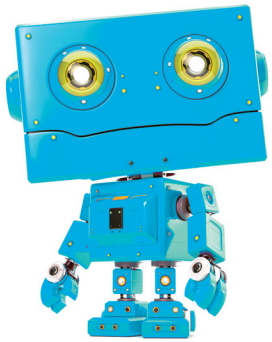
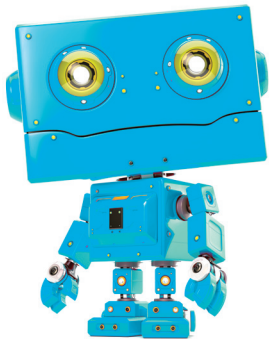
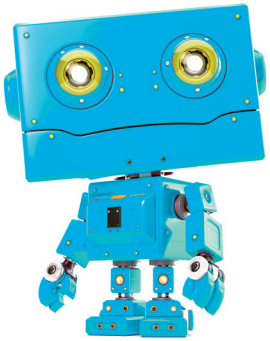
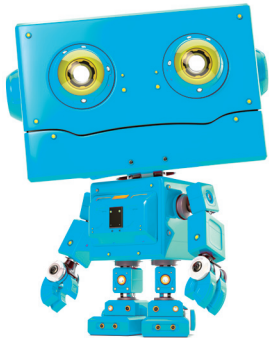
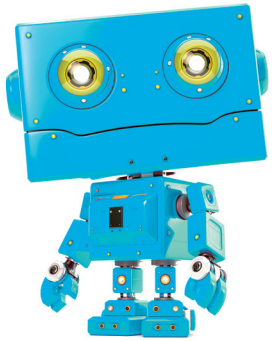
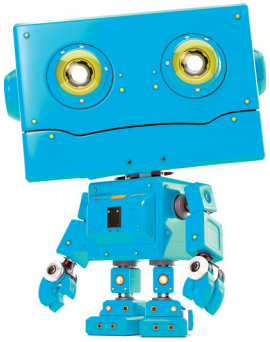
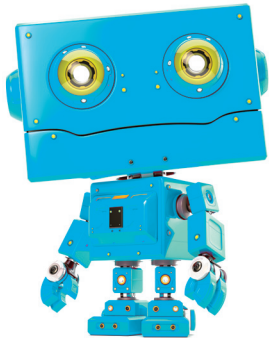
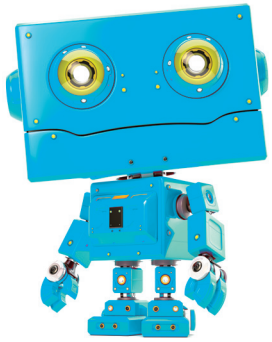
Extension

- Increase the number of dice to four after the first game.
- Introduce multiplication and division into the rules *(together with a calculator, and a higher maximum number for the targets)*.

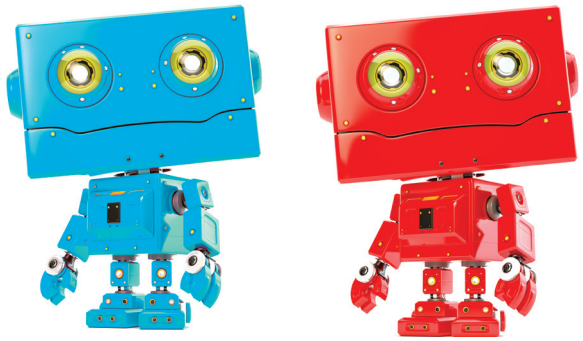

11


11



Set the targets for the other team



- Write a target number on the top of a sticky note and stick it to a robot.
- Set a target for every robot.
- Target numbers can be from 0 to 18
- These are the targets for the other team.

Play the game

- Take it in turns to throw 3 dice. Use those numbers to make any one of the target numbers on the robot pieces your team is collecting.
- If you can make a target number, you take that robot (write the calculation on the sticky note and remove it). If you can't, then it's the other team's turn.