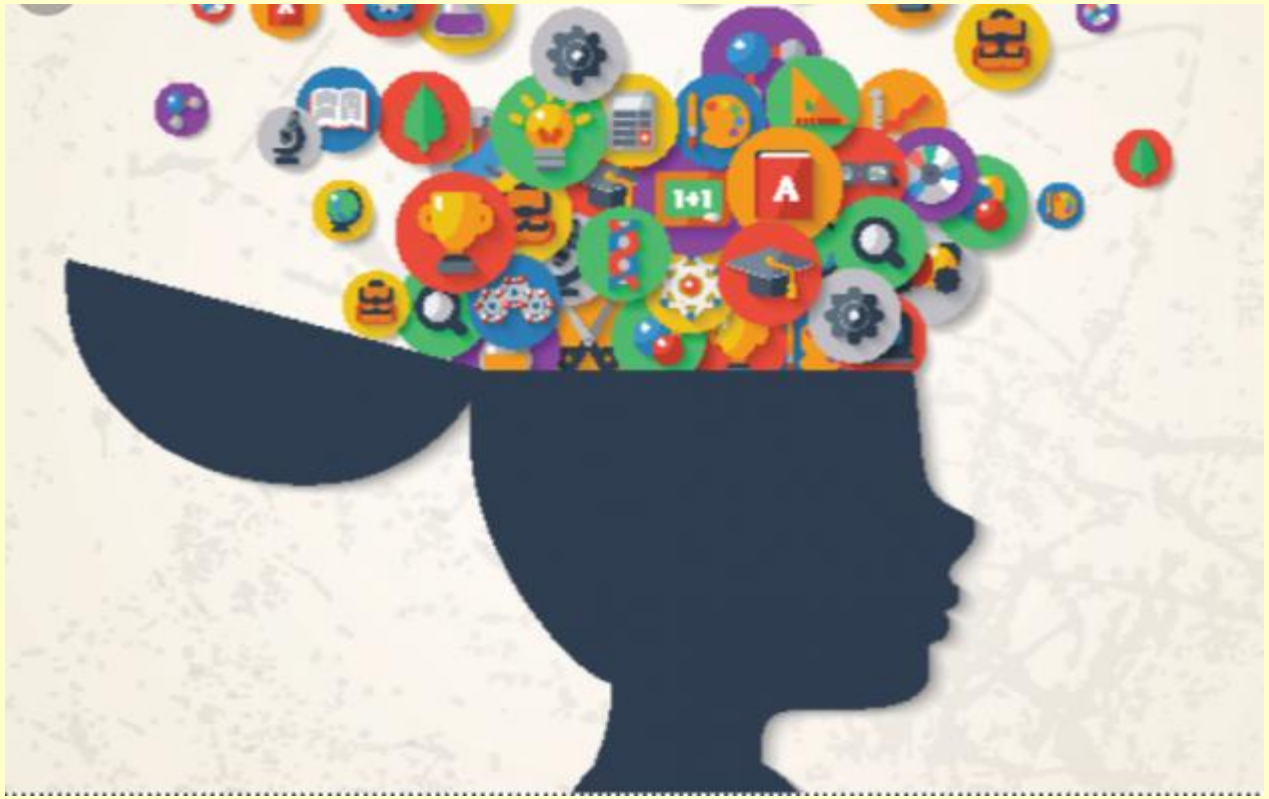
Meeting the needs of all learners.

Jasmin Taylor
Mastery Specialist



Aim of workshop

To look at how TfM approaches can meet the needs of all learners through effective differentiation of learning.

(Differentiation is not by task - including low threshold high ceiling problem solving).

Teaching for Mastery

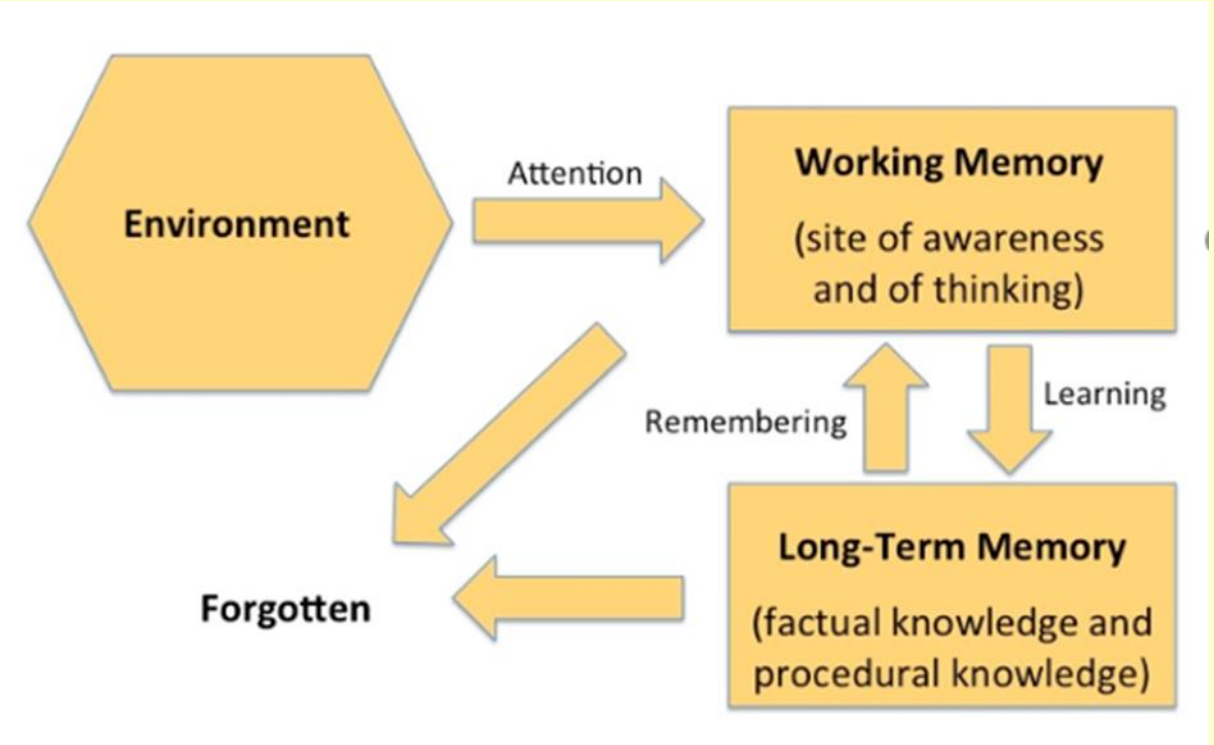
The belief that all pupils can achieve
Keeping the class working together so that all can access and master mathematics
Development of deep mathematical understanding
Development of both factual/procedural and conceptual fluency
Discussion – the answer is only the beginning
Ping-Pong style – small steps providing sufficient scaffold for all pupils to access
Repetition and chorusing
Sharing and analysis
Attention to mathematical relationships
Precision in the use of mathematical language and speaking in full sentences
Carefully chosen examples and representations to draw out the structure and essence of the concept
Reviewing material
Intelligent practice
Challenge question(s)

What is learning?

Learning is the bringing about of some changes in the long-term memory.

MEMORY

Memory is the remnants of our thoughts



A simple model for how memory works is based on the concept of building schemata in our long-term memory.

The concept of understanding is really memory in disguise. New information is only stored if we can connect it to knowledge that we already have. Prior knowledge is a major factor in our capacity to learn new information. The more complex and interconnected our schemes are, the easier it is to make sense of related information.

Read these letters and try to remember them.

XBB

CCI

AIT

VFB

ISA

SMF

IX

It’s quite tricky. This list is new, so the working memory struggles to cope.

Read these letters again.

However, if something is already embedded in the long-term memory, we are able to draw upon already-leant knowledge. So if we can shine the new idea from the perspective of established knowledge, this means we have far less demands on the working memory.

X

BBC

CIA

ITV

FBI

SAS

MFI

X

Present new material using small steps

- Present new material in small steps with students practice after each step.
- Limit the amount of material students receive at one time.
- Give clear and detailed instructions and explanations.
- Think aloud and model steps.
- Use more time to provide explanations.
- Provide many examples.
- Re-teach materials where necessary.

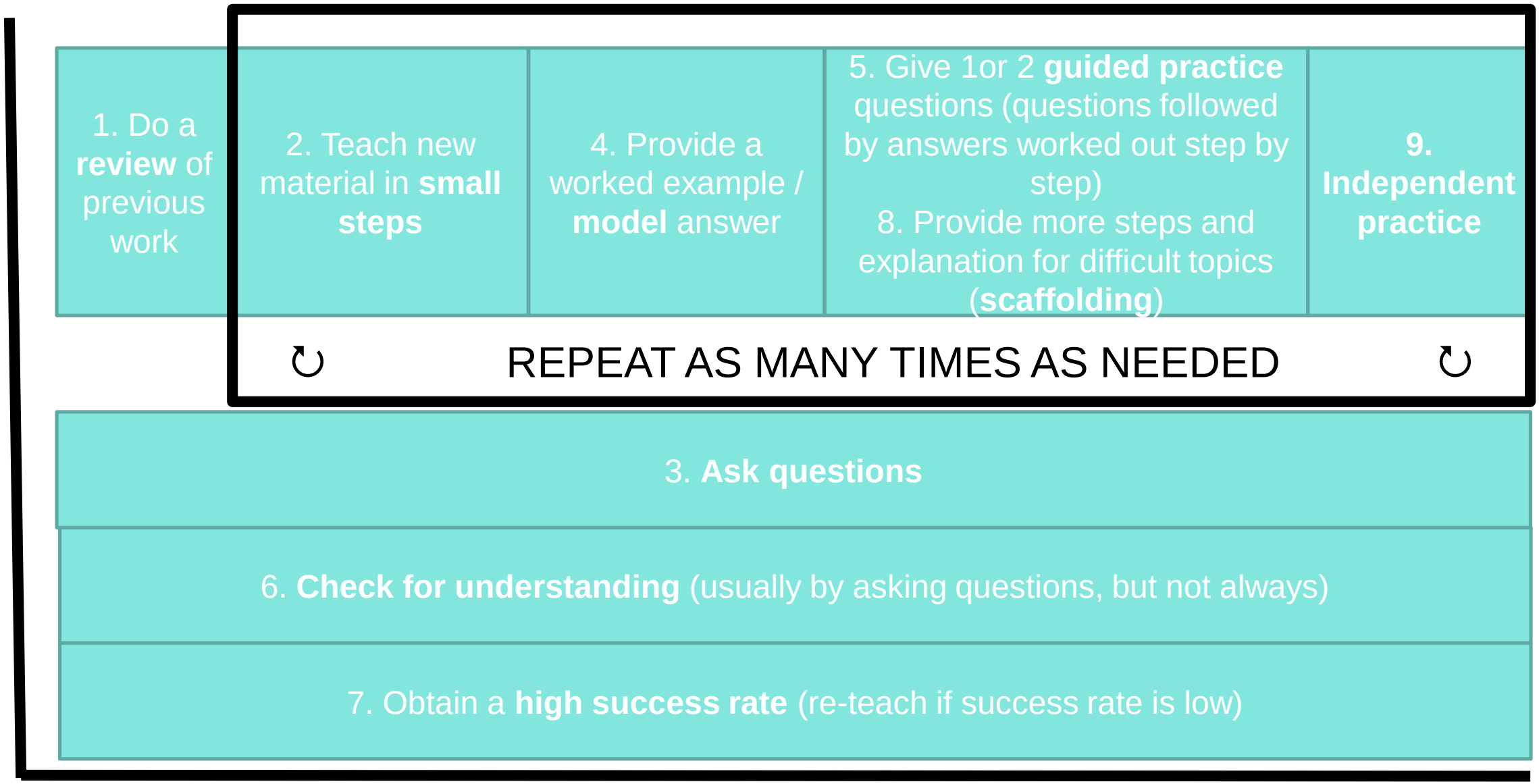
As teachers, we will be more successful if we recognise the limitations of working memory and succeed in breaking down concepts and procedures into small steps. Then ensure that pupils have the opportunity to practice each steps. The modelling and scaffolding that accompany this phase of the lesson all roll into one part of the process of explaining, providing well-structures support for pupils as they build their schemata for new concepts.

