Rugged robot 30-second challenge

Students will be exploring formal units of time (seconds) and space (centimetres) whilst engaging in a challenge to guide a robot through a maze. After playing some unplugged games to familiarise students with 10 seconds and 30 seconds, they program a **Rugged Robot** to navigate a maze in exactly 30 seconds. Students will create algorithms and then program the robot using either an app or the button commands to follow a determined pathway. Through repeated testing and timing, they practise measuring elapsed time and comparing their results to the 30-second target. When their robot finishes too fast or too slow, students debug their algorithms or the maze by systematically adjusting movements or distances, then retesting to get closer to the precise time goal.

Curriculum links

This activity is aligned with elements of the following learning areas. We encourage teachers to adapt the content to suit the needs of their students between Year 3 and Year 4. More curriculum details are provided in the supporting documents.

Digital Technologies	Mathematics

Required resources

You will need the following materials:

CSER Lending library kit (Rugged Robot – 4 robots and 4 iPads supplied)

- Rugged Robot (1 per group)
- iPad with Rugged Robot App (1 per group)
- Stopwatch (1 per group)
- Measuring tape (1 per group)
- Outdoor or floor space with masking-tape or chalk
- Record keeping chart – digital or paper

Pre-requisite knowledge

Prior to this session, students would benefit from having experience with:

- playing games that involve locations and position including the language of directions – left, right etc
- giving and following simple directions to position themselves or objects
- Rugged Robot features – simple programming with and without App
- use of a stopwatch to record seconds.

Suggested steps

- **10-second action game**
  Students perform a specific 'silly action' for exactly 10 seconds. When they think the 10 seconds are up, they must freeze in the most ridiculous statue pose possible. You might give them an action e.g., "The Invisible Electric Guitar," "The Slow-Motion Astronaut," or "The Hyperactive Penguin".

  Anyone who is already frozen when the teacher calls "TIME" or presses a buzzer is safe. Anyone who is still moving, or who froze way too early (like at 5 seconds), is out for that round. The "Statue Champion" is the one who freezes closest to the buzzer.

- **30-second estimation game**

  Students find a space of their own to stand. The teacher has a stopwatch but keeps it hidden from view. When the teacher says "GO," students close their eyes and count silently in their heads (or use their own method to estimate time). When they think exactly 30 seconds have passed, they sit down quietly and stay silent. The teacher continues timing until everyone is seated, then reveals who was closest to 30 seconds.

- **Human robot – practising giving instructions**

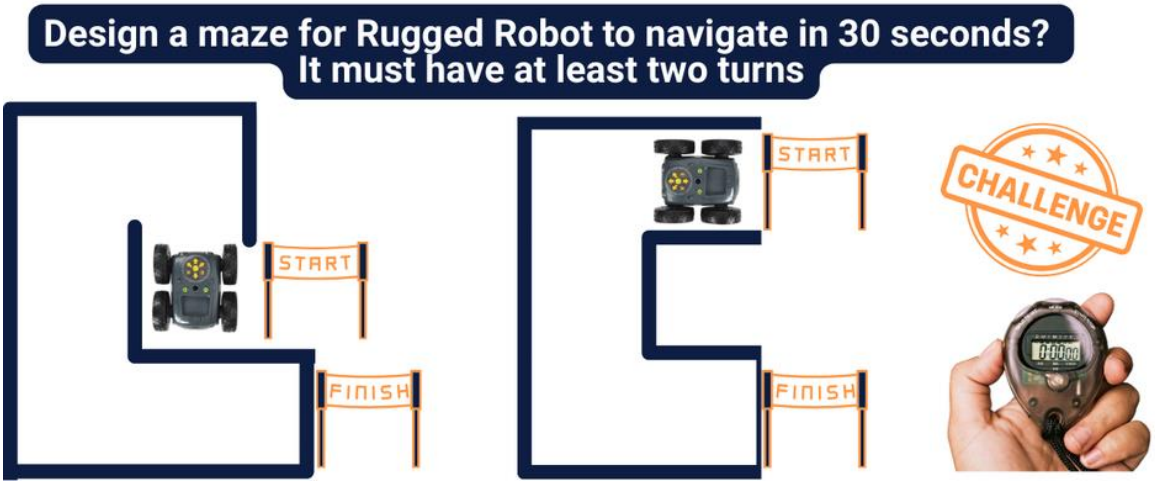
  Students give and follow simple directions to move a classmate "robot" between obstacles, perhaps chairs and tables (forward 3 steps, turn right a quarter turn, etc.). Highlight language: forward, backward, left/right, quarter/half turn, start, finish, obstacle, path.

- **Explore time and distance -** Ask students to explore and answer the following questions:
  - How far does Rugged Robot move in a straight line in 30 secs? _____ cm
  - How many seconds does it take for a Rugged Robot to move 40 cm? _____ seconds
  - How many seconds does it take for a Rugged Robot to follow a 40 cm x 40 cm square? _____ seconds

  Discuss their results.

- **Describe the challenge (If preferred, please alter the challenge to suit your students)**

  Students design a maze for Rugged Robot to navigate in 30 seconds.
  The maze must have at least 2 turns



When planning their maze, have students:

- Create a simple maze (using tape, chalk or physical materials (blocks)).
- Write the algorithm (pseudocode) and program (code) the robot to follow the path.
- Test, time and record the results. Calculate the difference between the result and the 30-second goal.
- Refine algorithm **if necessary.**
- Refine maze **if necessary.**
- Keep updating the code and repeating trials until the pathway is achieved in as close to 30 seconds as possible.

