INTRODUCTION

Number Chart Chess – The Rook

Y3

Summary of learning goals

- Students explore the place-value patterns on the number chart as they move along rows and columns. They use place value to aid and model the difference between numbers.

Australian Curriculum: Mathematics (Year 3)

ACMNA053: Apply place value to partition, rearrange and regroup numbers to at least 10 000 to assist calculations and solve problems.

ACMNA054: Recognise and explain the connection between addition and subtraction.

ACMNA055: Recall addition facts for single-digit numbers and related subtraction facts to develop increasingly efficient mental strategies for computation.

Summary of lessons

Who is this sequence for?

- Students should be able to count in 10s, on and off the decade. They should be familiar with different addition and subtraction strategies when working with one- and two-digit numbers.
- It is also expected that they are familiar with the 1–100 number chart and its use as a tool to find and justify patterns, such as place value.

Lesson 1: Number Chart Chess – The Rook

This resource uses the moves of the rook in chess to look at place value and the addition and subtraction of numbers. Students explore the different ways that the rook can move between numbers on a number chart, using the same movements that are possible in chess. This builds an understanding of how the number chart can be used as a tool to aid and model addition and subtraction using 10s and 1s.

reSolve: Mathematics by Inquiry is funded by the Australian Government and is managed by the Australian Academy of Science.

Reflection on this sequence

Rationale

The number chart is a powerful tool for exploring patterns, including place value, and to model the addition and subtraction of numbers.

reSolve mathematics is purposeful

- This task draws on the context of chess to explore place value and the addition and subtraction of numbers. In particular, it provides an opportunity to look at the key developmental understandings of compensation and equivalence as students look at different pathways between two numbers.
- The task also draws on spatial reasoning skills, as students consider all the squares that are possible to pass through as they move between two numbers in a specified number of moves.

reSolve tasks are inclusive and challenging

- This task draws on a common experience for many children, which is playing chess. At a basic level, students are able to explore the different ways in which the value of the numbers change as the rook moves on the number chart and explore some of the place-value patterns that these moves generate.
- At a more complex level, students develop understandings around equivalence and compensation as they realise the difference between two numbers remains constant, regardless of the pathway chosen.

reSolve classrooms have a knowledge-building culture

- This task draws on the multiple approaches used by students to build the understanding of the class community. Students are asked to record, in a way of their choosing, the different ways in which the value of the numbers change as the rook moves. Although the recording methods might look different, their similarities reveal key number concepts. Discussion is used to promote a shared understanding of these concepts in the class.

LESSON 1

Number Chart Chess – The Rook

Number Chart Chess – The Rook

Y3

About this lesson

This resource uses the moves of the rook in chess as context to look at place value and the addition and subtraction of numbers. Students explore the different ways that the rook can move between numbers on a number chart, using the same movements that are possible in chess. This builds an understanding of how the number chart can be used as a tool to aid and model addition and subtraction using 10s and 1s.

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Mathematical purpose

- Students explore the place-value patterns on the number chart as they move along rows and columns. They use place value to aid and model the difference between numbers.

Learning intention

- To explore patterns along the rows and columns of the number chart.

Time

A lesson of approximately 1 hour.

Vocabulary

- compensation
- equivalence
- place value

Resources

- a chess set or pictures of the different chess pieces plus board
- a large copy of a 1–100 chart
- a rook piece or representative token for each student
- Student Sheet 1 – Chess Number Chart (one per student)
- reSolve PowerPoint *1a Number Chart Chess – The Rook*