The purpose of daily review is to ensure a small step from prior knowledge to new knowledge.

Reviewing material

Pupils need to be involved in extensive practice in order to develop well-connected networks of ideas (schemas) in their long-term memory. The more one rehearses and reviews information, the stronger the interconnections between the materials become. Review also helps pupils develop their new knowledge into patterns and helps them to acquire the ability of past learning automatically. The best way to become an expert is through practice, and being an expert means the working memory is free to pay attention to new details.

Lesson structure:



Subtraction – year 2

Review:

17 - 7 =

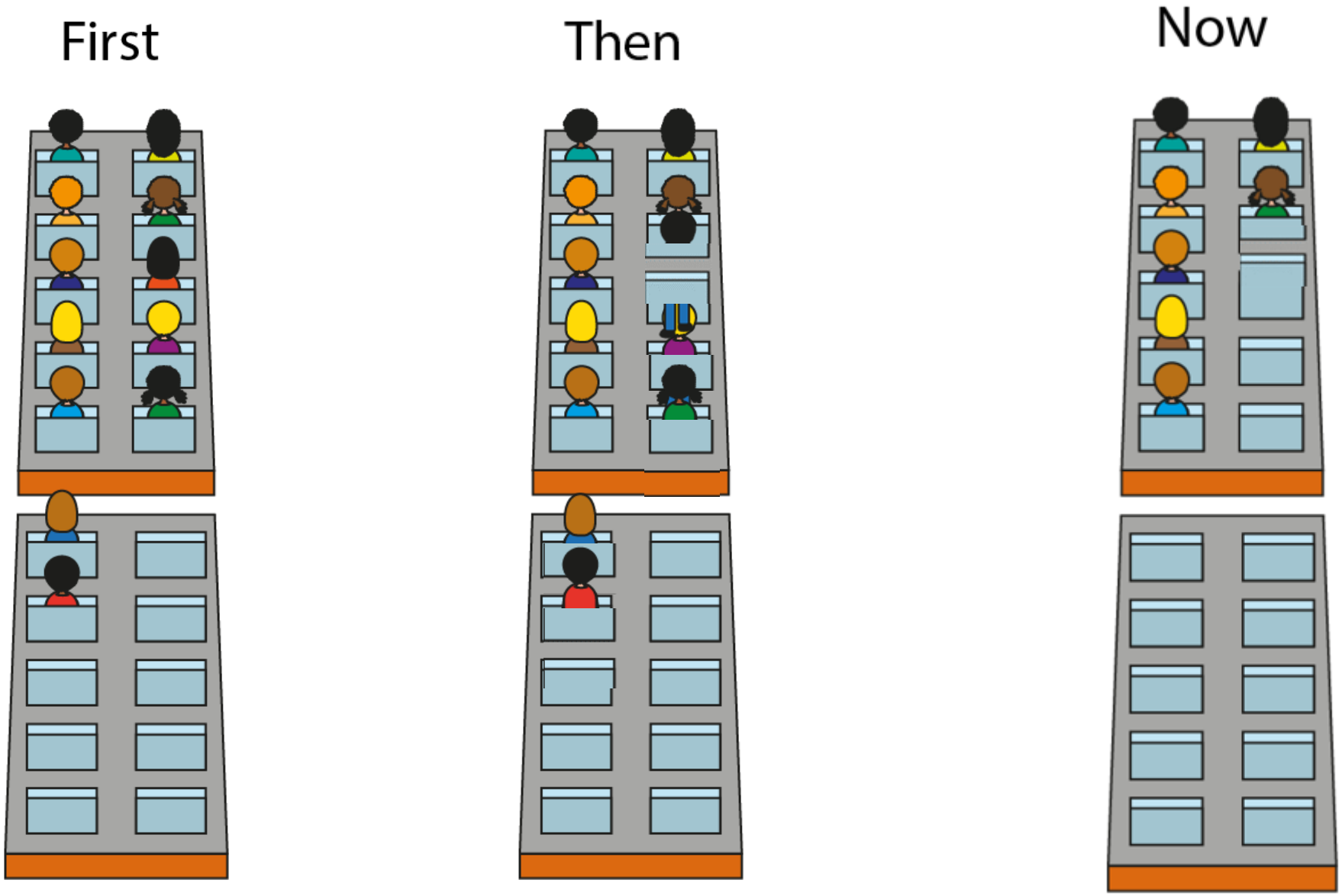
14 - 4 =

16 - 6 =

19 - 9 =

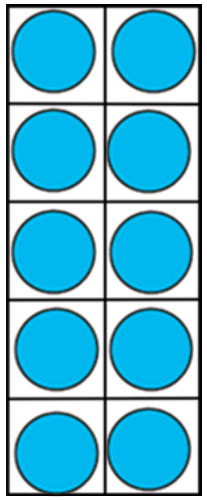
What do you notice?

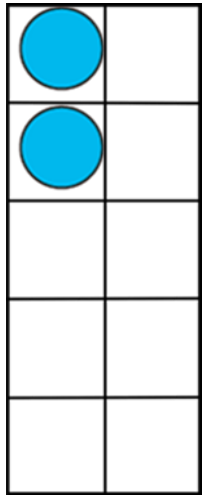
First there were 12 children on a ride. Then 5 children got off. Now there are 7 children.

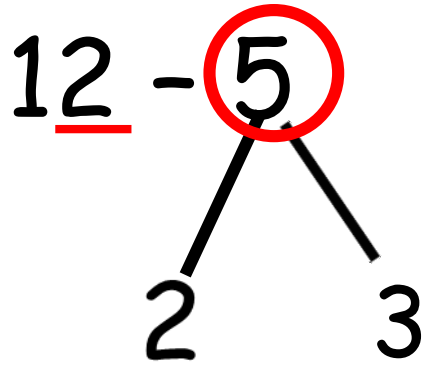


First there were 12 children on a ride. Then 5 children got off. Now there are 7 children. What is the number sentence?

$12 - 5 = 7$







We can make ten first.

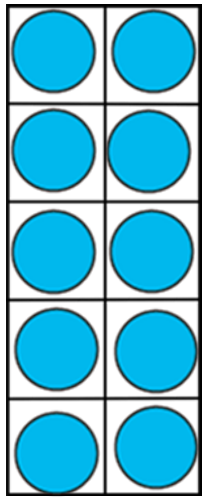
Split 5 into 2 and 3.

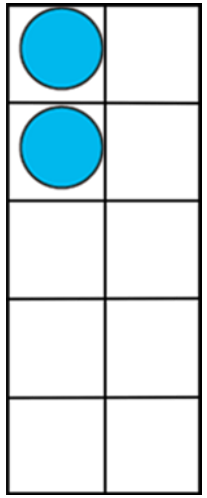
$12 - 2 = 10$

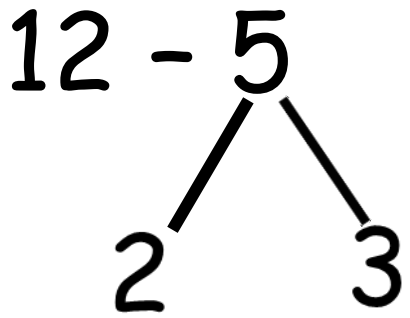
$10 - 3 = 7$

Use the number line to calculate.

$12 - 5 = 7$

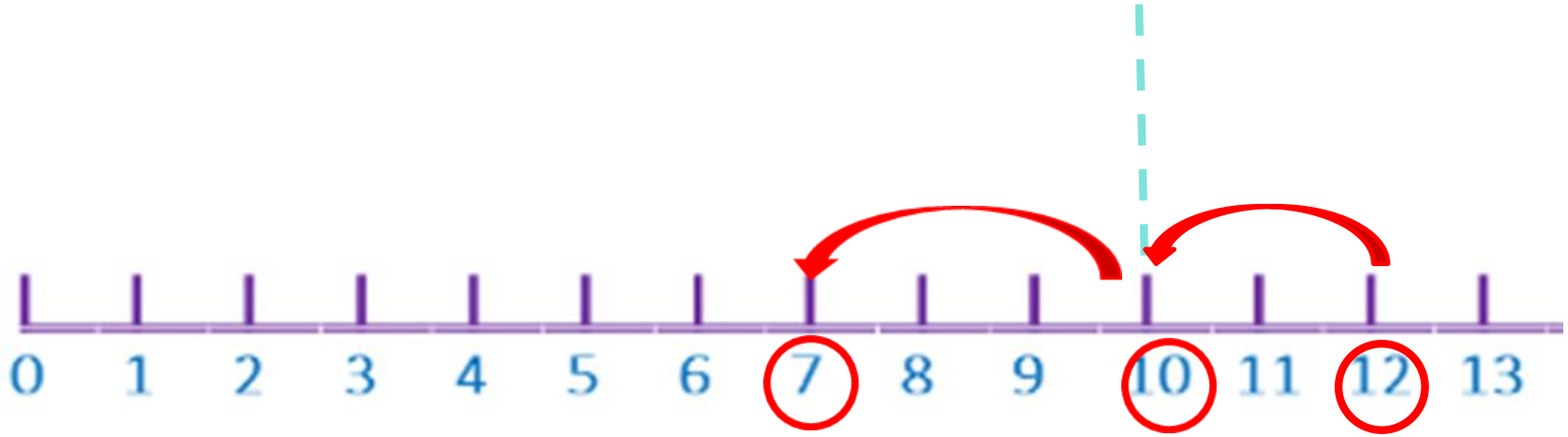




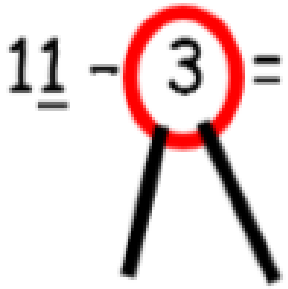


We can make ten first.

Step 1: Split 5 in to __ and __
Step 2: 12 - 2 = 10
Step 3: 10 - 3 = 7

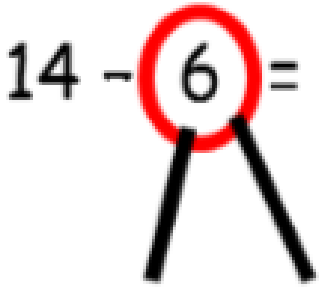


Guided practice: use the ten frames. Look carefully because some of the working out has been done for you.



11 - ___ = 10

10 - ___= ___



14 - ___ = 10

10 - ___= ___

Challenge 1: Use the ten frame.
Record the number sentences into your book. Look at the example. Make sure you show all 3 steps!

16 - 7 =

16 - __ = 10

10 - __ = __

13 - 6 =

15 - 8 =

Example:
13 - 5 =

3 2

We can make ten first.

13 - =
10 - =

Challenge 2: Show the number sentences and record all the steps.

Tom had 16 cakes. He gave 9 away. How many does he have now?

Katie had 13 sweets. She gave 8 to her friend. How many does she have now?

It takes Phil 13 minutes to walk to school. He has already walked 7 minutes. How many more minutes will it take him to get to school?

Challenge 3: can you find different ways to calculate?

16-9= 7

MathsHUBS SHaW

Challenge 3: Fill in the missing numbers. Use what you have just learned about splitting the number.

'Fill in the missing numbers.'

