

Summary of learning goals

- These lessons introduce negative numbers through real-world contexts. Students build a strong mental model that they can use to understand what negative numbers are and how they work. The intention is that they will be able to draw on this mental model as they work with negative numbers in later years.

Australian Curriculum: Mathematics (Year 6)

ACMNA124: Investigate everyday situations that use integers. Locate and represent these numbers on a number line.

Summary of lessons

Who is this sequence for?

- These lessons assume no previous experience of directed number.
- At the simplest level, students need to be able to count up and back with positive whole numbers, including using a number line.

Lesson 1: Elevator Challenge

Students play a game that involves moving an elevator up and down in a hotel. Through playing the game they develop a strong mental model of negative integers.

Lesson 2: Solar Temperatures

Students explore the temperatures of the different planets in the solar system. Using a thermometer that models a vertical number line, students read off average temperatures for the planets. They then determine and graph the maximum and minimum temperature ranges for each planet.

Reflection on this sequence

Rationale

This sequence aims to provide a firm foundation for conceptual understanding of negative numbers (i.e. that they indicate directed quantities), and for understanding the meaning of a limited range of calculations with them. This is done using familiar situations as mental models, from which students build the abstract numbers. The focus is on conceptual development and everyday applications. Students use a number line to support any calculation that is required.



reSolve mathematics is purposeful

- Students start with a real-world situation, from which they abstract directed numbers. They use the real-world situation to reason about number properties.
- Students build reasoning skills using a vertical number line as a mental model.



reSolve tasks are inclusive and challenging

- Inclusivity in this sequence arises from use of the real-world situation to develop a firm mental model. Transition from relying fully on the real-world situation to using the somewhat more abstract number line occurs at a pace set by the student.



reSolve classrooms have a knowledge-building culture

- Lesson 1 is presented in a game format, enabling discussion between students.
- Through this sequence students build a deeper knowledge of directed number, as well as a deeper understanding of fractions and decimals.
- The teacher is central to the development of a knowledge-building environment in promoting the positive attitudes of curiosity and independence.

The Elevator Challenge

Y6

About this lesson

Students play a game that involves moving an elevator up and down in a hotel. Through playing the game they develop a strong mental model of negative integers.

Australian Curriculum: Mathematics (Year 6)

ACMNA124: Investigate everyday situations that use integers. Locate and represent these numbers on a number line.

Mathematical purpose

- Students develop a vertical number line as a mental model of positive and negative integers. This lesson focuses on the ordering of negative integers.

Learning intention

- To learn about the numbers with a value below zero.



Time

A lesson of approximately 1 hour.



Vocabulary

- integer
- positive
- negative
- 'negative 3'
- number line



Resources

- reSolve video *1a Elevator Challenge Animation*
- reSolve PDF *1b Elevator Cards* printed double sided (one per pair of students)
- Student Sheet 1 – Elevator Challenge Rules (one per pair of students)
- Student Sheet 2 – Hotel reSolve (one per pair of students)
- 6-sided dice (one per pair of students)
- plastic counters (one per pair of students)

The Elevator Challenge game

Discuss the context of elevators. Introduce the Elevator Challenge game:

Amy and Barry are employees at Hotel reSolve. The manager has given them each six errands to run on six different floors of the hotel. They need to share the elevator to get up and down to complete each task. The person who finishes all their jobs first will be Employee of the Month.



Resources: Show students reSolve video *1a Elevator Challenge Animation*.

Playing the game



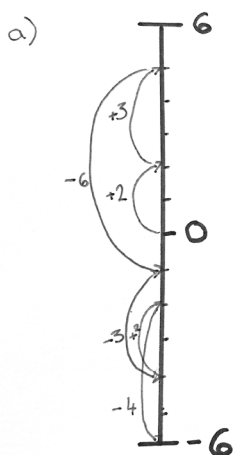
Resources: Provide students with *1b Elevator Cards*, Student Sheet 1 – Elevator Challenge Rules and Student Sheet 2 – Hotel reSolve.

Have students play the game in pairs.

After the students have played the game, ask them to fold the diagram of the Hotel reSolve elevator in half vertically so that only the floor numbers are visible. Have them turn the cards over so that only floor numbers are visible, not the icons. Ask the students to record their movements up and down the elevator.



Possible student response:



b) $0 + 2 + 3 - 6 - 3 + 2 - 4 \dots$

c) We were at the lobby.
I rolled a 2 so we went up to the business centre.
Then Barry rolled a 3 so we went to the spa. Next I rolled 6 so we went down to...

| Starting level | 0 | 2 | 5 | -1 | -4 | -2 | -6 |
|----------------|---------|---------|------------|------------|------------|------------|------------|
| Roll | 2 | 3 | 6 | 3 | 2 | 4 | 2 |
| New level | up to 2 | up to 5 | down to -1 | down to -4 | down to -2 | down to -6 | down to -4 |



Teacher note:

- This is an important shift in the focus of the game because it abstracts the number line. Students will need to focus on the numbers, not the pictures.

Noticing students' working

Observe how students are moving up and down the number line. It is likely that they will start to use zero as a benchmark.