	Goal	Actual time (seconds)	Difference How many seconds too many or too few?
Test 1	30 seconds		
Test 2	30 seconds		
Test 3	30 seconds		

Additional challenges

- Try different times (45 seconds, 60 seconds).
- Add obstacles they must avoid.

Group work ideas

Allocate roles that rotate at given intervals

- Programmer – inputs algorithm and places robot at START and press PLAY in the App or GO on the robot
- Timekeeper - starts the stopwatch when the robot moves and stops the timer when the robot finishes
- Record keeper - records the actual time and calculates the difference for each attempt.

Mathematics note [Australian Curriculum]

Turn: the measures of turn concept is formally introduced at Year 3
Definition:
A measurement of rotation from an initial starting position.
A turn can be a fraction of a circle (quarter turn) or complete rotation (revolution).
It can be directional (clockwise or anti-clockwise).
A quarter turn is the same as a right angle; a half a turn is greater than a right angle and is the same as 2 right angles; a three-quarter turn is greater than a right angle and is the same as 3 right angles

Younger students using a Rugged Robot could be encouraged to use the term 'right turn'.
Two right turns = a right angle or 90°.

Rugged Robot instructions

Using the robot buttons

Forward - one 20 cm step forward
Side arrow right - 45° turn to right
Side arrow right (twice) - 90° turn to right

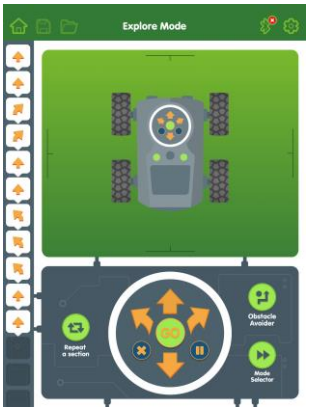
Side arrow left - 45° turn to left
Side arrow left (twice) - 90° turn to left
Back arrow – one 20 cm move backward
X – deletes program
II – pauses motion for 1.5 secs

Using the App

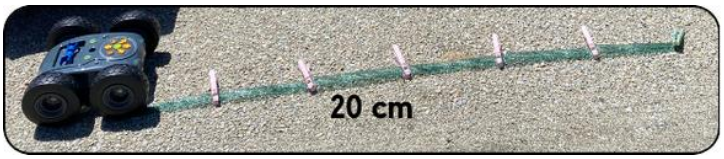
Using the Rugged Robot App, users can design the algorithm, including using the repeat function.

Connect the robot via Bluetooth to the iPad.
The app can retain up to 256 steps.

The algorithm can be viewed before being run.



To visualise 20 cm, use pegs on a ribbon spaced at 20 cm



Pose questions

Use these example open-ended questions to prompt student reflection, check for understanding, and encourage discussion to help students explain their thinking and build on each other's ideas.

- What have you discovered about the turns the robot makes? How far does it go in one press? Two presses? When pressing a turn arrow, does the robot move forward?
- How did you alter your code to achieve the 30 second goal?
- How did you alter your maze to achieve the 30 second goal?
- Can you represent your algorithm in a variety of ways?

Why is this relevant? (Real world connections)

This activity helps students see how maths and programming are the same tools engineers use to manage everything from delivery drones to self-driving cars. By adjusting their program to hit an exact time, students practise the iterative, real-world logic used to solve technical problems in the modern workforce.

Assessment

Observation can be used to check students' ability to carry out tasks aligned to the Australian Curriculum. We have included some suggested questions for teachers to reflect on and to guide these observations.

Checking for understanding

- Were the students able to follow and describe an algorithm required to demonstrate the solution to the problem?
- Were they able to debug and adjust their algorithm to meet the time required?
- Did they use positional and directional language accurately?

For more assessment resources we recommend the Assessment resources on Digital Technologies Hub.

Supporting document

Australian Curriculum

Depending on teacher judgement and classroom requirements, this activity could be adjusted for students between Year 3 and Year 4.

Digital Technologies

Students learn to:

- follow and describe algorithms involving sequencing, comparison operators (branching) and iteration (AC9TDI4P02) (Years 3 & 4).

Mathematics

Students learn to:

- identify angles as measures of turn and compare angles with right angles in everyday situations (AC9M3M05) (Year 3 Measurement)
- recognise and use the relationship between formal units of time including days, hours, minutes and seconds to estimate and compare the duration of events (AC9M3M030) (Year 3 Measurement).

Teacher professional learning opportunities

We would like to thank the Australian Government Department of Education for funding our Lending Library and the associated resource development.

We run a range of STEM programs for Australian teachers, including our online CSER MOOC courses, free professional learning events, and our National Lending Library.

Our free, self-paced online courses available from CSER and Maths in Schools in the following areas:

- Decoding Digital Technologies - Primary
- Digital Technologies + X - including a Sustainability module
- Cyber Security and Awareness – Primary and Secondary
- Teaching AI in the classroom – Primary and Secondary
- Maths in Schools – Foundation – Year 2, Year 3 to 6 and Year 7 to 10

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