$13 - 3 - 4 = 10 - \square$

$12 - 2 - \square = 12 - 7$

$16 = 3 + \square + 6$

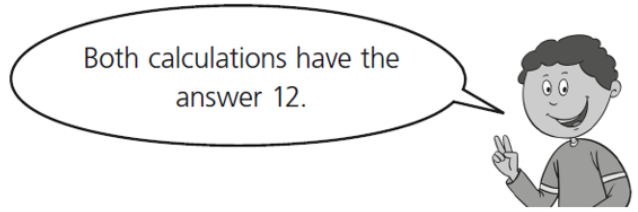
Challenge 4: Write as many addition and subtraction calculations with the answer 12

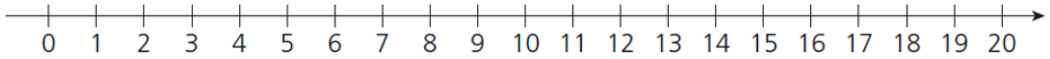
Toby uses a number line to work out:

10 + 2 =

and

15 – 3 =





Start at 20. Write a calculation with the answer 12. 20 – ☐ = 12

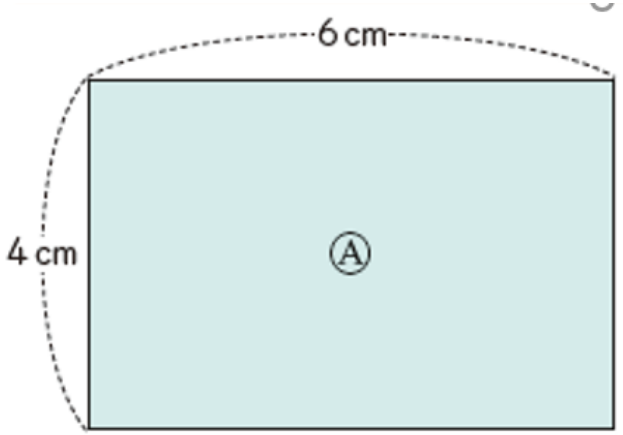
Start at 4. Write a calculation with the answer 12. 4 + ☐ = 12

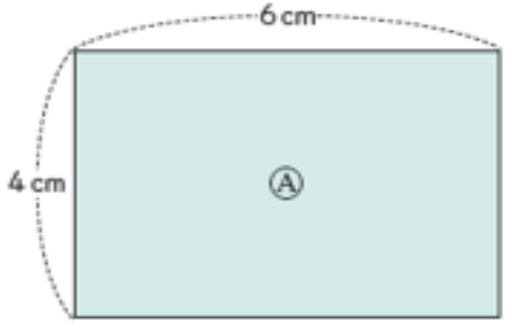
Write as many calculations as you can with the answer 12.

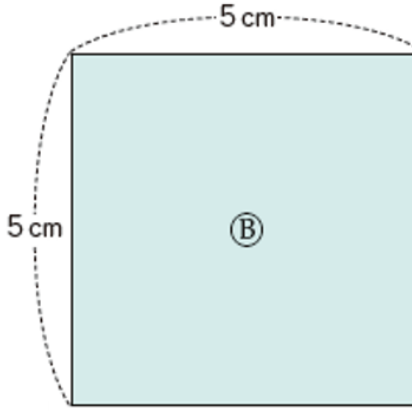
Investigating area

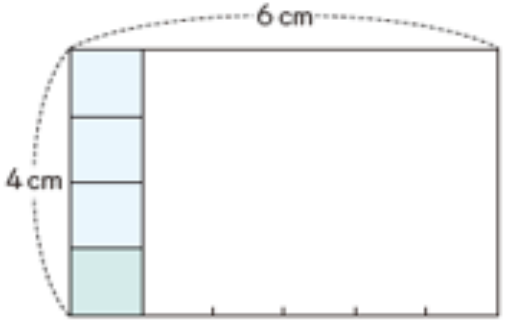
Year 5

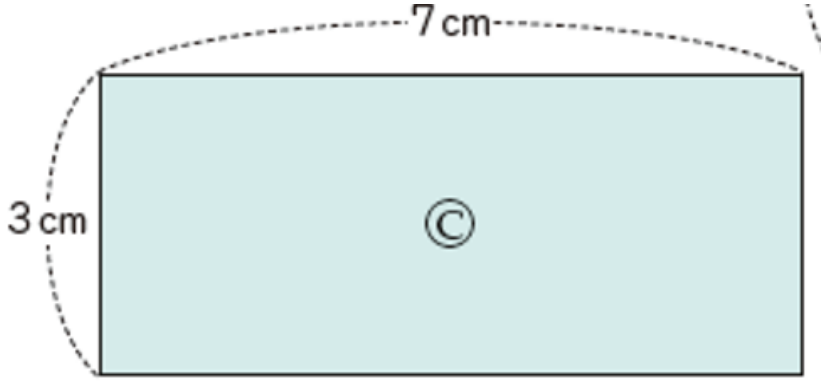
Review: think, pair, share about how to find the area of the square and rectangles below.

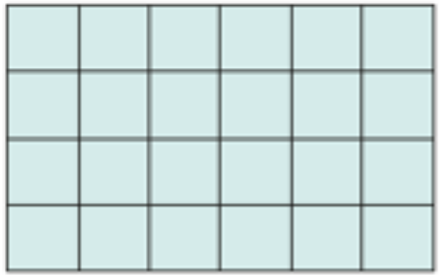












F

F
i
I
y
so far that you can use?

Write down your ideas. Make sure other people can understand them.

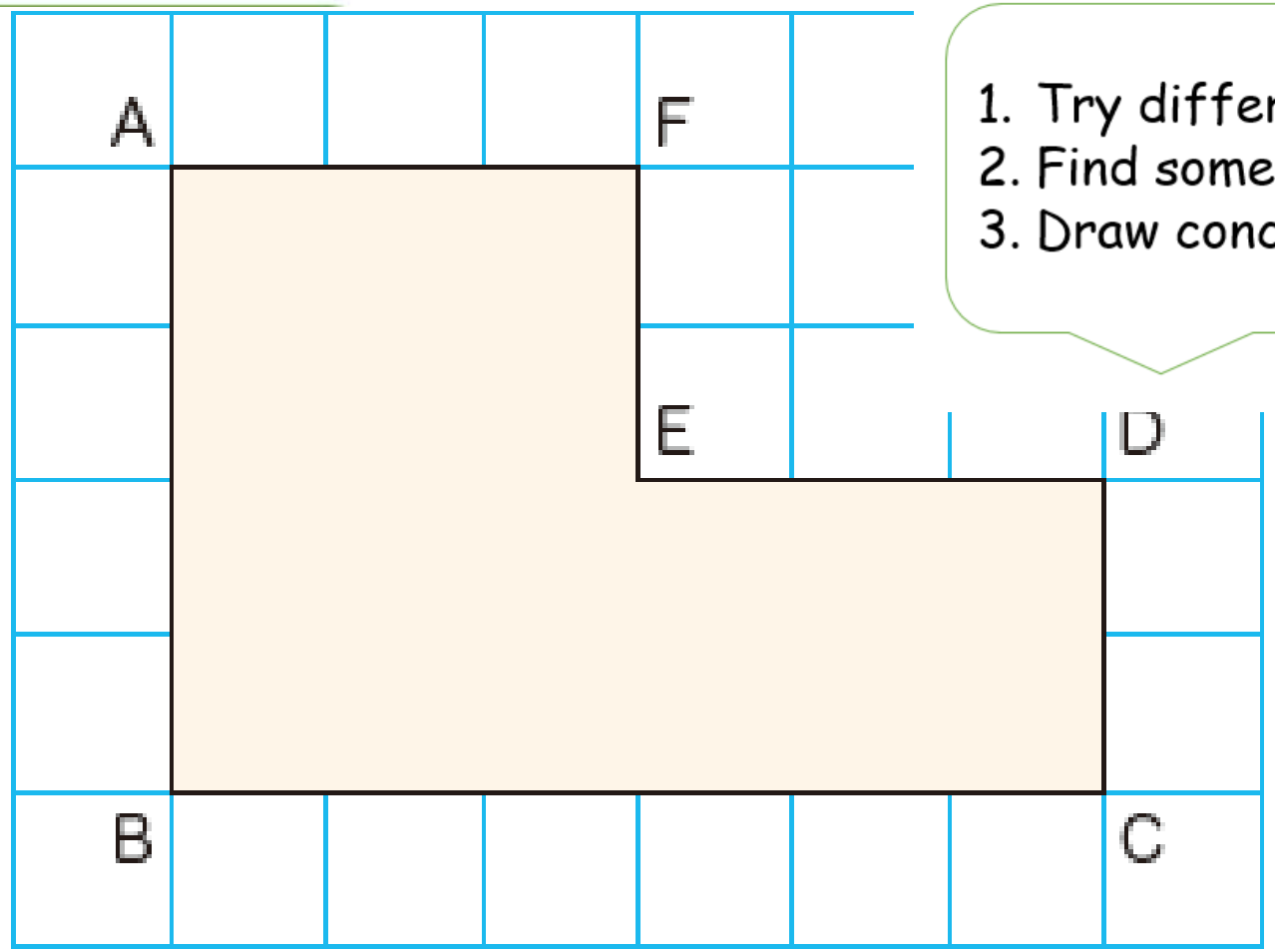
If you find one way, try and find another way. Make sure you use maths sentences.

Kátie

If the shape is a rectangle or a square, we studied how to calculate its area, so ...

how we
area of
?

1 cm



1. Try different methods.
2. Find some answers.
3. Draw conclusions.

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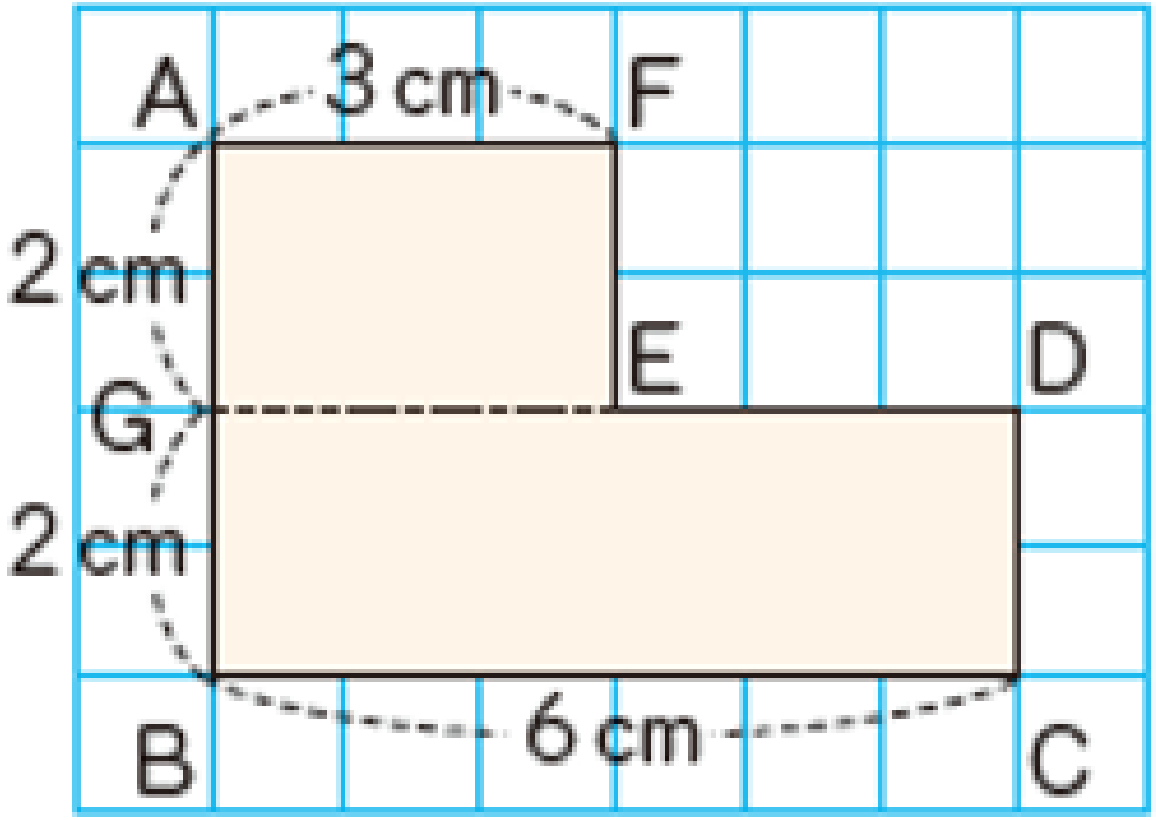
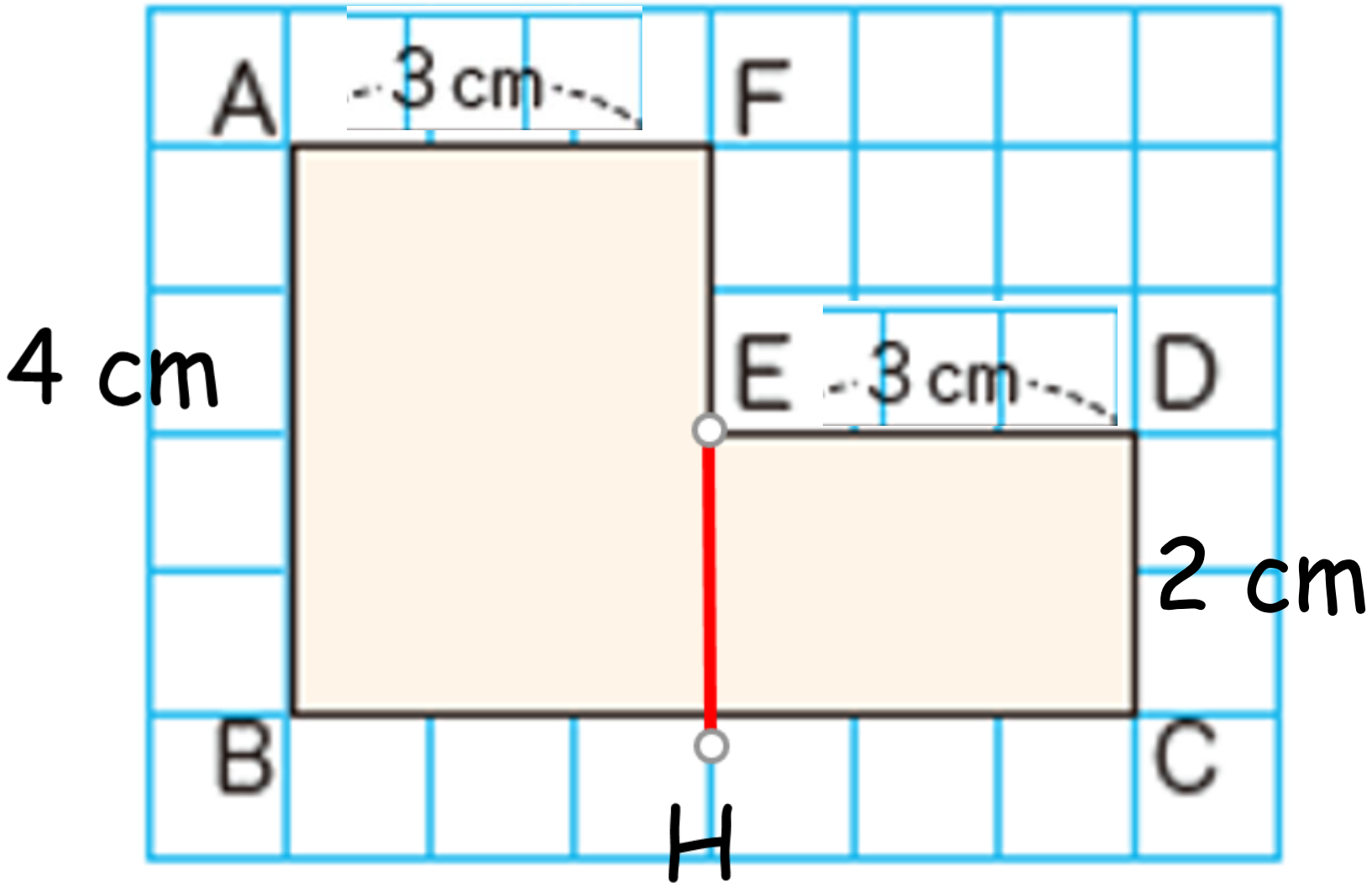
Look at Sally's methods. She is using the segment that connects G and E