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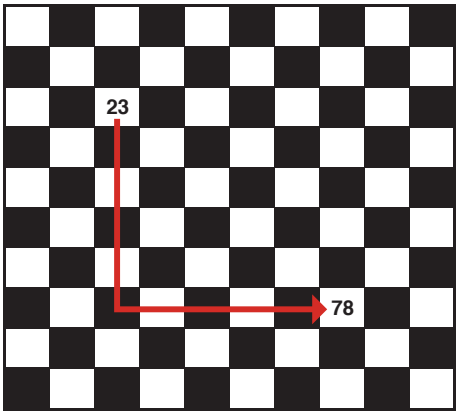
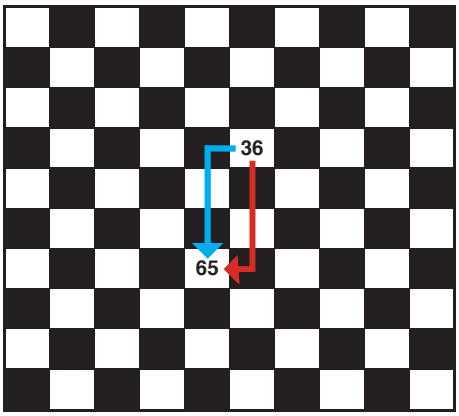
Teacher background information

This task asks students to record the different ways in which the value of the numbers change as the rook moves on the chessboard. One way that this can be recorded is to use a chart indicating the change in value of the numbers and the resulting square that the rook lands on.



23	+10	+10	+10	+10	+10	+1	+1	+1	+1	+1
23	33	43	53	63	73	74	75	76	77	78

$$23 + 10 + 10 + 10 + 10 + 10 + 1 + 1 + 1 + 1 + 1 = 78$$
$$23 + (10 + 10 + 10 + 10 + 10) + (1 + 1 + 1 + 1 + 1) = 78$$
$$23 + (50 + 5) = 78$$
$$23 + \quad 55 \quad = 78$$



Red path:

36	+10	+10	+10	−1
36	46	56	66	65

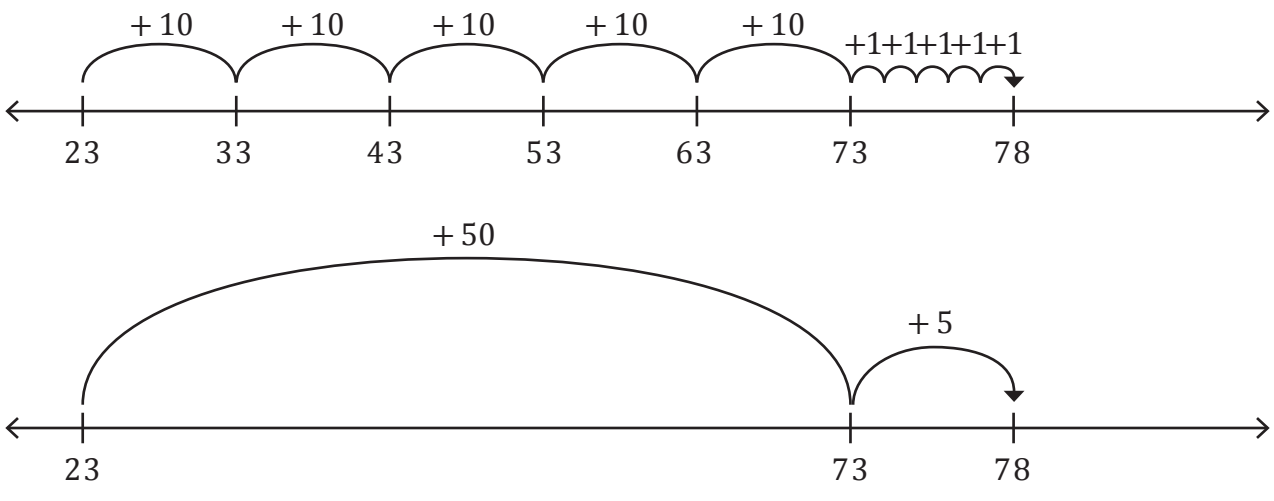
$$36 + 10 + 10 + 10 - 1 = 65$$
$$36 + 30 - 1 = 65$$

Blue path:

36	−1	+10	+10	+10
36	35	45	55	65

$$36 - 1 + 10 + 10 + 10 = 65$$
$$35 + 30 = 65$$

A number line is also a powerful tool that can be used to record the moves.



