



Design your own Mission to the Moon!

TEACHER'S GUIDE

This resource is intended to assist in the planning and running of the *Design your own Mission to the Moon!* workshops/lessons. Use with the associated worksheet, and feel free to move, add or remove pages/activities as you see fit.

Mission Summary

As the teacher, you're the mission commander guiding students through their lunar rover journey.

Target Age Group & Subject Areas:

- Best suited for **Years 5–8**.
- Links to **Science, Technology, Design & Technologies**, and **Digital Technologies** curriculum areas.
- Flexible enough to be adapted for upper primary or lower secondary levels.

Recommended Duration:

- The full workbook is designed for **3–4 lessons of 45–60 minutes each**.
- Activities can also be delivered as standalone tasks for shorter sessions, STEM clubs, or enrichment activities.

Learning Outcomes:

By completing this workbook, students will be able to:

- **Identify** challenges of the lunar environment and why exploration is important.
- **Design** rover features (sensors, power systems, mobility) to meet specific mission goals.
- **Plan** and sequence a rover's mission timeline.
- **Communicate** their ideas through drawings, labels, and a mission briefing card.

Equipment Needed:

- Printed copies of the workbook (one per student).
- Pencils, coloured pencils, rulers.
- Optional: scissors, cardboard and glue for a craft activity add-on.
- Whiteboard/projector for whole-class discussion.

The following pages are titled to match each activity of the Student Workbook.

Welcome, Mission Specialist!

A summary of activities and learning outcomes is below.

Part 1: Mission Design

Activities:

- **Choose** mission objective (search for water, study Moon dust, collect Moon rocks).
- **Plan** how the rover will sense, move, and use tools.

Learning Outcomes:

- Students can **identify** and **justify** a mission goal for lunar exploration.
- Students can **describe** how sensors, movement systems, and tools help meet specific objectives.

Part 2: Rover Design

Activities:

- **Draw** and **label** the rover design.
- **Plan** how to keep the rover operating in the harsh lunar environment (protection, power, communication, gravity).

Learning Outcomes:

- Students can **represent** a rover design visually and **label** its key features.
- Students can **explain** environmental challenges on the Moon and **propose** design solutions.

Part 3: Design Review

Activities:

- **Check** rover design against a mission checklist.

Learning Outcomes:

- Students can **evaluate** their rover concept against mission requirements.
- Students can **identify** missing or incomplete design elements and **refine** their plan.

Part 4: Concept of Operations

Activities:

- **Plan** the rover's mission timeline (launch to mission end).

Learning Outcomes:

- Students can **create** a sequential plan of tasks aligned with a mission objective.
- Students can **link** rover actions to mission goals and constraints (e.g., sunlight period).

Part 5: Mission Complete

Activities:

- **Imagine** rover's discoveries and **illustrate** them.
- Fill in the Mission Briefing Card (launch date, name, objective, best feature, discovery).

Learning Outcomes:

- Students can **communicate** mission outcomes through drawings and written details.
- Students can **summarise** their rover concept and discoveries in a structured format.

Your Mission Objective

Summary of task: Students select one of three main mission objectives for their rover (e.g., searching for water, studying Moon dust, or collecting Moon rocks). They will later design features that help achieve that mission.

Facts:

- Scientists believe some water exists as ice in permanently shadowed craters near the Moon's poles. Finding water is important for drinking, growing food, and making rocket fuel for future astronauts.
- Moon dust (regolith) is made of tiny particles created by billions of years of meteor impacts. It contains minerals like silicon, aluminium, calcium, magnesium, and iron. In some areas, it may also hold traces of oxygen or other chemicals.
- Because there is virtually no atmosphere on the Moon and no weather, regolith particles are very sharp and can damage machines, clog joints, and be harmful to breathe in.
- Moon rocks can tell scientists the Moon's age, how it formed, and whether it has ever had volcanic activity. Some rocks may be over 4 billion years old.