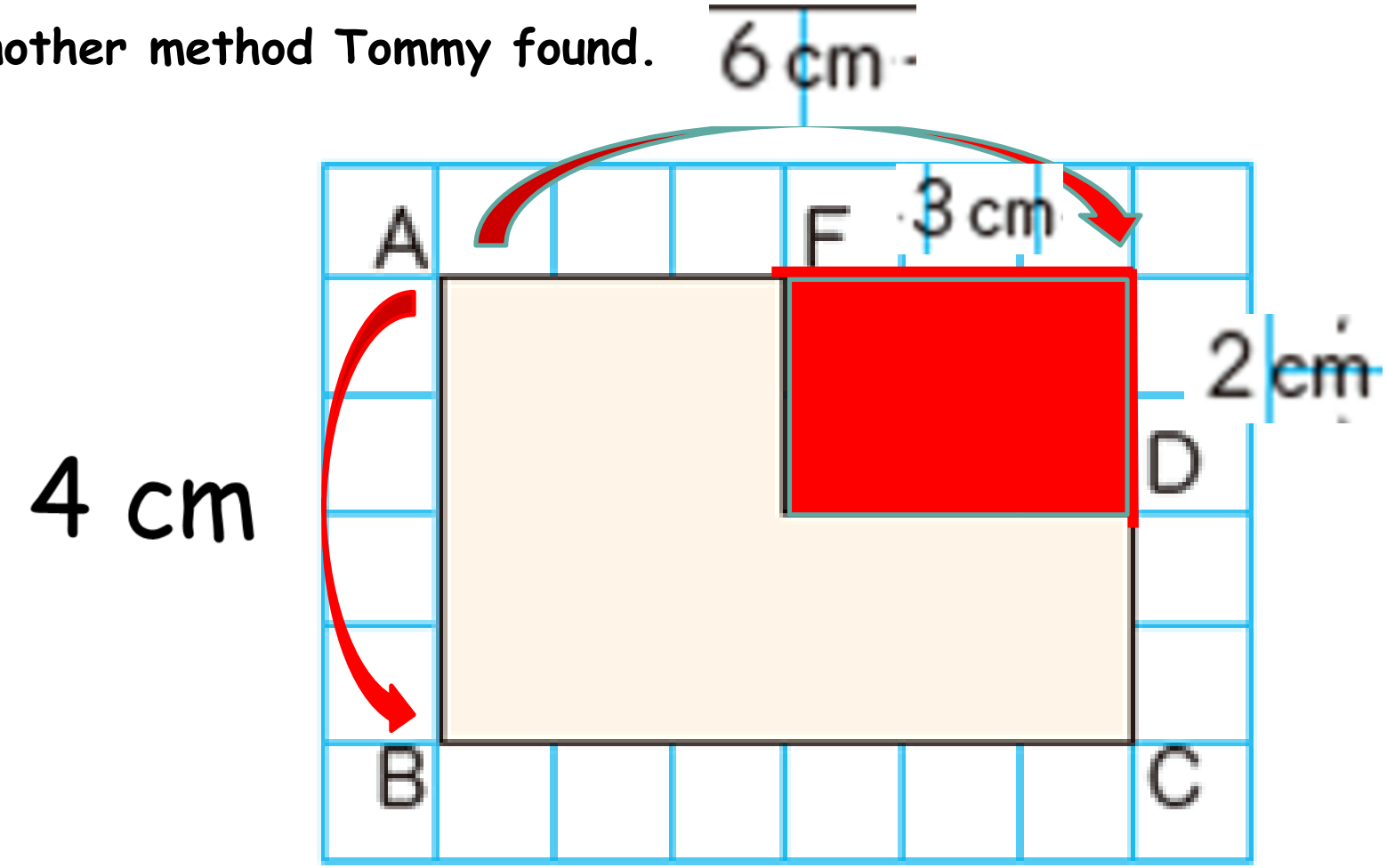
Did your group use this method
If so, what does your maths sentences look like?
If not, look at what Sally drew and write down her ideas using number sentences.

Let's look at Tommy's method. I think he joined segments E to H



Did your group use this method?
If so, what do your number sentences look like?
If not, look at what Sally drew and write down her ideas using number sentences.

Look at another method Tommy found.



$$4 \times 6 - 2 \times 3 = 24 - 6$$

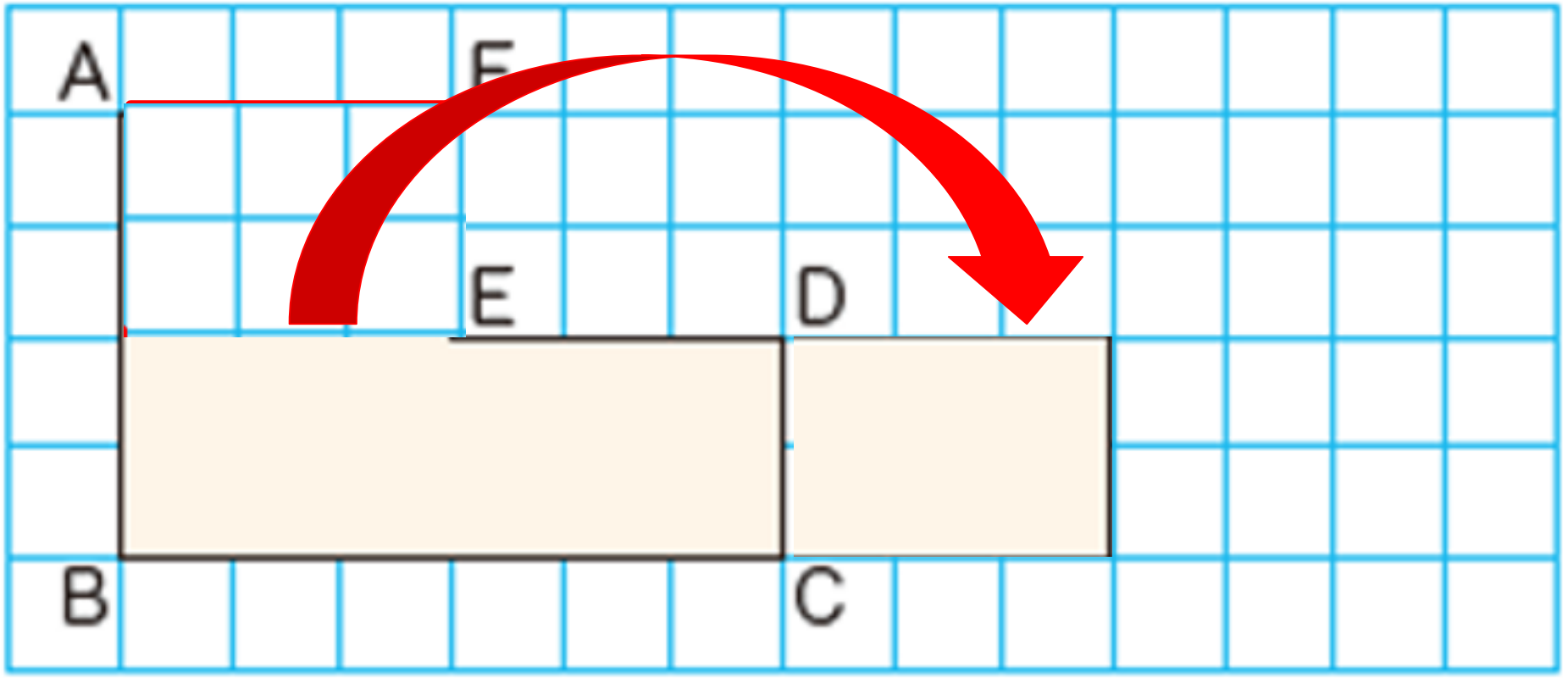
$$= 18$$

Answer $18 cm^2$

Look at the number sentences Tommy wrote and explain how he thought about the problem.

Hint: Write down the lengths of the segments and draw in additional segments in the figure above.

Tommy has also found another way.



What idea is common with these methods?

