Summer Block 4

Negative numbers

White Rose Maths

Small steps

Step 1	Understand negative numbers
Step 2	Count through zero in 1s
Step 3	Count through zero in multiples
Step 4	Compare and order negative numbers
Step 5	Find the difference

Understand negative numbers

Notes and guidance

In this small step, children are introduced to negative numbers for the first time. The focus of this step is exploring negative numbers in real-life contexts, including temperatures, distances above and below sea level and floors in a building that go underground.

In this first step, only vertical representations are used to develop understanding of the concept. Draw attention to the fact that negative numbers can be seen as a reflection of the positive numbers. This will help to avoid the common misconception of counting 3, 2, 1, 0, −10, −9, −8 …

Careful attention should be paid to language choices and children should be encouraged to say, for example, −3 as "negative three" rather than "minus three", so that they see negative numbers as numbers rather than operations.

At this stage, children do not need to calculate using negative numbers.

Things to look out for

- As children are often shown scales from positive 10 to negative 10, they may count incorrectly across zero, for example 3, 2, 1, 0, −10, −9, −8 etc.

- Children may only look at the digit and think that, for example, −7 is greater than −2

Key questions

- What are negative numbers? How do you write them?

- As the temperature gets warmer/colder, do the numbers get greater or smaller?

- If zero degrees Celsius is freezing point, how do you write temperatures that are colder than freezing?

- Is −5 colder or warmer than −2? Which temperature is closer to freezing point (zero degrees Celsius)?

- If the ground floor is zero and the first floor is 1, what number represents the basement?

- Which of these floors are above/below the ground floor, −3 and 3?

- If 5 m represents 5 metres above sea level, how do you write 5 metres below sea level?

Possible sentence stems

- Numbers greater than zero are called _____ numbers.

- Numbers less than zero are called _____ numbers.

National Curriculum links

- Interpret negative numbers in context, count forwards and backwards with positive and negative whole numbers, including through zero

# Understand negative numbers

Key learning

- Mr Rose is in the lift of a building.

  He is on the ground floor.

  ▶ What number represents the ground floor?

  Mr Rose wants to go to a shop on the floor above him.

  ▶ What number button does he need to press?

  Mr Rose's car is parked in the car park on the floor below ground level.

  His hand is covering the button.

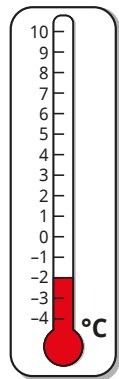 ▶ What number will this be?
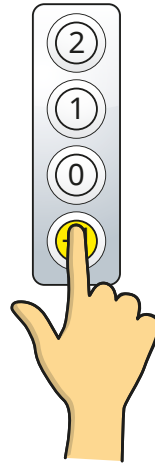
- The thermometers show the temperatures in four cities measured in degrees Celsius (°C).
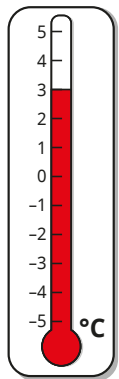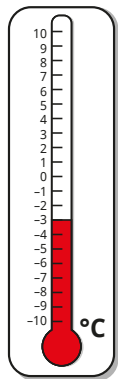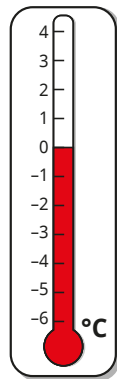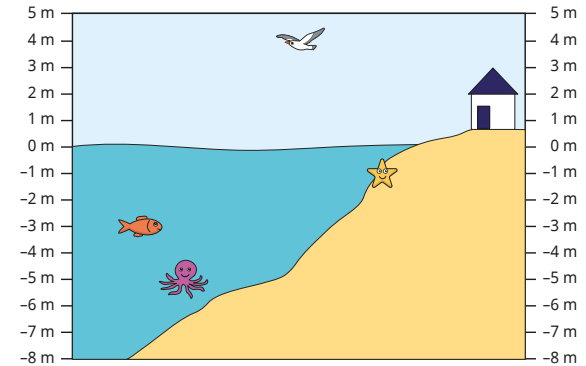
  Paris   Oslo   London   Berlin

  What temperatures are shown on the thermometers?

