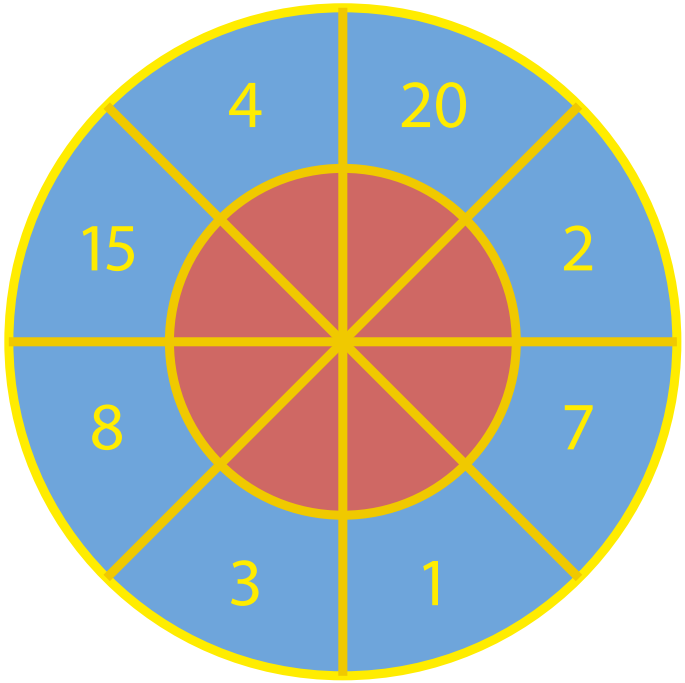
Reasoning in the classroom

Double trouble



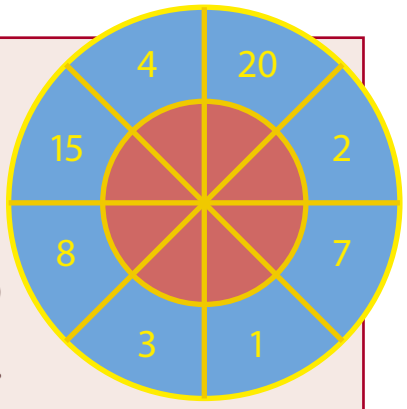
Support materials for teachers

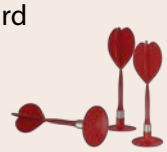
Year 5

Llywodraeth Cymru
Welsh Government

Year 5 Reasoning in the classroom – Double trouble

These Year 5 activities start with an item that was included in the 2014 National Numeracy Tests (Reasoning). They continue with two linked activities, in which learners use their numerical understanding to solve problems.





Activity 1

Double trouble

Learners use the context of a simplified darts board to work out different number combinations.

Includes:

- Teachers' script
- PowerPoint presentation
- Double trouble questions
- Markscheme

Activity 2

Double-double magic

They explore number relationships within the context of a popular playground clapping game.

Includes:

- Explain and question – instructions for teachers
- Whiteboard – Double double
- Whiteboard – Add them up

Activity 3

Poor Alice

Learners investigate what happens when the rate of growth of an item doubles each day.

Includes:

- Explain and question – instructions for teachers
- Whiteboard – Poor Alice
- Teachers' sheet – Cards (sheet 1 and sheet 2)
- Resource sheet – Which one?

Reasoning skills required

Identify	Communicate	Review
Learners use their reasoning skills to find numerical relationships.	They explain their reasoning and present their work so that others can understand it.	They check their work and review other people's.