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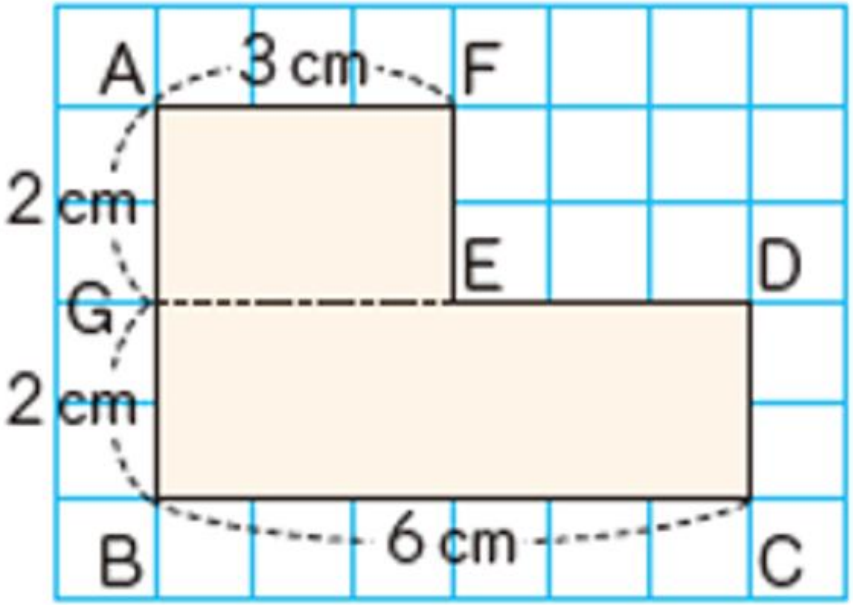
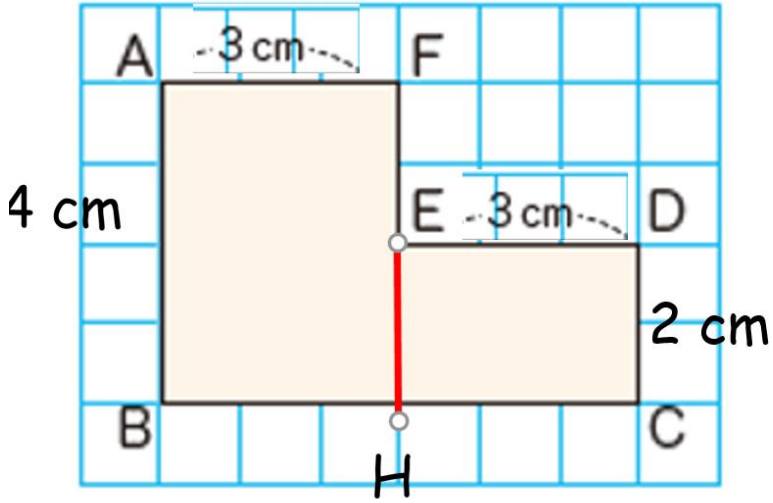
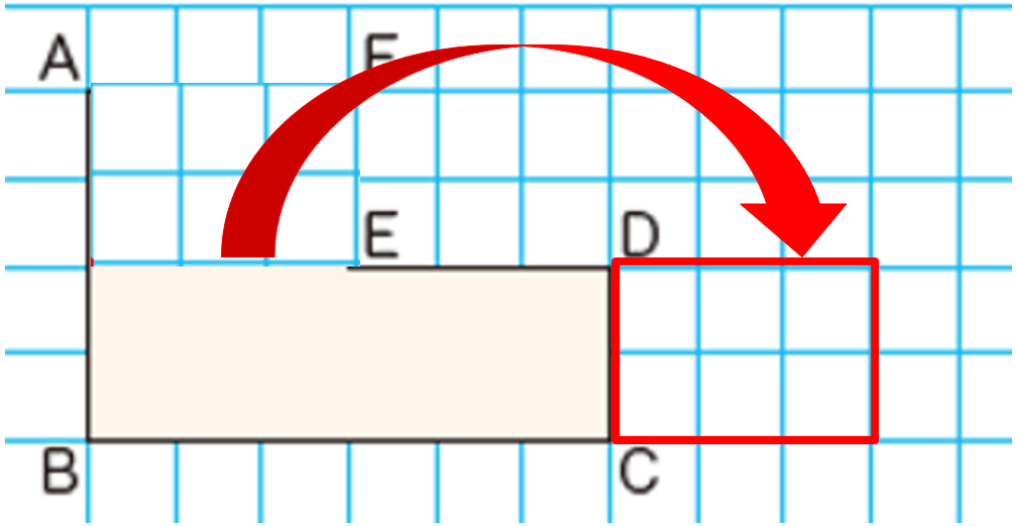
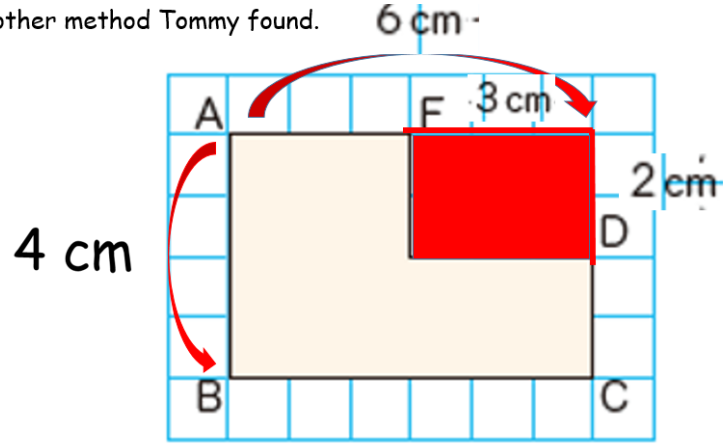


All of them changed the shape into rectangles.





ok at another method Tommy found.

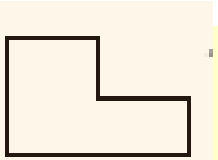


$4 \times 6 - 2 \times 3 = 24 - 6$

$= 18$

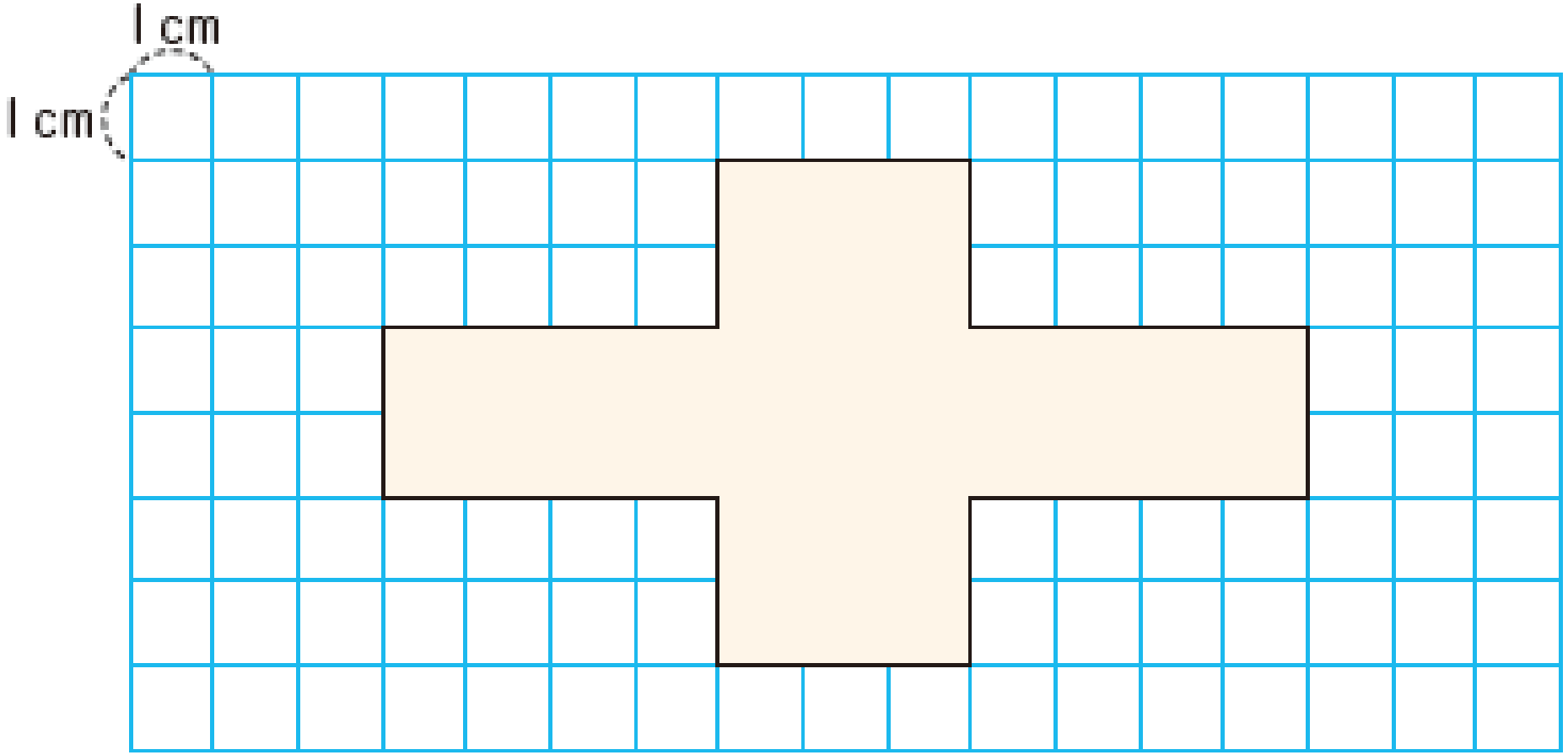
Answer $18 cm^2$

In talk partners summarise what you have just learned.

We can calculate the area of the shapes like  by making use of rectangles and squares.

We need to use what we have learned so far.

Calculate the area of the shape below in many different ways. Use what you have learned.



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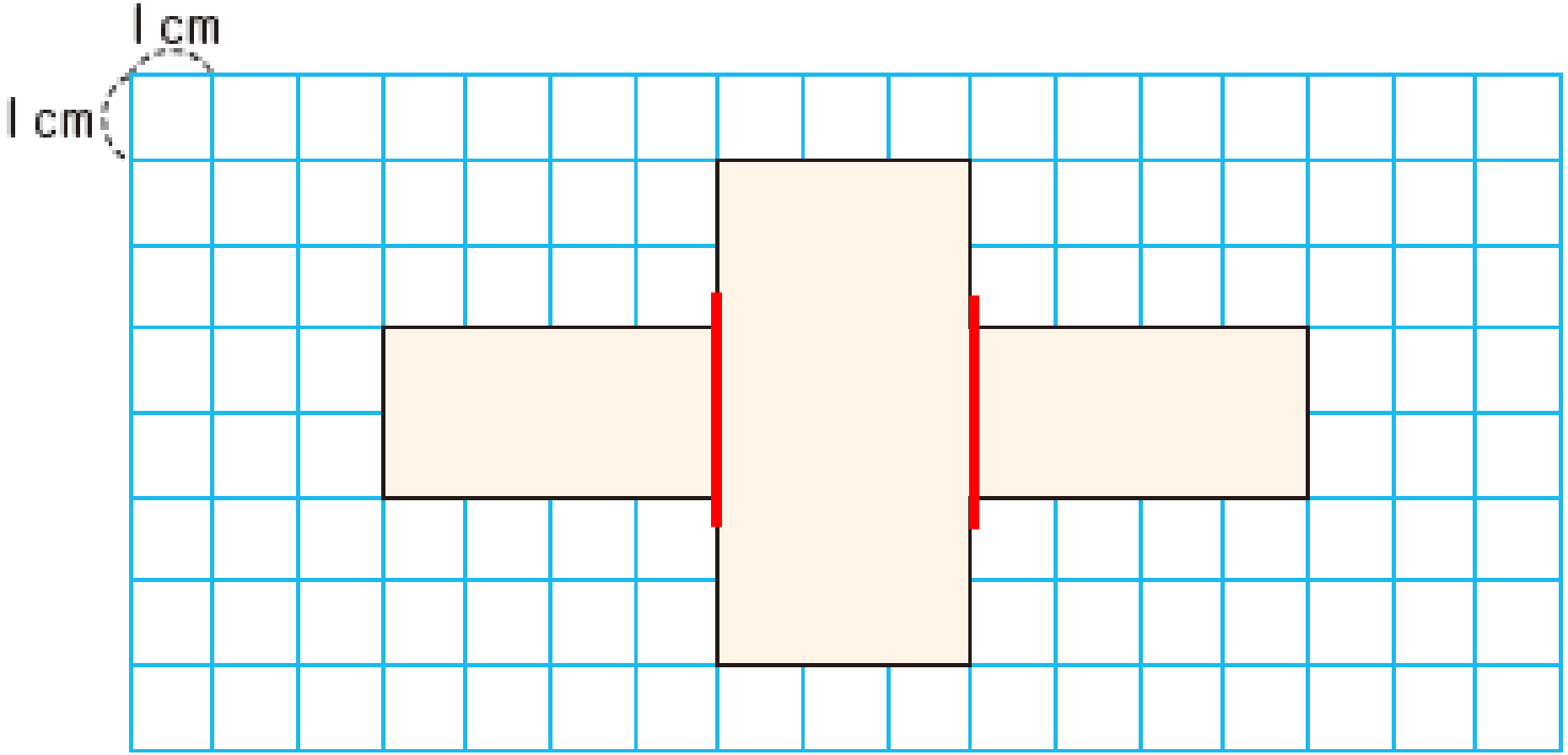