- The diagram shows distances above and below sea level.

  ▶ At what height is the bird flying?

  ▶ Which creature is at a deeper level, the starfish, fish or octopus?

  ▶ How many metres below the surface of the water is the fish?

- The table shows the temperatures at different times of the day.

Time	Temperature
5 am	−4 °C
12 noon	1 °C
6 pm	−1 °C

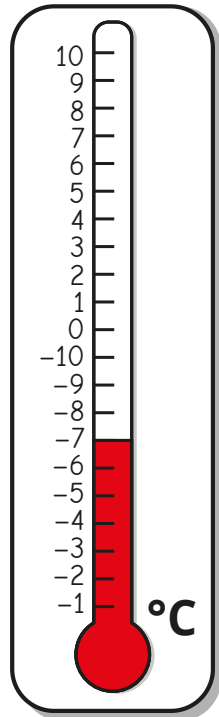 Use the clues to work out the temperature at each time.

  - At 9 am, the temperature was 1 degree warmer than at 5 am.

  - At 4 pm, it was colder than at 12 noon but warmer than at 6 pm.

  - At 11 pm, it was 1 degree colder than at 5 am.

Understand negative numbers

White Rose Maths

Reasoning and problem solving
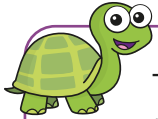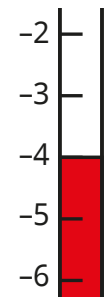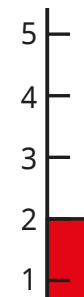
Tiny has labelled the thermometer incorrectly.

What mistake has Tiny made?

What temperature is shown?

−4 °C

The thermometers show the temperatures in New York and Athens.

New York   Athens

The temperature in Rome is warmer than in New York, but colder than in Athens.

What could the temperature in Rome be?

−3 °C, −2 °C, −1 °C, 0 °C or 1 °C

Count through zero in 1s

Notes and guidance

In this small step, children become more fluent with negative numbers and explore counting both forwards and backwards through zero in 1s. Counting in other multiples through zero will be covered in the next step.

Alongside the vertical representations used in the previous step, children now see horizontal number lines. This will help to reinforce the reflective nature of positive and negative numbers. Use of horizontal number lines provides an opportunity to revisit and develop skills in labelling and identifying numbers on a number line covered in earlier blocks.

Once confident with counting both forwards and backwards through zero on a number line, children then apply these skills to solving problems involving change in temperature.

Things to look out for

- Children may forget to include zero in a count, for example 3, 2, 1, −1, −2 , −3

- Children may not see the reflective nature of negative numbers and count after zero with the negative partner of the first positive number, for example 3, 2, 1, 0, −3, −2, −1

Key questions

- What is a negative number? How do you write negative numbers?

- What is the next number in this count: 3, 2, 1?

- What is the number after that?

- Are the numbers counting forwards or backwards?

- What is the sequence counting forwards/backwards in?

- What number comes before/after _____ when counting forwards/backwards in 1s?

Possible sentence stems

- Numbers less than zero are called _____ numbers.

- I know the numbers are counting forwards/backwards because …

- The number before/after _____ when counting forwards/backwards in 1s is _____
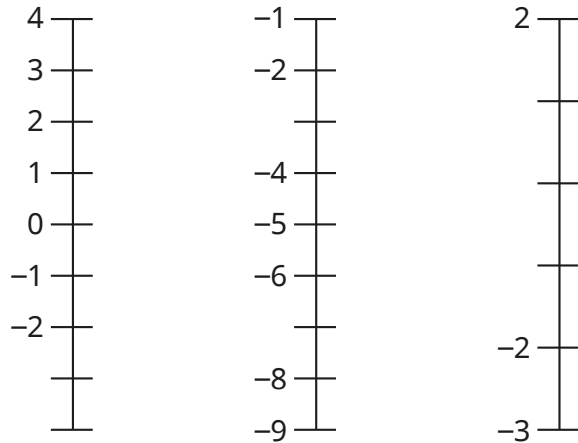
National Curriculum links