Procedural skills

- **Addition**
- **Subtraction**
- **Doubling**
- **Multiplication**
- **Conversion of units** (optional)

Numerical language

- **Double**
- **Digits/consecutive digits**
- **Difference**
- **Total**
- **Order**
- **Solution**

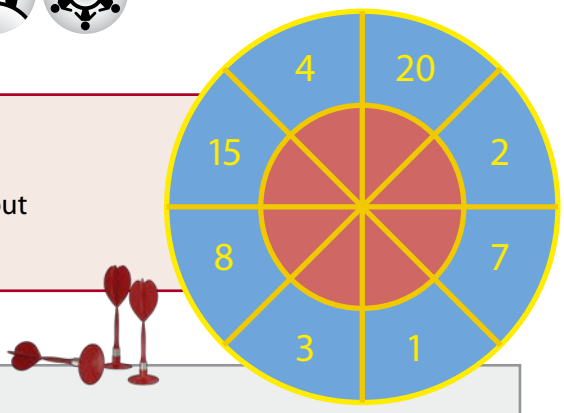
Activity 1

Double trouble

Activity 1 – Double trouble

Outline

In this Year 5 activity, learners use a simplified darts board to work out different number combinations.



You will need

Teachers' script

PowerPoint presentation

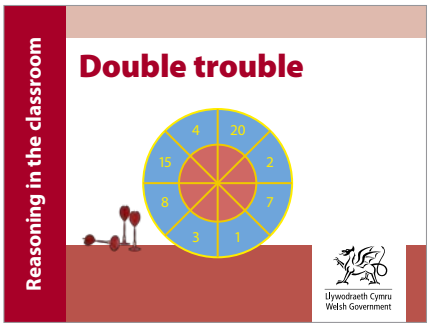
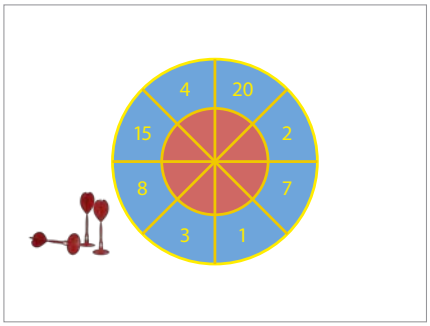
Double trouble questions
Two pages for each learner, can be printed double-sided

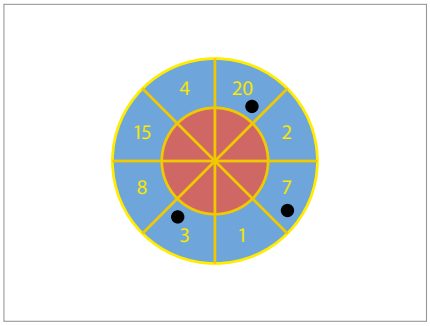
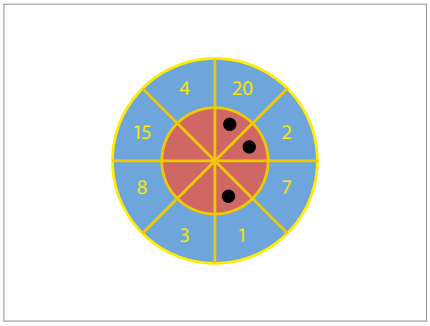
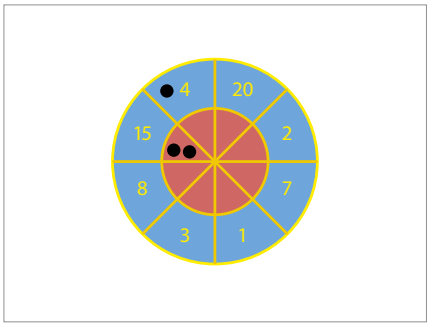
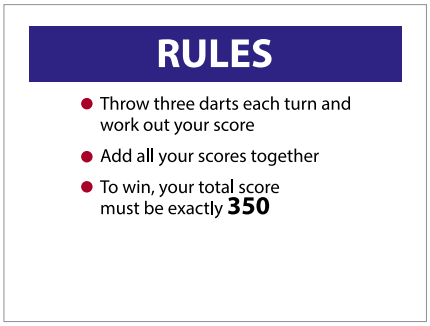
Markscheme

TS

Presentation to be shown to learners before they work on Double trouble

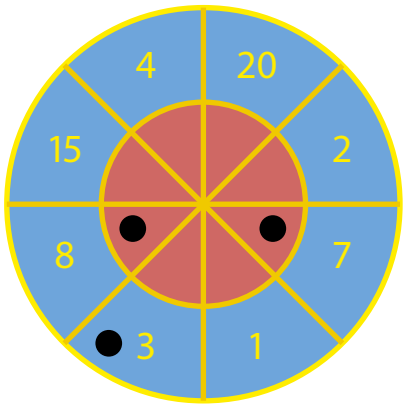
The text in the right-hand boxes (but not italics) should be read to learners. You can use your own words, or provide additional explanation of contexts, if necessary. However, if you are using this as an assessment item, no help must be given with the numeracy that is to be assessed.