The role of the rook

Introduce the game concepts of chess. Ask the students who have played chess to share their knowledge of the rules.

Show the students the different chess pieces or pictures of them. Ask the students to name the pieces and describe the ways in which they can move on the chessboard.

Show the students a large copy of a 1–100 chart. Create a story/scenario in which the chess pieces have escaped from the chessboard and been found on a 100 chart.

Resources: Provide the students with a copy of Student Sheet 1 – Chess Number Chart and a rook chess piece. A counter, cube or picture of a rook could be used if a chess piece is not available.

Show students slide 2 of reSolve PowerPoint *1a Number Chart Chess – The Rook*. Discuss the moves of the rook. It can move only along rows or columns.

Show students slide 3 and ask: *In what ways do the values of the numbers change as the rook moves on the number chart?*

Exploring the number chart

Allow the students to explore the different ways in which the value of the numbers change as the rook moves on the number chart. As the rook moves along a row, the value of the numbers increases or decreases by 1. As it moves up and down a column, the value increases or decreases by 10.

Discuss in what ways the value of the numbers change and how this corresponds to the patterns that can be seen on the chart.

Show students slide 4 of reSolve PowerPoint *1a Number Chart Chess – The Rook*.

Pose the challenge: *The rook starts at 23 and moves to 78. What are the different ways that the rook can get from 23 to 78 in two moves? In what ways do the values of the numbers change as the rook moves? Record the different ways that the values of the numbers change as the rook moves.*

There are only two ways for the rook to move from 23 to 78. Discuss the values of the rook's move Although the two moves differ, the value of the move is still the same. This illustrates the **commutative property** of addition:

$$10 + 10 + 10 + 10 + 10 + 1 + 1 + 1 + 1 + 1 = 1 + 1 + 1 + 1 + 1 + 10 + 10 + 10 + 10 + 10$$

$$50 + 5 = 5 + 50$$

Pose the challenge: *What are the different ways that the rook can get from 23 to 78 in three moves? What is the longest path that you can find? What is the shortest? In what ways do the values of the numbers change as the rook moves? Record the different ways that the values of the numbers change as the rook moves.*

Note: The length of the route is measured by how many squares are passed through.

There are many ways that the rook can use three moves to get to 78:

- There are multiple routes that pass through only 10 squares. Any 10-square route uses addition of five 10s and five 1s in differing combinations.
- The longest route is 14 squares. Passing through 14 squares uses a combination of addition and subtraction.

Questioning to direct the investigation and challenge students' thinking and reasoning:

What is similar and what is different about the various ways of using three moves to get to 78? Why is it that the value of a move is always 55, regardless of the number of squares that you pass through?

- The difference between 23 and 78 will always be 55, regardless of how you get there. This gives the opportunity to look at **compensation**. For every extra 10 or 1 that is added above 55, they will be subtracted.

Which squares are impossible to pass through when getting from 78 to 23 in three moves?

- It is not possible to land in the 2 × 2 squares in the very corners of the board.

Extending prompt:

- *Assuming a 90° turn is made after each move, how many different ways can you get to 78 from 23?*
  - ◊ There are 16 different ways that you can get between these two numbers, using three moves with a 90° turn after each move.

Further exploration

Show students slide 5 of reSolve PowerPoint *1a Number Chart Chess – The Rook*.

What are the different ways that the rook can get from 36 to 65? Record the different ways that the values of the numbers change as the rook moves.

- Using two moves, there are two ways to get from 36 to 65. Both require subtraction and addition. Once again, this is an opportunity to look at compensation strategies when performing mental or written calculations.

What is similar and what is different about the way the rook uses two moves to get from 23 to 78 and 36 to 65?

- The main difference is that 36 to 65 requires subtraction. It is not possible to move using only addition.

Show students slide 6.