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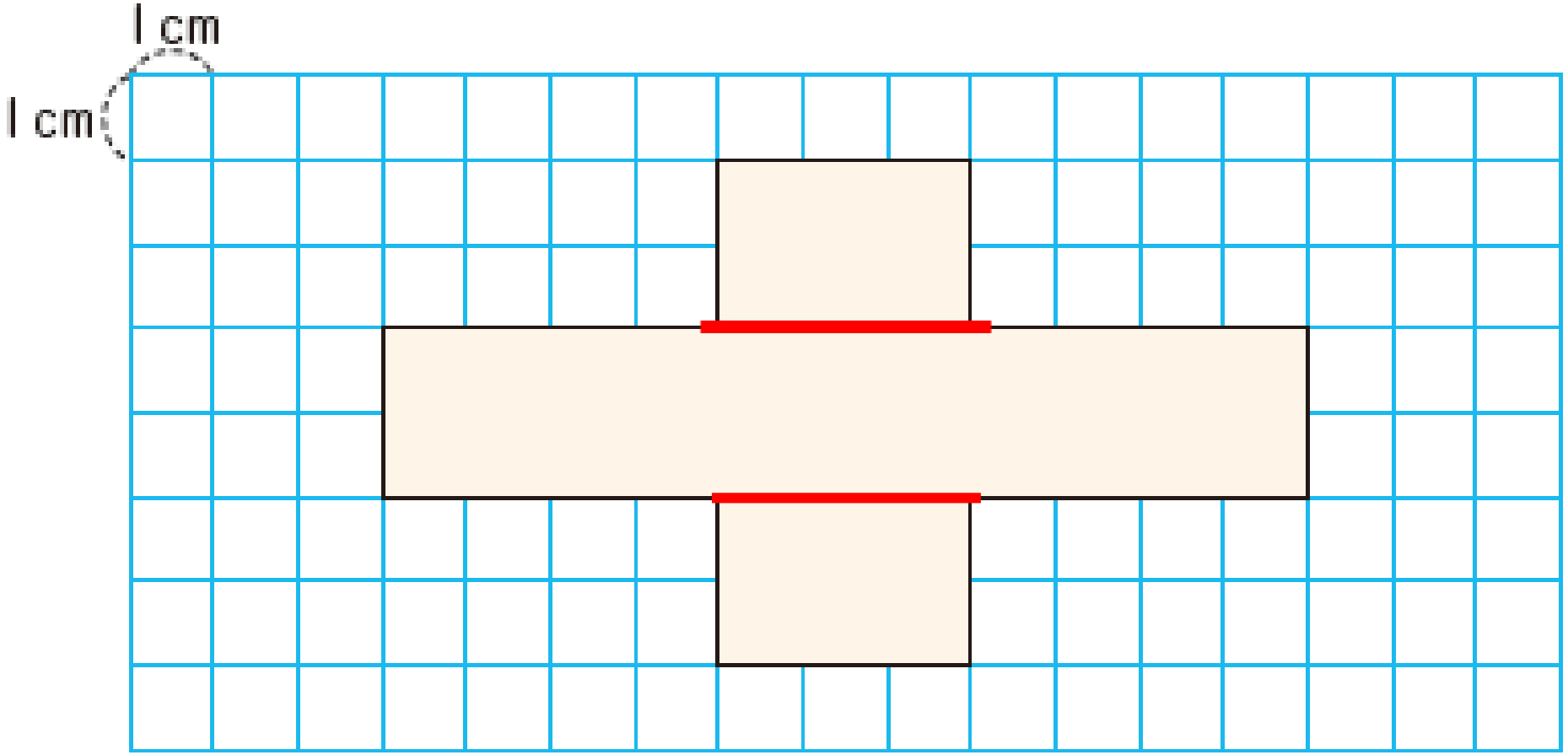

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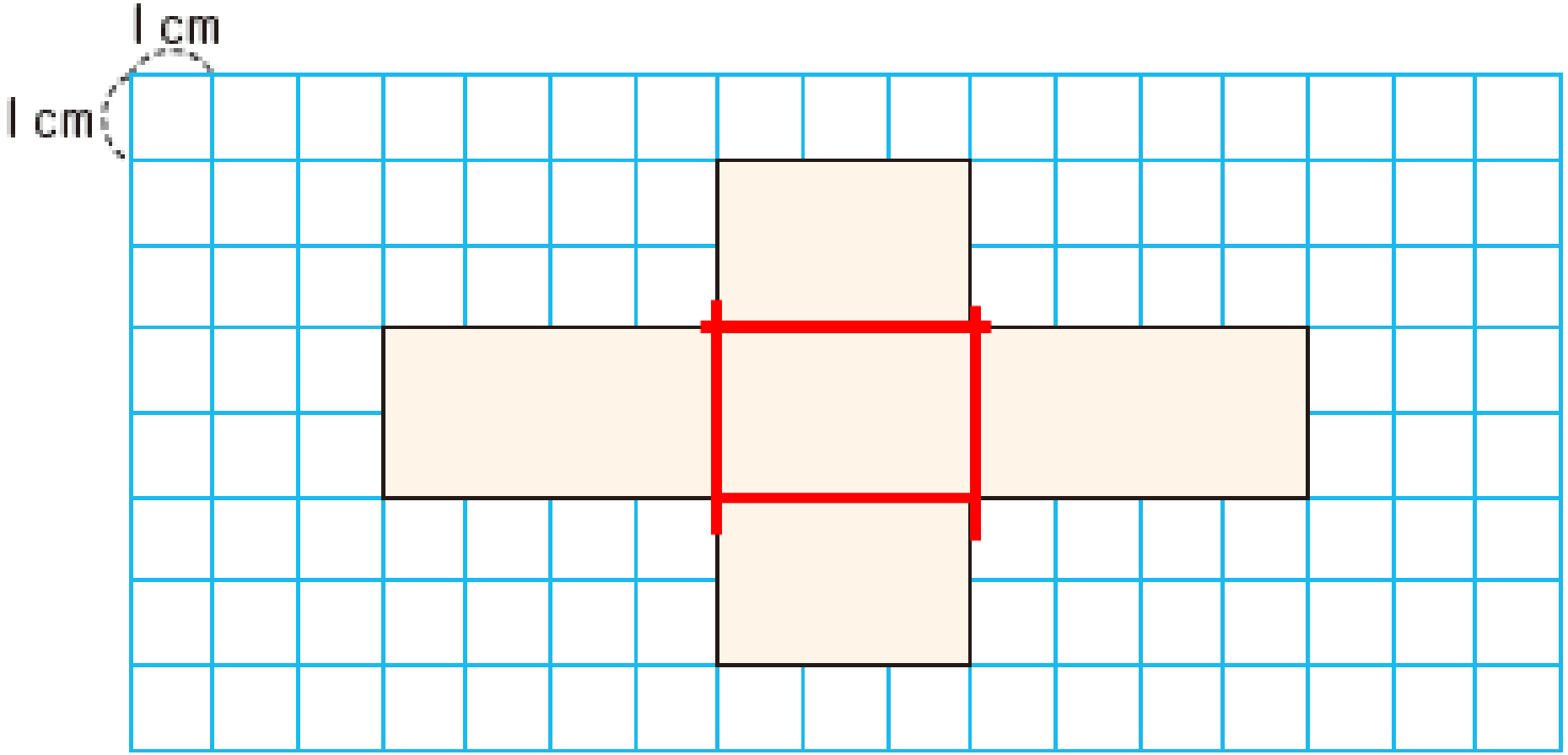
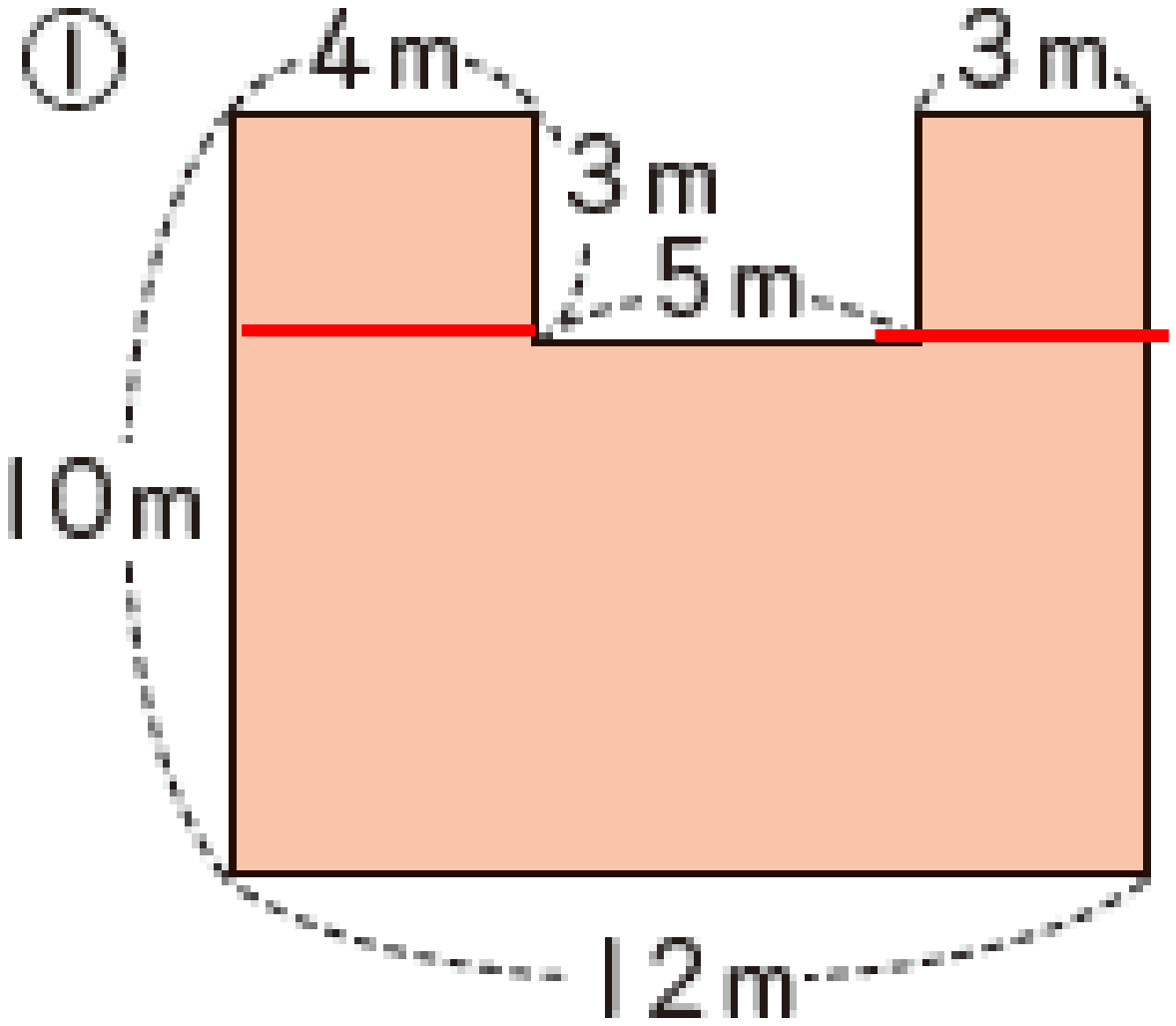


Use what you have learned to find the area of the shape below. If you find one way, try to and find another way. Make sure you use maths sentences to show your thinking.



Use your knowledge of what you have learned to find the area of the shape below. If you find one way, try and find another way. Make sure you use maths sentences.