- Interpret negative numbers in context, count forwards and backwards with positive and negative whole numbers, including through zero
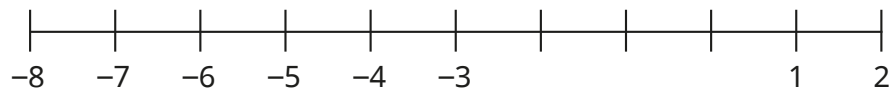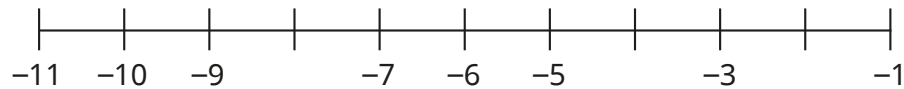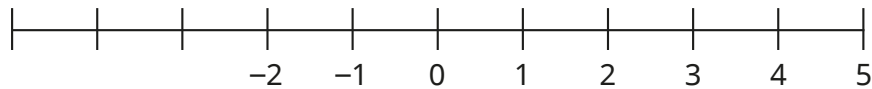
Count through zero in 1s
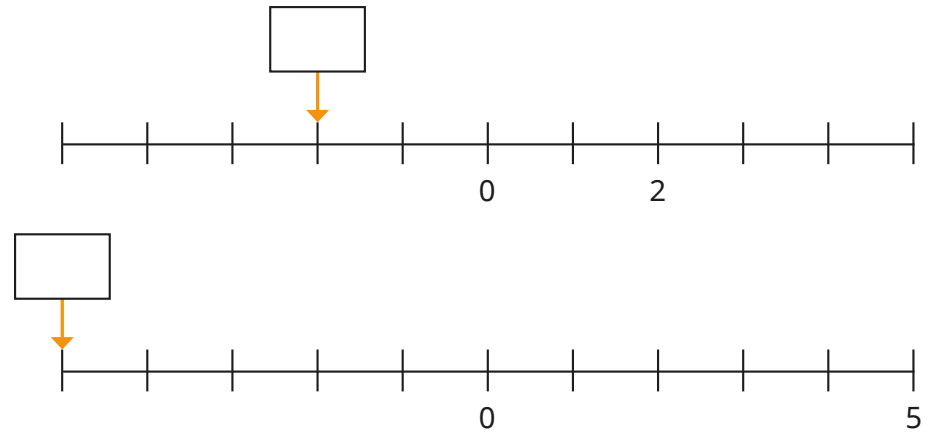
Key learning

- Work out the missing numbers.

- Complete the number lines.

- What are the next three numbers in each sequence?

  ▸ −20, −19, −18, −17, _____, _____, _____

  ▸ 5, 4, 3, 2, _____, _____, _____

  ▸ −6, −5, −4, −3, _____, _____, _____

- What numbers are the arrows pointing to?

What do you notice?

- The temperature in Halifax is 2 °C.

  The temperature in Manchester is 5 degrees colder.

  What is the temperature in Manchester?

Count through zero in 1s

Reasoning and problem solving

Ron and Whitney are completing this counting sequence.

4, 3, 2, 1, _____ , _____ , _____ , _____

The missing numbers are −1, −2, −3, −4

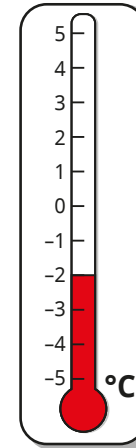Ron

The missing numbers are 0, −4, −3, −2

Whitney

What mistake has each child made?

Complete the counting sequence correctly.

0, −1, −2, −3

The thermometer shows the temperature in Helsinki on Monday.

On Tuesday, the temperature was 5 degrees warmer than on Monday.

On Wednesday, the temperature was 7 degrees colder than on Tuesday.

What was the temperature on Wednesday?

Compare methods with a partner.

−4 °C

Count through zero in multiples

Notes and guidance

In this small step, children continue to practise counting both forwards and backwards through zero, but now in multiples other than 1s.