Slide 1		*(Keep this slide on the screen until you are ready to start the presentation.)*
Slide 2		This is a group of Year 5 children working together. They are designing and making a game. Their game is called 'Double Trouble'. This is their version of a game called darts.
Slide 3		Have any of you seen a dartboard? Well, their board *(point)* is like a dartboard, but it's simpler so that children of all ages can play. To play the game you throw three darts at the board. If a dart lands in the blue part of the board *(point)* then you score that number. Let's look at an example . . .

Slide 4		The black circles show where the three darts landed. So this dart *(point)* scores 20. What do the other darts score? *(3 and 7)* So what is the total score for all three darts? That's right, it's 30 because 20 + 3 + 7 = 30 *(Note that for this and any other calculation in the script you may use the whiteboard.)* This red part *(point)* of the dartboard is special. If your dart lands in this red section, you score double the number.
Slide 5		So what does this dart *(point to 20)* score? That's right, it's in the red section so it scores 40 because double 20 is 40. What do the other darts score? Why? *(Double 2 is 4, double 1 is 2)* What's the score for all three darts? Good, it's 46 because double 20 + double 2 + double 1 = 46
Slide 6		With the person next to you, work out the score for these three darts. *(Encourage discussion, and agree that because double 15 appears twice, and there is a 4, the score for the three darts is 64)* As with any game, there are rules. So, let's look at the rules for the game of Double Trouble.
Slide 7		*(Read out the rules and then clarify the last rule by saying . . .)* To win, your total score must be exactly 350, not more, not less.

Slide 8		But . . . the children have made the game more difficult . . . you must finish the game with a double. Of course you can throw doubles with any of your darts; that way you score bigger numbers and get to 350 more quickly. But you must finish with a double. And that's why the game is called . . .
Slide 9		. . . Double Trouble! Now you are going to answer some questions about the game Double Trouble. 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.)*

Jen threw these three darts:

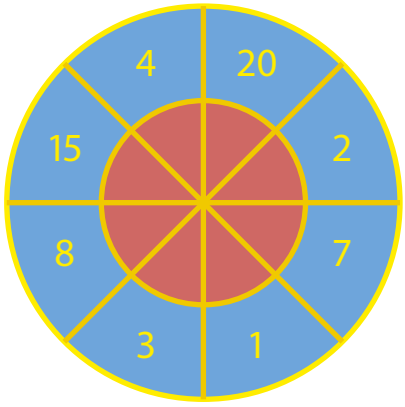


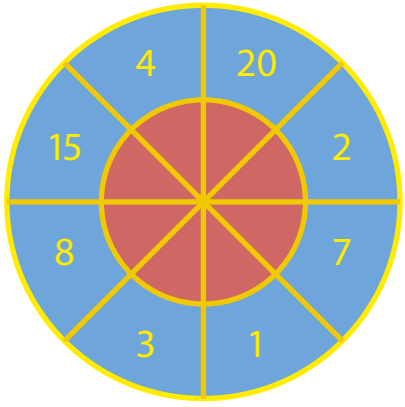
What did she score?

1m

On her next turn, she threw three darts and scored **100**

Show two **different** ways to score 100 with three darts.