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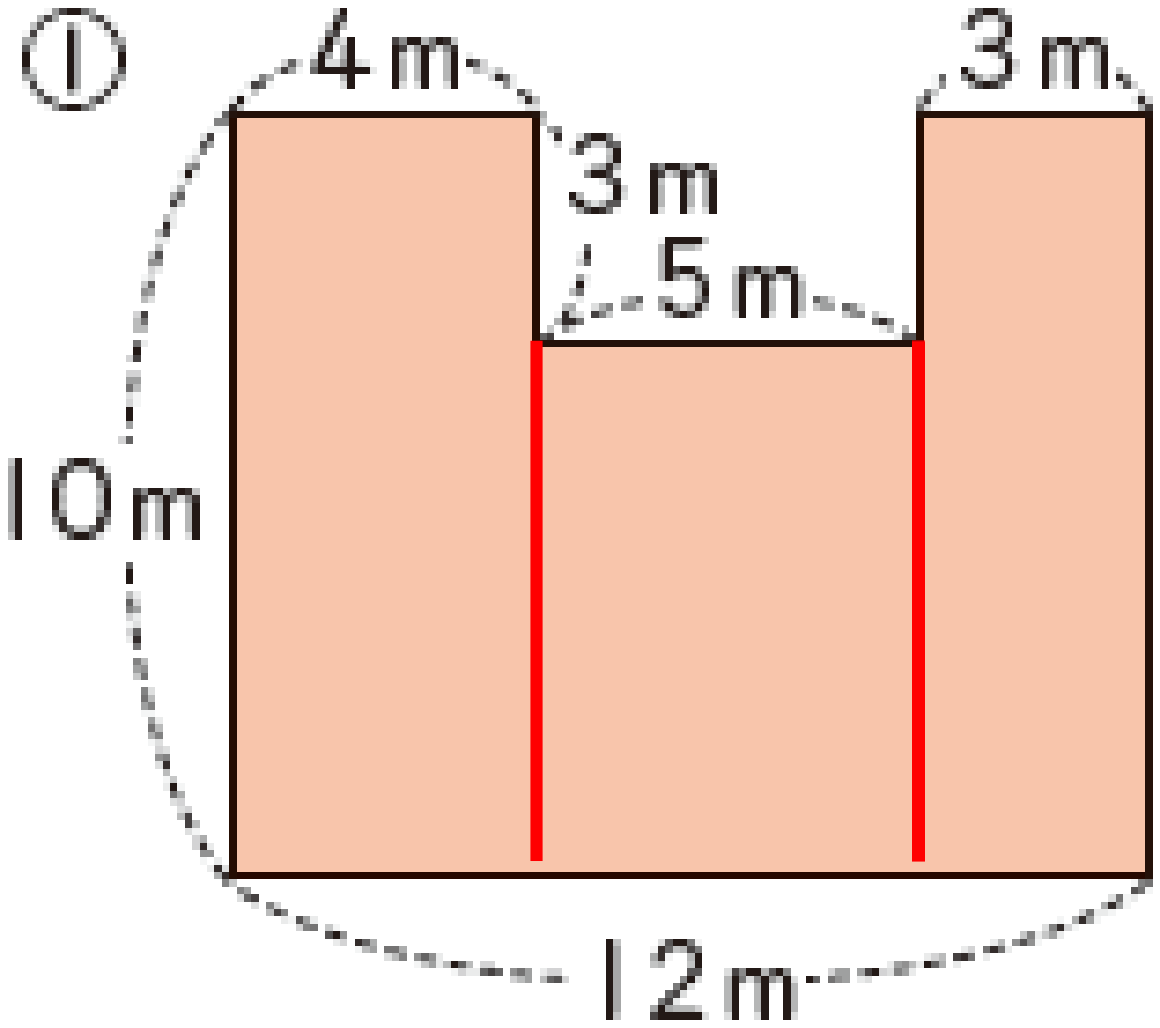
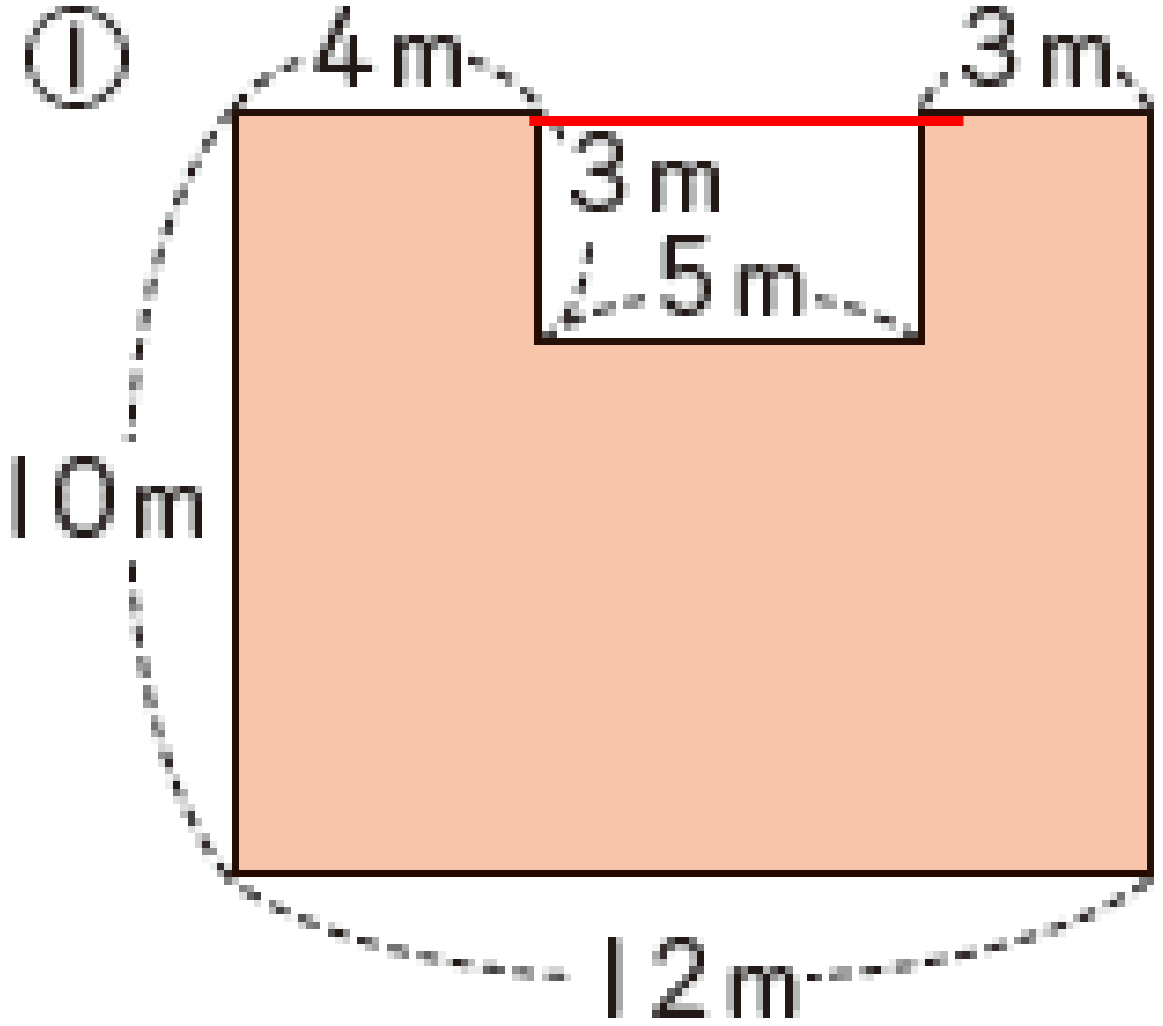


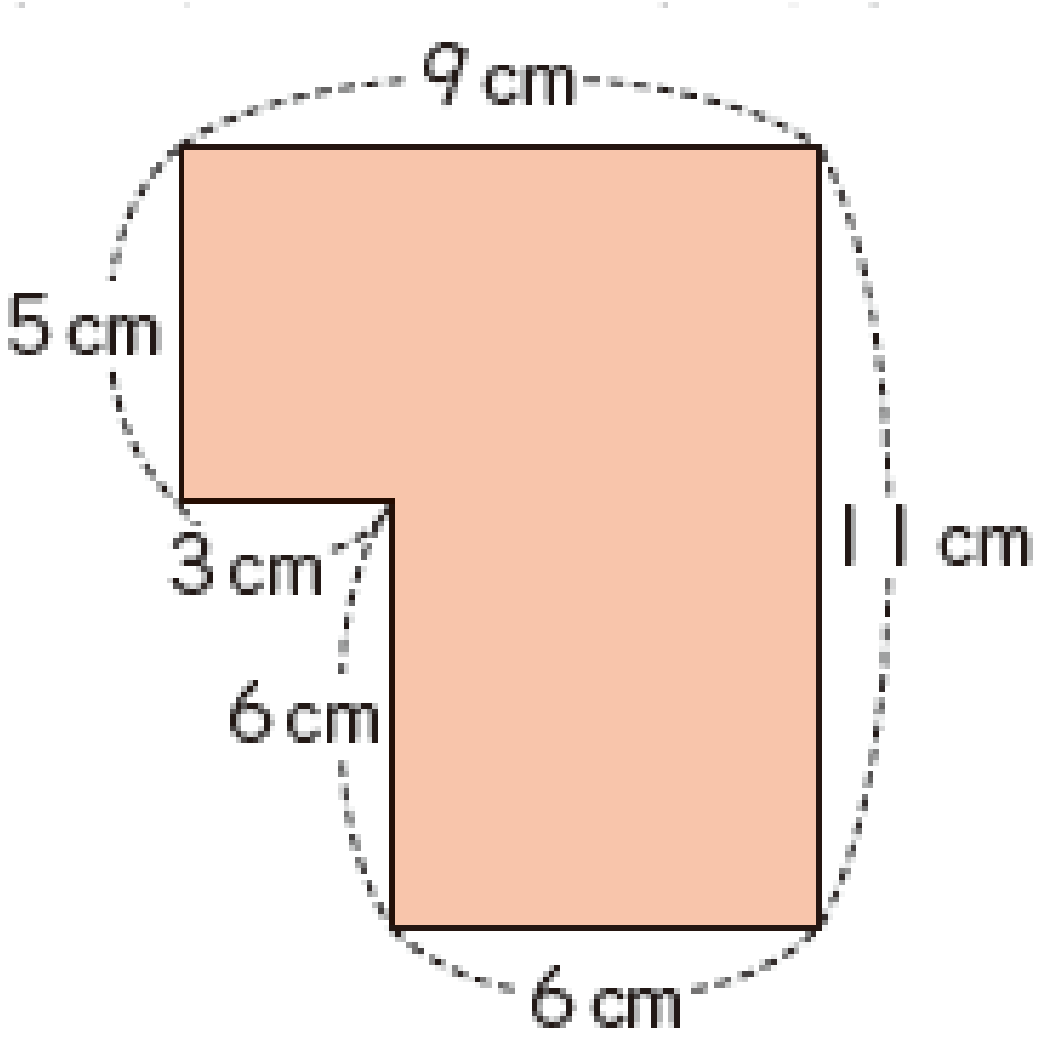
Use your knowledge of what you have learned to find the area of the shape below. If you find one way, try and find another way. Make sure you use maths sentences.