Pose the question: *How is zero helping you move on the number line?*

Discuss how playing the game without the pictures changes students' thinking.

Starting at the second floor

Pose the question: *Imagine that you have just landed at Floor -2, The Car Park. What might your dice roll have been to get there? What level did you come from? What are all the possibilities for how you got to the car park? Show that you have found them all.*

| | Going down to car park | | | | | Going up to car park | | | | | |
|---------------------|------------------------|---|---|---|---|----------------------|----|----|----|----|----|
| Dice roll | 6 | 5 | 4 | 3 | 2 | 1 | × | 1 | 2 | 3 | 4 |
| Floor you came from | 4 | 3 | 2 | 1 | 0 | -1 | -2 | -3 | -4 | -5 | -6 |



Extending prompt:

- Imagine you have just started a game. You start at the lobby. You notice that after three turns you are back at the lobby. What might the three rolls have been?
 - Some of the possible rolls for starting at the lobby and ending back at the lobby are recorded below with number sentences. Note that one of the throws has to equal the sum of the other two throws.

$$0 + 1 + 1 - 2 = 0$$

$$0 + 2 - 1 - 1 = 0$$

$$0 + 3 - 1 - 2 = 0$$

$$0 + 4 - 1 - 3 = 0$$

$$0 + 5 - 1 - 4 = 0$$

$$0 + 6 - 1 - 5 = 0$$

Further activities

Variations of the Elevator Challenge game

- Place all 12 cards on the hotel at the appropriate floors. Players collect the cards when they land on a level. The winner is the player with the most cards.
- Have three players. Deal out the cards as usual but have players keep their cards in their hands so that the others can't see which cards each player has. That way, if you don't have the card for a level, you will be uncertain which of your opponents has it.
- Deal out an extra 'dummy' hand that no-one sees. These cards are now 'safe' floors but no-one knows what they are.

Elevator Challenge Rules

Name: _____









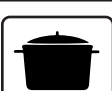


Amy and Barry are employees at Hotel reSolve. The manager has given them each six errands to run on six different floors of the hotel. They need to share the elevator to get up and down to complete each task. The person who finishes all their jobs first will be Employee of the Month.

How to play

1. Deal out the 12 elevator floor cards equally between two players. These are your six errands.
2. A counter (the elevator) is placed at Floor 0, The Lobby.
3. Roll a dice to see which player goes first. The player who rolls the largest number goes first.
4. Player 1 rolls the dice and moves the number of floors according to the number shown on the dice, either up or down as they choose. Whoever holds the card matching the floor the elevator lands on can discard it. Errand complete!
5. Player 2 then rolls the dice and moves the elevator from the level where it is, up or down in either direction. Once again, when the elevator stops, the owner of the card for that level can discard it.
6. Continue rolling the dice, taking turns to move the elevator up or down.
7. The winner is the first player to complete all their jobs and be awarded Employee of the Month!
8. You cannot go above floor 6, below floor -6 or 'bounce' the elevator off the top or bottom. This means if you are on floor 5 and roll a 3, you must go down. Each journey can be in one direction only. You have to move the total of your dice roll.

Hotel reSolve

Name: _____

| | | |
|----|-----------------|---|
| 6 | Pool |  |
| 5 | Spa |  |
| 4 | Restaurant |  |
| 3 | Guest Rooms |  |
| 2 | Business Centre |  |
| 1 | Café |  |
| 0 | Lobby |  |
| -1 | Gym |  |
| -2 | Car Park |  |
| -3 | Kitchen |  |
| -4 | Laundry |  |
| -5 | Deliveries |  |
| -6 | Storage |  |

Solar Temperatures

Y6

About this lesson

Students explore the temperatures of the different planets in the solar system. Using a thermometer that models a vertical number line, students read off average temperatures for the planets. They then determine and graph the maximum and minimum temperature ranges for each planet.

Australian Curriculum: Mathematics (Year 6)

ACMNA124: Investigate everyday situations that use integers. Locate and represent these numbers on a number line.

Mathematical purpose

- To extend students' understanding of negative numbers and build strategies to calculate the difference between positive and negative numbers.

Learning intention

- To work with negative numbers in a real-world situation.



Time

A lesson of approximately
1 hour.



Vocabulary

- maximum temperature
- minimum temperature
- temperature range



Resources

- reSolve PowerPoint *2a Solar Temperatures*
- [Student Sheet 1 – Average Temperatures](#)

Temperatures on the planets

Introduce negative numbers in the context of temperatures.



Resources: Show the students slide 2 of reSolve PowerPoint *2a Solar Temperatures*.

Discuss the idea of average temperatures for the different planets. Students can predict what they think the average temperature might be based on the planet's distance from the Sun.

Show slide 3 and discuss if their predictions were correct.



Teacher notes:

- This information has been sourced from NASA; see <https://solarsystem.nasa.gov/>.
- It is helpful for students to think about -5°C as '5 degrees below zero' as a way of developing the context of the number line and the importance of zero.



Resources: Provide students with Student Sheet 1 – Average Temperatures.

Have students complete the table. Students' responses should be within $\pm 2^{\circ}\text{C}$ for the average temperature.