Initially, the focus is on counting where zero is included in the count, which leads to a reflective pattern, for example −6, −4, −2, 0, 2, 4, 6. Once children are confident with this, they explore counting through zero that does not follow this pattern, for example 8, 5, 2, −1, −4, −7. Encourage children to explore how partitioning of the multiple can support counting through zero. For example, when counting back in 5s from 3, they can use the fact that 5 can be partitioned into 3 and 2. This will allow them to first jump to zero and then from zero to reach −2

Number lines, both vertical and horizontal, continue to be a key representation in supporting this understanding.

Things to look out for

- In counts that include zero, children may forget to include it.

- Children may just reflect a given sequence rather than counting through zero, for example −8, −5, −2, 2, 5, 8

- When counting through zero, children may continue the count from zero, for example 5, 3, 1, 0, −2, −4, −6

Key questions

- What is the next number in this count: 6, 4, 2? What is the number after that?

- Are the numbers counting forwards or backwards?

- What is the sequence counting forwards/backwards in?

- What number comes before/after _____ when counting forwards/backwards in _____ s?

- How does partitioning the multiple help when counting through zero?

Possible sentence stems

- The sequence is counting in _____ s.

- The number before/after _____ when counting forwards/ backwards in _____ s is _____

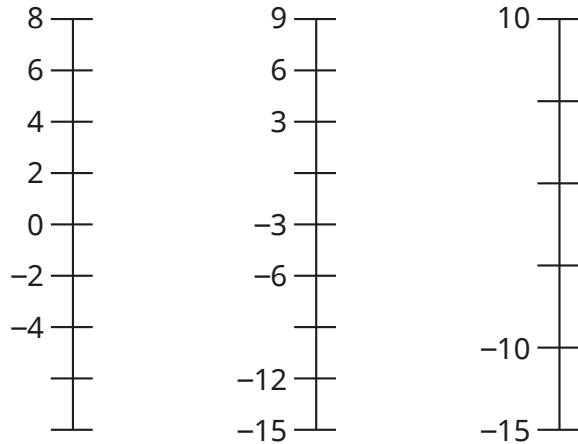- I can partition _____ into _____ and _____ to help count through zero.

National Curriculum links

- Interpret negative numbers in context, count forwards and backwards with positive and negative whole numbers, including through zero

Count through zero in multiples

Key learning
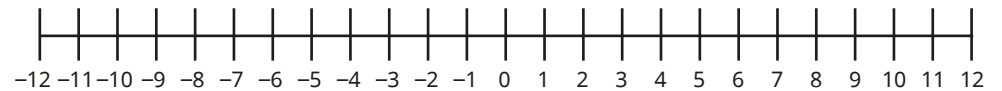
- Work out the missing numbers.

- Complete the sequences.

  ▶ −16, −12, −8, ____ , ____ , ____

  ▶ −5, −10, −15, ____ , ____ , ____

  ▶ −9, −6, −3, ____ , ____ , ____

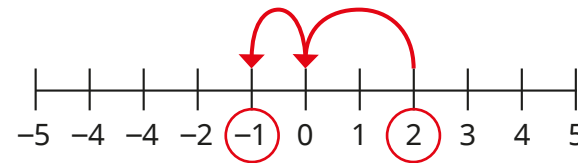 ▶ 18, 12, 6, ____ , ____ , ____

- The temperature at 3 pm is 4 °C.

  The temperature drops by 2 degrees every hour.

  What will the temperature be at 7 pm?
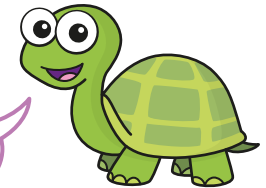
- Use the number line to complete the sequences.

  ▶ 5, 3, 1, ____ , ____ , ____   ▶ 7, 4, 1, ____ , ____ , ____

  ▶ −9, −7, −5, ____ , ____ , ____   ▶ −9, −5, −1, ____ , ____ , ____

- Tiny is counting backwards in 3s from 2

  I can partition 3 into 2 and 1 and jump to zero.

  Use Tiny's method to find the next number in these counts.

  ▶ counting back in 4s from 2   ▶ counting back in 5s from 3

  ▶ counting back in 4s from 3   ▶ counting forwards in 5s from −3

Count through zero in multiples

Reasoning and problem solving

Starting at sea level, a diver descends 5 m every minute for 3 minutes.