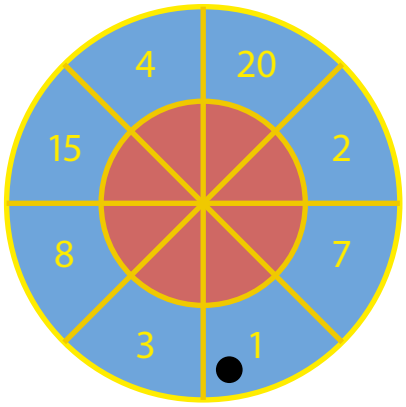
2m

Later, Jen's score is **338**

My score is **338**

To finish the game
I need exactly **350**

Her first dart scores **1**



Her third dart must be a double.

Write two **different** ways she can finish the game with exactly **350**

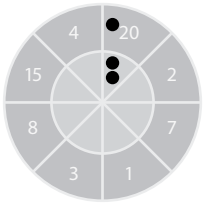
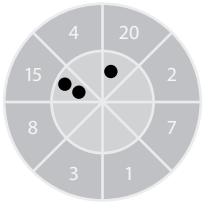
1st dart:	1	2nd dart:		3rd dart:	double

Or

1st dart:	1	2nd dart:		3rd dart:	double

2m

Activity 1 – Double trouble – Markscheme

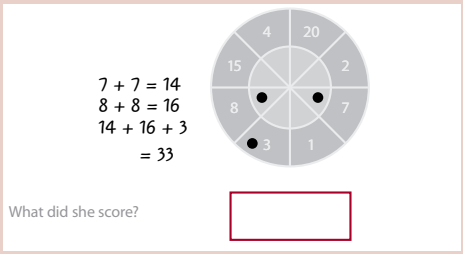
Q	Marks	Answer
i	1m	**33**
ii	2m	Shows both correct ways, in either order, i.e.  
	Or 1m	Shows one correct way
iii	2m	Shows both correct ways, in either order, i.e. **3**, double **4** **7**, double **2**
	Or 1m	Shows one correct way Or Shows any two of **8**, double **2** **4**, double **4** double **4**, double **2** double **3**, double **3** double **2**, double **4** Or Shows any two of **1**, double **5** **5**, double **3** **9**, double **1**

◀ **First dart ignored, so darts sum to 12**

◀ **Darts sum to 11 but uses numbers that are not on the board**

Activity 1 – Double trouble – Exemplars

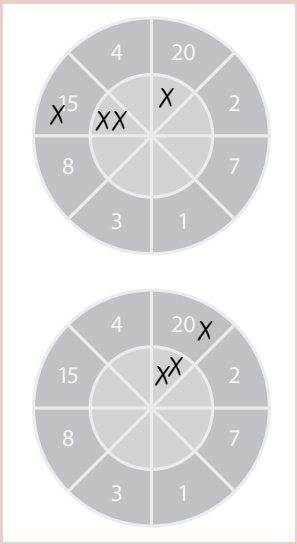
Part i



Correct; **1 mark**

- The answer is clearly shown in the working.

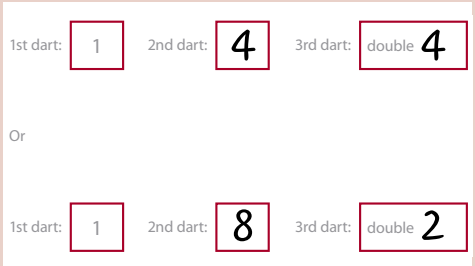
Part ii



One correct; **1 mark**

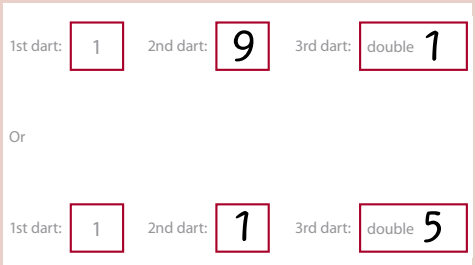
- The use of crosses is unambiguous but the first board shows 4 darts so must be incorrect.

Part iii



Both sets of darts sum to 12; **1 mark**

- This learner has ignored the first dart so has consistently given darts that sum to 12 rather than 11



Both sets of darts sum to 11; **1 mark**

- This response shows understanding but 9 and 5 are not on the board.