Possible student response:

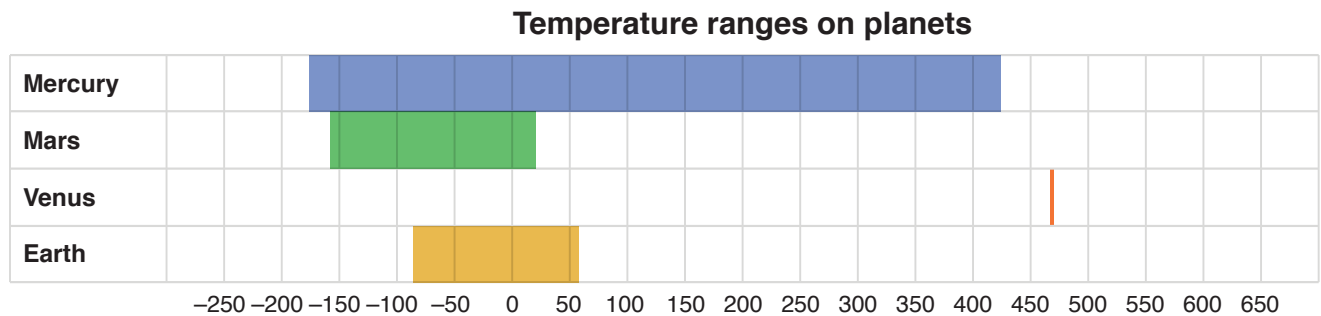
| Planet | Average temp. ($^{\circ}\text{C}$) | Minimum temp. ($^{\circ}\text{C}$) | Maximum temp. ($^{\circ}\text{C}$) | Temp. range |
|---------|--------------------------------------|--------------------------------------|--------------------------------------|-------------|
| Mercury | 167 | -173 | 427 | 600 |
| Mars | -65 | -153 | 20 | 173 |
| Uranus | -197 | | | |
| Saturn | -140 | | | |
| Venus | 462 | 462 | 462 | 0 |
| Jupiter | -110 | | | |
| Earth | 15 | -88 | 58 | 146 |
| Neptune | -225 | | | |

Looking at temperature ranges

Have students complete a horizontal bar graph of the temperature range on Mercury, Mars, Venus and Earth. Students will need to choose an appropriate scale for the graph.



Possible student response:



Noticing students' working

Calculating the temperature range

- It might be helpful for students to use an empty number line to perform these calculations. This helps reinforce the importance of zero as the reference point, not only for describing temperatures but also for performing calculations.

Sharing ideas on data

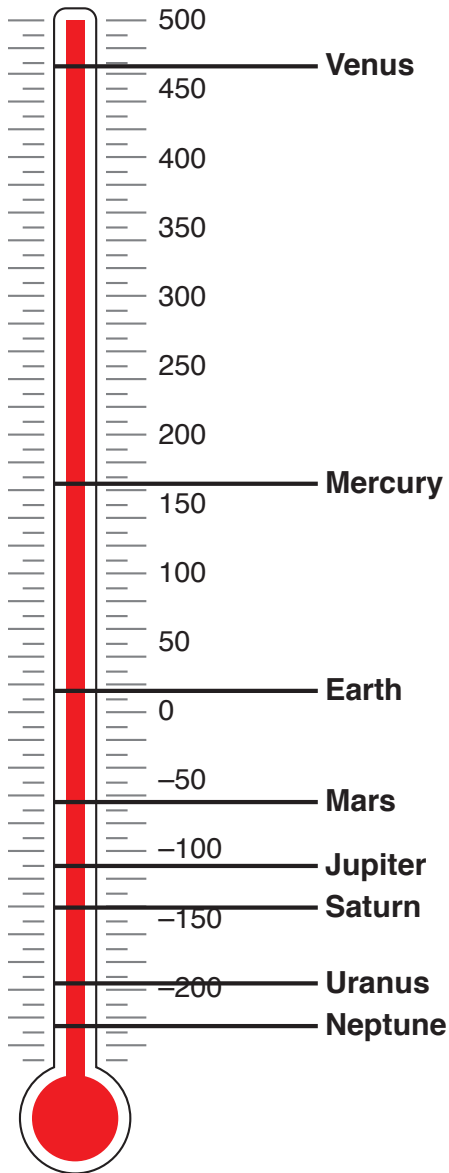
Discuss the completed table and graphs. Ask students what comments they can make on the data; for example:

- Some planets have a very large temperature range, whereas others do not.
- The range is always a positive number even when you have two negative temperatures.

Average Temperatures

Name: _____

Use the thermometer to complete the table.



| Planet | Average temp. (°C) | Minimum temp. (°C) | Maximum temp. (°C) | Temp. range |
|---------|--------------------|--------------------|--------------------|-------------|
| Mercury | | -173 | 427 | |
| Mars | | | 20 | 173 |
| | -197 | | | |
| Saturn | | | | |
| | 462 | | | 0 |
| | -110 | | | |
| | | | 58 | 146 |
| | -225 | | | |

Create a horizontal bar graph of the temperature ranges for Mercury, Mars, Venus and Earth.

Temperature ranges on planets