We are going to think about how to calculate the area of the shape below.

$$5 \times 9 + 6 \times 6 = 45 + 36$$
$$= 81$$

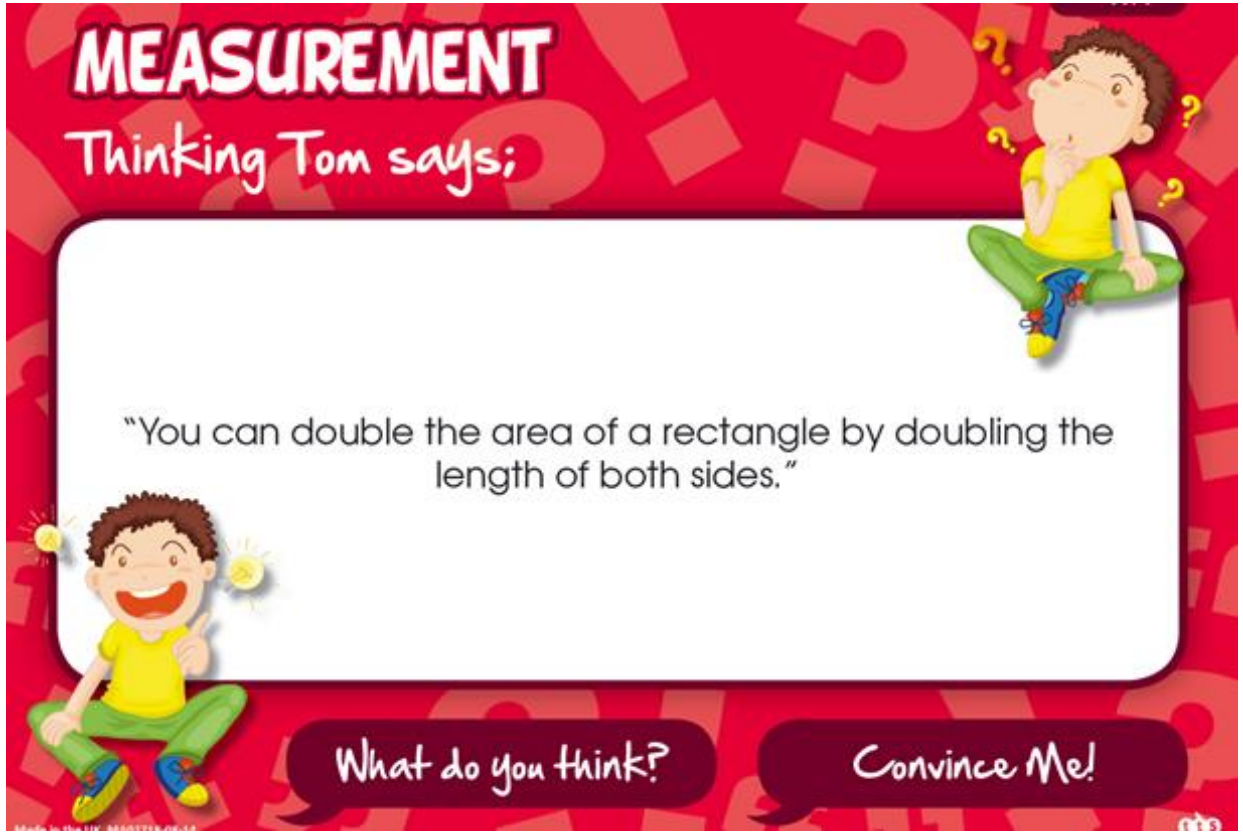
Answer $81\,cm^2$



Explain Sally's way of calculating the area.

Find the area of this shape that is different from Sally's idea.

Convince me:


MEASUREMENT
Thinking Tom says;
"You can double the area of a rectangle by doubling the length of both sides."
What do you think?
Convince Me!

Plenary: create a summary and reflection record.

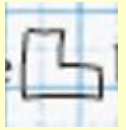
Include:

What you have learned

What you've come to understand.

What you noticed.

Summary:

I have learned that we can find the area of a shape like  by making use of rectangles and squares.

Examples of the different amounts of challenges given in different to try and meet the needs of all learners.

Challenge 1:

Record these calculations
Into your book and calculate.

22 ÷ 10 = __ r __
__ tens are ____.

16 ÷ 5 =
17 ÷ 5 =
18 ÷ 5 =
19 ÷ 5 =

54 ÷ 10 =
55 ÷ 10 =`
56 ÷ 10 =

15 ÷ 2 =
15 ÷ 3 =
15 ÷ 4 =

21 ÷ 5 = 4 r 1

4 fives are 20

21 - 20 = 1 1 < 5

Challenge 2: fill in the missing numbers.

Use what you know about the relationship between multiplication and division

☆ ÷ 5 = 6 r □

△ ÷ ◇ = 2 r 1

What is the greatest remainder? (____)

What is the smallest divisor? (___)

Challenge 3

There are 37 school children going on a school trip. The mini bus can only take 10 children. How many mini buses will be needed?

Challenge 4

Show your thinking and explain your answers.

Explore

With **12 matchsticks**
I can make:

□ triangles △
□ squares □
□ pentagons ⬠

With **15 matchsticks**
I can make:

□ triangles △
□ squares □
□ pentagons ⬠

Challenge 1: Use the ten frame.
Record the number sentences into your book. Look at the example. Make sure you show all 3 steps!

16 - 7 =

16 - __ = 10

10 - __ = __

13 - 6 =

15 - 8 =

Example:
13 - 5 =

3 2

We can make ten first.

13 - =
10 - =

Challenge 2: Show the number sentences and record all the steps.

Tom had 16 cakes. He gave 9 away. How many does he have now?

Katie had 13 sweets. She gave 8 to her friend. How many does she have now?

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Challenge 3: can you find different ways to calculate?

16-9= 7

MathsHUBS SHaW

Challenge 3: Fill in the missing numbers. Use what you have just learned about splitting the number.

'Fill in the missing numbers.'

$13 - 3 - 4 = 10 - \square$

$12 - 2 - \square = 12 - 7$

$16 = 3 + \square + 6$

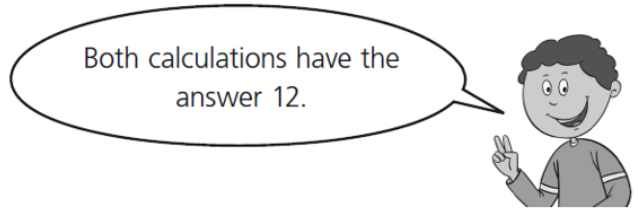
Challenge 4: Write as many addition and subtraction calculations with the answer 12

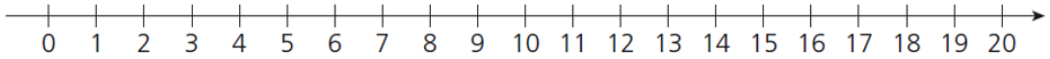
Toby uses a number line to work out:

10 + 2 =

and

15 – 3 =





Start at 20. Write a calculation with the answer 12. 20 – ☐ = 12

Start at 4. Write a calculation with the answer 12. 4 + ☐ = 12

Write as many calculations as you can with the answer 12.

2 paper tapes were broken, can you guess which original paper tape is longer?

Why? How do you get your answer?

$\frac{1}{5}$ 

$\frac{1}{5}$ 

F

Kátie

If the shape is a rectangle or a square, we studied how to calculate its area, so ...

how we
area of
?

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i
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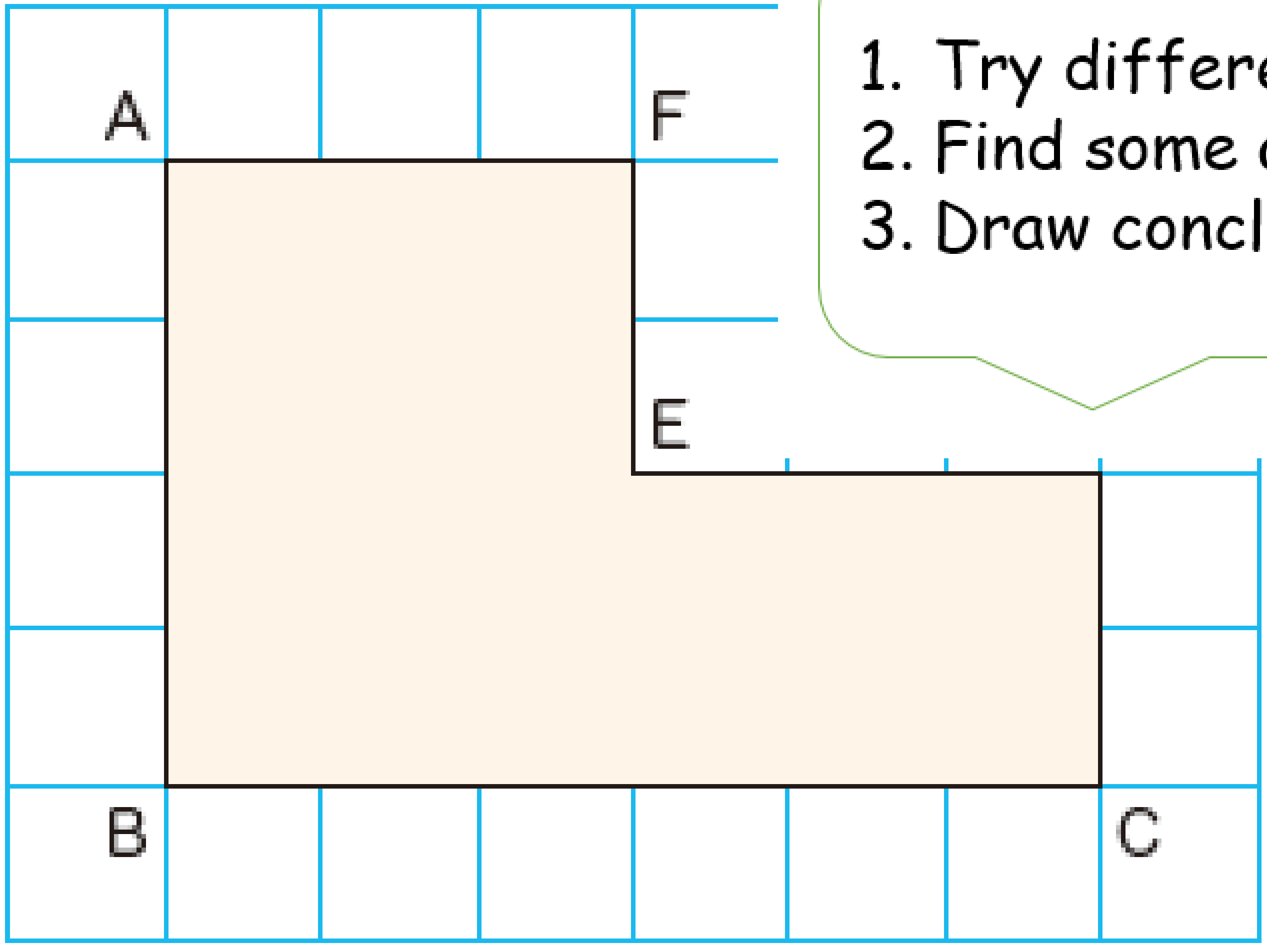
so far that you can use?

Write down your ideas. Make sure other people can understand them.

If you find one way, try and find another way. Make sure you use maths sentences.



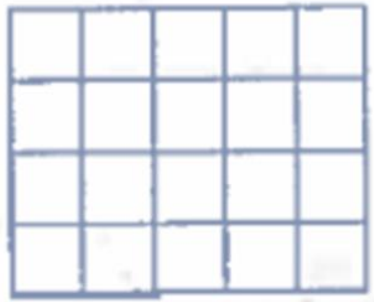
1. Try different methods.
2. Find some answers.
3. Draw conclusions.

Challenge 2:

Look at the picture, and write the number sentence

$2 \times 3 = 6$

$3 \times 2 = 6$



Challenge 4:

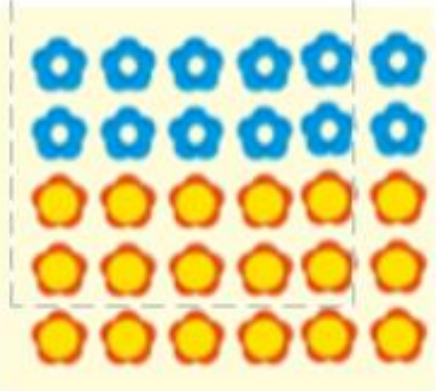
You can buy 2 packs of 6 cupcakes or 3 packs of 4 cupcakes. Which one would you rather buy? Explain your thinking/reasoning. Draw an array to help you prove it. You could also use counters.

2 packs

3 packs

Challenge 6:

Circle and say:



What do you see? How many different multiplication number sentences can you find?

Challenge 7:

Write these addition sentences as multiplication sentences.

$10 + 10 + 10 + 5 + 5 =$

$2 + 2 + 2 + 4 =$

$2 + 2 + 4 + 4 =$

$5 + 5 + 5 + 2 + 3 =$

Reflection

Think back through the different lessons/ tasks and consider:

- **how did they meet the needs of all learners?**
- **identify how the lessons used differentiation.**
- would you have done the lessons in the same way?
- what is the main mathematical purpose of each lesson?
- what concepts would you want children to take from this lessons?
- how are the lessons building conceptual, procedural understanding?
- how are the lessons promoting problem solving?

Key Messages

Differentiation is through scaffold, practical equipment and depth of learning.

The learning is accessible for all learners through small steps planning and low threshold high ceiling.

A lesson on problem solving has a clear purpose and clearly planned small steps.

Children can learn concepts by teaching through problem solving .