Activity 2

Double-double magic

Activity 2 – Double-double magic

Outline

In this Year 5 activity, learners use logic to solve a problem.
The context is the well-known clapping game, 'Double double'.

You will need

WB **Whiteboard – Double double**

WB **Whiteboard – Add them up**

Activity 2 – Double-double magic

Explain

'Double double this this, double double that that' is a well-known clapping game commonly played in playgrounds. It is a simple game that can be seen on www.youtube.com/watch?v=gWXNbleftRk or www.youtube.com/watch?v=g4ea2GmBqFo
Ask learners to demonstrate *(or do so yourself)*.

Explain that they are going to play 'Double double' but with numbers rather than claps. Show **Double double** on the whiteboard, replacing 'this' with '1' and 'that' with '2'. Make sure that learners understand that two 1's, for example, are read as 'eleven' not 'one, one'. Discuss the meaning of 'double double' *(double, then double again)*. Then ask them in their pairs to work out the total of all five lines. Show the solution in **Add them up**.

Next, ask what will happen if the numbers for 'this' and 'that' are reversed, so 'this' becomes 2 and 'that' becomes 1. Will the total still be 186? If not, what will it be? Tell learners you have double-double magical powers, so you know the answer! *(It is 222. Your magic power is the knowledge that the change is to the final line only – the 'double double this that' becomes 'double double that this'. The difference between reversed consecutive numbers is always 9, and as 9 × 4 = 36 you simply add 36 to 186 to get the new total, 222.)*

Write the total on a piece of paper and dramatically place it out of reach so you can produce it later to demonstrate your powers. Ask learners to work out the total for 2 and 1, then show your total.

Ask learners to choose any two consecutive digits, smaller first, and work out the total. When they tell you the total, you will use your magic powers to tell them the total when the digits are reversed. *(For example, if this = 5 and that = 6, the total is 730. When the digits are reversed, the new total will be 730 + 36 = 766.)* Repeat as many times as you wish.

When appropriate, tell them you are taking pity on them and will share your magic. Ask them to go back to their workings and look carefully at the difference between the totals for each pair of digits. Use the questions below as a guide. Once they understand, let them use their 'magic' by working with another pair, and then perhaps at home to impress their friends and families!

Question

- Is there a quicker way of working out 'double double' than multiplying by two and then multiplying by two again? *(Multiply by four.)*
- When you are working out the totals for the reversed digits, do you need to work everything out from the beginning again? Why not? *(Only the last line changes.)*
- Look at the totals for each pair of digits. What is the difference between the totals for this pair? What about this pair? Or this pair? What do you notice? How does that explain my magic?
- I asked you to use two consecutive digits, smaller first. If you used the bigger first what would I need to do to find the new total when the digits were reversed? *(Subtract 36.)*

Extension

- What if the digits are not consecutive, e.g. 5 and 7? What rules can you find for their totals?

Let's change **'this'** to the digit **1**

Let's change **'that'** to the digit **2**

Double double **this this**.
Double double **that that**.
Double **this**.
Double **that**.
Double double **this that**.

→

Double double **11**
Double double **22**
Double **1**
Double **2**
Double double **12**

Work them out
then find their total.

Double double 11	=	2 × 2 × 11	=	44
Double double 22	=	2 × 2 × 22	=	88
Double 1			=	2
Double 2			=	4
Double double 12	=	2 × 2 × 12	=	48
			Total	**186**

Activity 3

Poor Alice

Activity 3 – Poor Alice

or

Outline

This Year 5 activity is based on *Alice in Wonderland*. Learners explore the growth of an item when the amount it grows doubles each day.

This activity could readily be extended into a cross-curricular exercise involving creative writing and/or drama.