The diver then ascends 3 m every minute until they reach the surface.

How many minutes does it take the diver to reach the surface?

> 5 minutes

Here are five numbers from a counting pattern.

| 5 | −15 | −3 | 1 | −11 |

The numbers are not in the correct order.

A sixth card is missing to complete the counting pattern.

What is the missing number?

> −7

Annie and Mo are completing the counting sequence.

8, 5, 2, _____ , _____ , _____

Annie: The missing numbers are −2, −5, −8

Mo: The missing numbers are 0, −3, −6

> −1, −4, −7

What mistake has each child made?

Complete the counting sequence correctly.

Compare and order negative numbers

Notes and guidance

In this small step, children compare and order integers that include negative numbers.

A common misconception is to apply the abstract "rules" of positive numbers to negative numbers. For example, children may believe that because 10 is greater than 3, then −10 must be greater than −3. Number lines are a key representation to help address this misconception. By comparing positive numbers and reflecting on their positions on a number line, children can begin to generalise that greater numbers lie to the right on a number line. Therefore, because −3 lies to the right of −10, it is greater. It can also be helpful to discuss real-life contexts to support this understanding. For example, children may be comfortable with the fact that, for example, −5 degrees is colder than −1 degree and can then apply this to show that −5 < −1

Once children are confident with comparing two numbers, they can begin to order groups of integers that include both positive and negative numbers.

Things to look out for

- Directly applying knowledge of comparing and ordering positive numbers can lead children to think that, for example, −7 > −3

Key questions

- Where is the number _____ on the number line?
- How can you use a number line to compare numbers?
- When comparing numbers on a number line, are the greater/smaller numbers on the right or the left?
- Are negative numbers greater or less than positive numbers?
- What temperature is warmer/colder, _____ or _____ ? So which number is greater?
- How do you know that −8 is less than −3?

Possible sentence stems

- Greater numbers are to the _____ of smaller numbers on a number line.
- Positive numbers are _____ than negative numbers.
- Ascending/descending order means ordering from _____ to _____

National Curriculum links

- Interpret negative numbers in context, count forwards and backwards with positive and negative whole numbers, including through zero

Compare and order negative numbers

Key learning

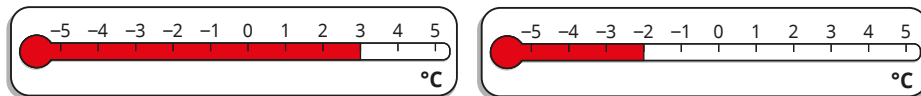- Use the number line to help compare the numbers.

  0 1 2 3 4 5 6 7 8 9 10

  6 ◯ 3   7 ◯ 9   2 ◯ 0

  Complete the sentence.

  Numbers to the left on the number line are _____ than numbers to the right.
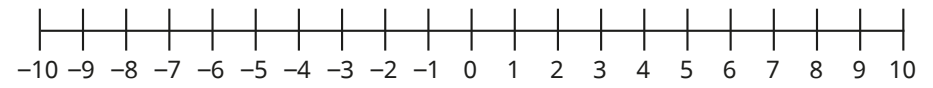
- Use the correct word to complete each sentence.

  −5 −4 −3 −2 −1 0 1 2 3 4 5 °C   −5 −4 −3 −2 −1 0 1 2 3 4 5 °C

  ▶ | warmer | | colder |

  3 degrees is _____ than −2 degrees.

  ▶ | less | | greater |

  −2 degrees is _____ than 3 degrees.

- Use the number line to help compare the numbers.

  −10 −9 −8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8 9 10

  6 ◯ −3   −8 ◯ −4

  5 ◯ −7   0 ◯ −5

- Write the temperatures in order, starting with the coldest.