Pose the challenge: *What are the different ways that the rook can get from 87 to 32 in two moves? What about 83 to 49? Record how the values of the numbers change as the rook moves. What is similar and what is different about the way the rook uses two moves to get from 87 to 32 and from 83 to 49?*

- 87 to 32 requires subtraction only, whereas 83 to 49 is a mix of addition and subtraction.

Look at the two moves of the rook. Which one better reflects an efficient strategy for subtracting two numbers? Why?

- 87 to 32 is the best representation. For 83 to 49, 49 is placed further to the right on the chart because its 1s digit is higher than in 83. As the rook is unable to move in one horizontal line from one decade to the next, a combination of addition and subtraction is required. The difference between the two numbers is still accurate, but it is not necessarily an efficient strategy for subtraction that would be commonly used.

How would you use the number chart to subtract 83 and 49 more efficiently?

- Some strategies that might be used:
  - ◊ Counting back from 83 to 79 and then subtracting three 10s
  - ◊ Subtracting three 10s from 83 to get to 53 and then counting back to 49.

Reflection

The focus of the reflection is to look at how moving in $\pm$ 10 and $\pm$ 1 highlights the place-value parts of the numbers and how partitioning by place value assists the addition and subtraction of numbers. Allow selected students to present their work to build to a discussion on place value and computation.

Show students slide 7 of PowerPoint *1a Number Chart Chess – The Rook.*

In what ways do the values of the numbers change as the rook moves on the number chart? In what ways does this reflect the patterns on the number chart?

- The rook always moves $\pm$ 10 or $\pm$ 1. This highlights the place-value parts of the numbers and therefore the place-value patterns that exist on the number chart.

How do the moves of the rook relate to mental computation strategies?

- The rook's moves shows how the jump strategy can be used to add and subtract numbers on the number chart.

How can the number chart be used for modelling addition and subtraction?

- Generalising the rook's moves on the chart to recognising the chart as a useful tool to aid and model addition and subtraction is important.

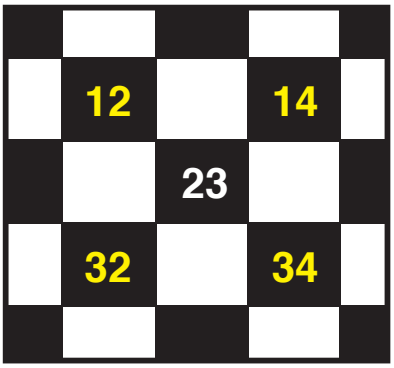
Further activities

Activity 1: The Bishop

The bishop starts on 23 and moves just one space. What numbers might the bishop have landed on? In what ways has the value of the numbers changed for each move?

The rook also starts on 23. What moves does the rook need to make to land on the same squares as the bishop? In what ways does the value of the numbers change with each move?

In what ways are the moves of the rook similar to and yet different from those of the bishop?



Starting at 23, the bishop can move to 12, 14, 34 and 32.

$23 - 11 = 12$
$23 + 11 = 34$
$23 - 9 = 14$
$23 + 9 = 32$

To move to the same squares from 23, the rook would need to make two movements: each time the rook would make one move of $\pm$ 10 and one move of $\pm$ 1. This helps illustrate why the bishop's moves are $\pm$ 11 and $\pm$ 9.

For the rook to get from 23 to 12:

$23\ (-10 - 1) = 12$
$23 \quad -11 \quad = 12$

For the rook to get from 23 to 14:

$23\ (-10 + 1) = 14$
$23 \quad -9 \quad = 14$

For the rook to get from 23 to 32:

$23\ (+10 - 1) = 32$
$23 \quad +9 \quad = 32$

For the rook to get from 23 to 34:

$23\ (+10 + 1) = 34$
$23 \quad +11 \quad = 34$

Activity 2

Use the moves of the rook to explain how the number chart can be used to add two numbers or to find the difference between two numbers.

Chess Number Chart

Name: _____

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100