You will need

WB **Whiteboard – Poor Alice**

T **Teachers' sheet – Cards (sheet 1 and sheet 2)**

R **Resource sheet – Which one?**
One sheet per group/pair

Activity 3 – Poor Alice

Explain

In *Alice in Wonderland*, Alice drinks potions that make her shrink, then grow. Learners are going to investigate this growing potion. Show **Poor Alice** on the whiteboard. Explain that each day the amount she grows doubles. Go through Alice's changes of height on the whiteboard, writing the relevant heights in the boxes. Then ask how tall she would be on day 7 *(780cm – more than five times her original height)*. And on day 8? *(1420cm – more than half the length of most swimming pools)* Poor Alice!

Tell learners that they are going to investigate how other things are affected by the growing potion *(doubling the rate of growth each day)*. In their groups, they choose one card from the teachers' sheet **Cards** which gives information about their item. *(Or allocate according to ability.)* They are going to create a puzzle for other groups to solve.

On their copy of the resource sheet **Which one?** learners insert the information from their card. They create their puzzle by inserting a day they have chosen and three possible answers A, B, and C, only one of which is correct. Groups then swap puzzles, deciding which of A, B and C is the correct answer. Encourage discussion and debate about learners' decisions on which one is correct: explaining their choices is an essential element of numerical reasoning.

Ask learners to record their work, to create a display for the classroom. The activity can be extended through creative writing or a drama exercise explaining how their item came to grow and what happened next.