  −12 −10 −8 −6 −4 −2 0 2 4 6 8 10 12 °C
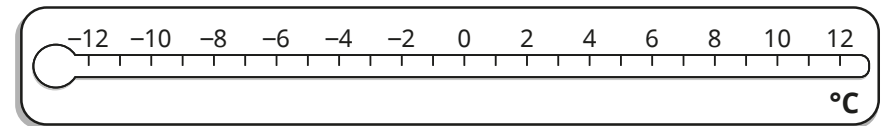
  ▶ 9 °C, 0 °C, 3 °C   ▶ −9 °C, 0 °C, −3 °C   ▶ 8 °C, −1 °C, −3 °C

- Write the numbers in ascending order.

  | −2 | | 0 | | 7 | | −7 | | 22 | | 4 |
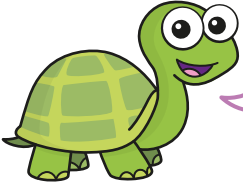
- Write the numbers in descending order.

  | −41 | | 104 | | −1 | | 14 | | −14 | | 4 |

Compare and order negative numbers

Reasoning and problem solving

Tiny is comparing numbers.

> 4 is greater than 1, so −4 is greater than −1

Draw a number line and label the positions of the numbers.

Explain why Tiny is incorrect.

Drawing of number line showing that −1 is greater than −4 as it is further to the right

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Fill in the missing number.

−3 < ☐ < 2

Find all the possible answers.

−2, −1, 0, 1

Amir is on floor 4 of a building.

He gets in a lift and goes down 7 floors.

Rosie is on floor −5 of the building.

She gets in a lift and goes up 3 floors.

Who is on the lower floor now?

Amir

Here are the temperatures in three cities on Monday.

Vancouver	Edinburgh	Stockholm
−7 °C	1 °C	−3 °C

On Tuesday, the temperature in:

- Vancouver is 4 degrees warmer
- Stockholm is 3 degrees warmer
- Edinburgh is 3 degrees colder.

Order the temperatures for Tuesday, starting with the warmest.

Stockholm 0 °C

Edinburgh −2 °C

Vancouver −3 °C

Find the difference

Notes and guidance

In this small step, children look at finding the difference between positive and negative numbers.

As with previous steps, vertical and horizontal number lines are a key representation in supporting this understanding. To begin with, children count either forwards or backwards in 1s through zero, seeing that the difference is the number of jumps between the two numbers. They then look at more efficient strategies by jumping to and from zero and adding the two jumps together to find the difference. For example, to find the difference between –4 and 3, they can jump 3 from 3 to 0 and then 4 from 0 to –4. The difference is 3 + 4 = 7

Contextual problems, such as finding the difference between temperatures or distances above and below ground, are very common, so this step is key for working with negative numbers.

Things to look out for

- When using number lines, children may count the numbers rather than the jumps, resulting in a difference that is 1 greater than it should be.

- Children may rely on always counting individual jumps rather than using the more efficient strategy of jumping to and from zero.

Key questions

- Where is the number _____ on the number line?

- How can you use a number line to find the difference between two numbers?

- How many jumps are there from _____ to _____?

- Does it matter if you count forwards or backwards?

- How far away from zero is _____?

- If the jump from _____ to zero is _____ and the jump from zero to _____ is _____ , what is the overall difference?

Possible sentence stems

- There are _____ jumps from _____ to _____ , so the difference is _____

- The distance from _____ to zero is _____

  The distance from zero to _____ is _____
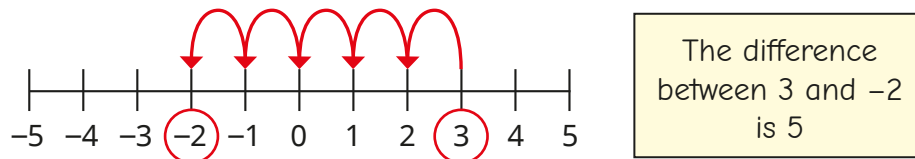
  So the difference between _____ and _____ is _____