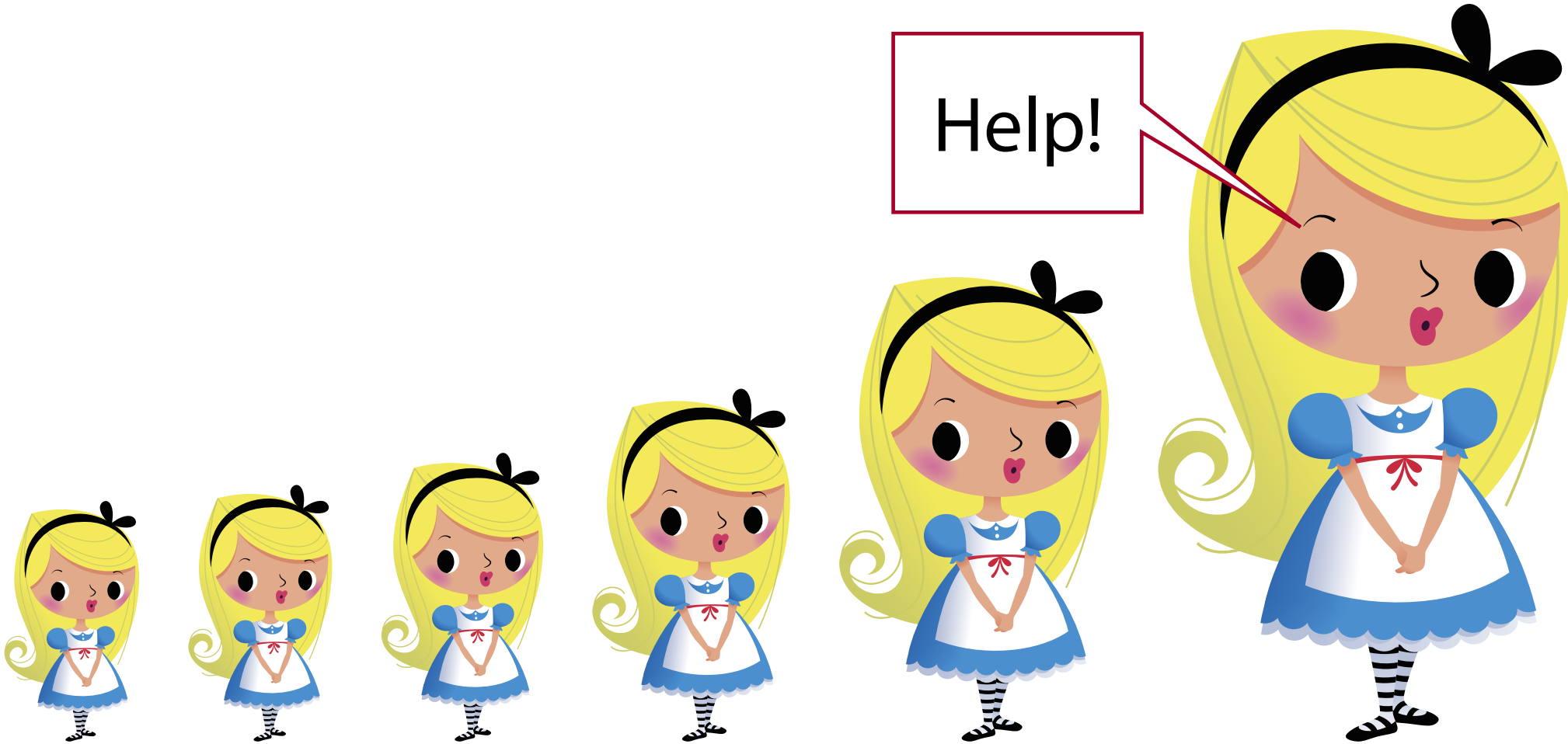
Question

- How confident are you about how your item grows? What number of days are you going to use in your puzzle? Why?
- How are you going to record your work so it makes sense to someone else – and to you?
- How do you know your solution is correct? Have you checked your work? How? Could you use different units? *(For example, kg instead of g)*
- Which other two 'answers' are you going to include? Why have you chosen them?
- *(When solving other groups' puzzles)* Why have you chosen this solution? What did you talk about to arrive at that decision? Did working on your own puzzle help? How?
- What would your item look like if it grew to the size in your puzzle? What could you compare it to so that others could understand how big it would be on day . . . ?
- What would happen if it kept growing like this? *(It would get incredibly big – learners can investigate using a spreadsheet.)*
- If Alice drinks a shrinking potion, and her size halves each day, will she disappear altogether? *(She will get very, very small indeed, but will never disappear entirely as half of x, however small x may be, will always exist. She will, however, be so tiny that no one could see her.)*

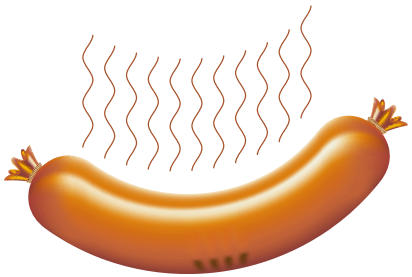
Extension

- The Tower, Meridian Quay in Swansea is the tallest building in Wales at 107m. If Alice continued to grow at the same rate, when would she be taller? *(Day 12 – she would then stand over 200m tall.)*

WB


Help!
Day 1
150cm
Day 2
160cm
Day 3
cm
Day 4
cm
Day 5
cm
Day 6
cm
+ 10cm
+ 20cm
+ 40cm
+ ___ cm
+ ___ cm

Prepare these cards in advance of the activity. Laminating would improve durability. One card for each group/pair.

 **A slimy worm** Length on day 1, 20cm Length on day 2, 25cm	 **A teacher** Weight on day 1, 60kg Weight on day 2, 70kg	 **An ice lolly** Weight on day 1, 16g Weight on day 2, 30g
 **A baby boy** Height on day 1, 50cm Height on day 2, 60cm	 **A smelly sausage** Length on day 1, 15cm Length on day 2, 29cm	 **A cuddly rabbit** Weight on day 1, 2kg Weight on day 2, $2\frac{1}{4}$kg

Prepare these cards in advance of the activity. Laminating would improve durability. One card for each group/pair.

 **Your nose** Length on day 1, 5cm Length on day 2, 8cm	 **A hairy spider** Height on day 1, 5mm Height on day 2, 1cm	 **A precious jewel** Weight on day 1, 3g Weight on day 2, 5kg
 **A flea** Length on day 1, 5mm Length on day 2, 1.1cm	 **A bar of chocolate** Weight on day 1, 45g Weight on day 2, 60g	 **Your tongue** Length on day 1, 7cm Length on day 2, 12cm

We gave the magic potion to

It measured

on day 1 and

on day 2

On day

was it

A?

B?

C?