National Curriculum links

- Interpret negative numbers in context, count forwards and backwards with positive and negative whole numbers, including through zero
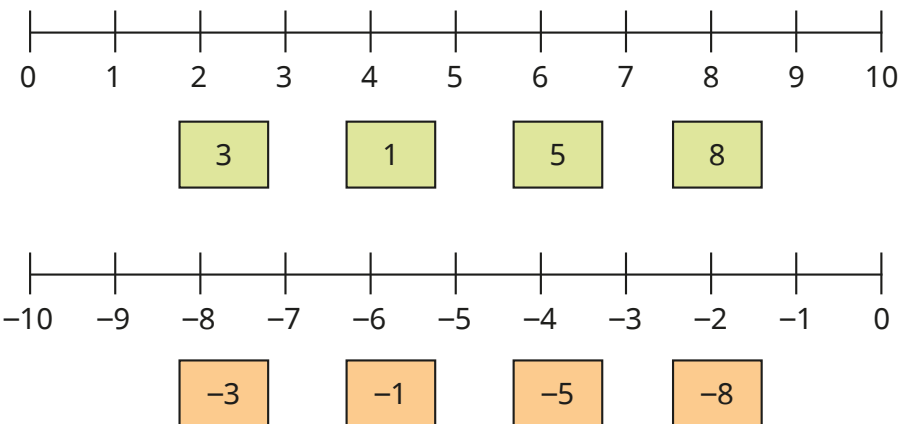
Find the difference

Key learning

- Max is finding the difference between 3 and –2

The difference between 3 and –2 is 5

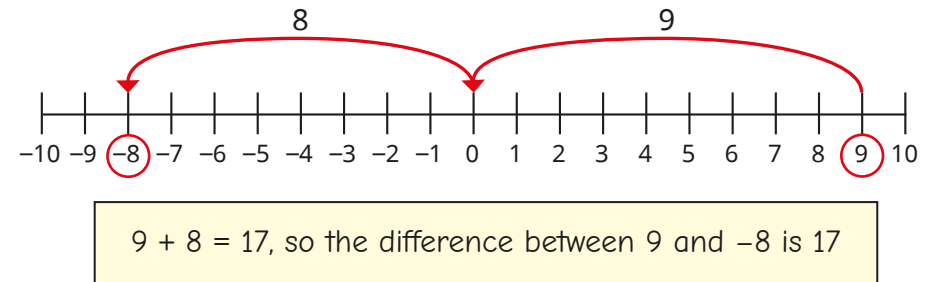Use Max's method to find the differences between the pairs of numbers.

▸ –1 and 2   ▸ 2 and –5   ▸ –2 and 5   ▸ 3 and –3

- Count the number of jumps from zero to each number.

| 3 | 1 | 5 | 8 |

| –3 | –1 | –5 | –8 |

What do you notice?

- Eva is finding the difference between 9 and –8

9 + 8 = 17, so the difference between 9 and –8 is 17

Use Eva's method to find the differences between the pairs of numbers.

▸ –5 and 7   ▸ 8 and –4   ▸ –1 and 9   ▸ 6 and –6

- The temperature in London is 8 °C.

  The temperature in Moscow is –7 °C.

  How much warmer is the temperature in London than in Moscow?

- Find the differences between the pairs of numbers.

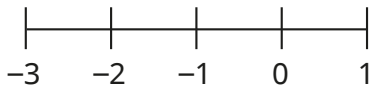 ▸ –32 and 65   ▸ –48 and 45   ▸ 132 and –224

- Mrs Fisher parks her car on level –3

  Her flat is on level 18

  How many floors does she have to go up to get to her flat?

Find the difference

Reasoning and problem solving

Kim is finding the difference between −3 and 1

| The difference is 5 |

What mistake has Kim made?

What is the difference between −3 and 1?

4

The table shows the highest and lowest temperatures recorded on a day in two cities.

City	Highest temperature	Lowest temperature
Oslo	4 °C	−6 °C
Helsinki	3 °C	−9 °C

Which city has the greater difference in its daily temperature?

Compare methods with a partner.

Helsinki

Jack is finding the difference between −47 and 54

I am going to count back from 54 to −47

54, 53, 52, 51 ...

Explain a more efficient method for Jack to find the difference.

What is the difference?

101

The temperature at 9 am is −5 °C.

At 1 pm, the temperature is 9 degrees warmer.

At 9 pm, the temperature has dropped 3 degrees since 1 pm.

What is the difference between the temperatures at 9 am and 9 pm?

6 degrees

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