Creative Suggestions: Encourage students to mix science with imagination (e.g., "A rover with a conveyor belt arm to collect dust samples"). Let them think of extra 'bonus' goals beyond the three listed.

Questions to Ask:

- Why might we want to collect rocks?
- What could scientists learn from dust from another world?
- What would you like to know about the Moon?

Assessment:

Excellent: Mission is clearly chosen, with a short reason why.

Good: Mission is chosen but no clear explanation.

Needs Support: No clear mission selected.

How Will Your Rover Work?

Summary of task: Students design how their rover will sense, use tools, and move to complete its mission. They decide on sensors, movement style, and any special arms or tools.

Facts:

- Sensors help a rover gather information. Cameras can take pictures and videos to 'see' the surface. Spectrometers can analyse the light reflected from rocks and dust to find out what they are made of. Touch sensors, drills, and scoops can feel, collect, and test materials.
- Because the Moon has almost no atmosphere, microphones can't hear sound in the air, but they can pick up vibrations through solid surfaces.
- Movement systems vary: wheels are reliable and easy to control, tracks give better grip on loose ground, legs can step over obstacles, and hoppers or springs can jump over rough areas.
- Some rovers have robotic arms to pick up samples or move tools into place. Power usually comes from solar panels.

Creative Ideas

- Try adding multiple senses (e.g., camera + touch pad).
- Use unique 'hands' like claws, scoops, brushes.
- Try different movement types (e.g., hopper for craters, levers for climbing).

Questions to Ask

- How will your rover know it's found something important?
- How will it avoid obstacles?
- How will it send information to Earth?
- How fast should it move?

Assessment

Excellent: Chose suitable sensors, tools, and movement, with clear explanations of how they support the mission.

Good: Chose mostly suitable features but with limited explanation or missing one area.

Needs Work: Features unclear, unrealistic, or unrelated to the mission.

Draw and Label Your Rover

Summary of task: Students draw attachments/features of their rover on a basic rover body (modelled off Roo-ver). They will show where they will place its sensors, tools, movement parts, and other features. They should label each part clearly.

Facts:

- Solar panels turn sunlight into electricity to power the rover. If they are on the side of a rover, this means that it is intended to land in a polar region of the Moon, where the sun stays on the horizon.
- The front face often contains cameras and other sensors to 'see' ahead. These can also be placed at the back for flexible movement.
- Radiators help release heat into space so the rover does not overheat.
- Wheels are the most common means of movement for rovers, but there are other concepts that may be feasible.

Creative ideas

Encourage students to add imaginative touches, like extra fold-out solar panels, unusual wheel designs, or multi-tool arms. They could colour-code different parts (e.g., sensors in blue, movement parts in black).

Questions to ask

- Where will you put your sensors so they work best?
- How will your rover move on bumpy ground?
- Do you think anything is missing?

Assessment

Excellent: Diagram includes all important parts with clear, accurate labels.

Good: Diagram includes most important parts but labels are unclear or incomplete.

Needs Work: Few parts are shown, or labels are missing/incorrect.

PART 2: ROVER DESIGN



Keep Your Rover Operating

Summary of task: Students create short plans to keep their rover working on the Moon. They will decide how to protect it from extreme temperatures, radiation, communication problems, and low gravity. They will also make a plan for how it will get power, send signals, and stay upright. Feel free to provide extra paper to allow more detailed responses.

Facts:

- On the Moon, it can reach about $+130^{\circ}\text{C}$ in sunlight and drop to about -170°C in areas of permanent shade.
- Without an atmosphere or magnetic field, the Moon gets more radiation from the Sun and space, which can cause electronics to malfunction or stop working completely.
- Solar panels work best in sunlight and must face the Sun to generate electricity. Facing solar panels away from the Sun or spending too much time in shadows can prevent power generation.
- Signals from a rover are sent via the lander vehicle to Earth. Big rocks, craters, or the rover itself can block the signal if the antenna is not positioned well.
- The Moon's gravity is about $1/6$ th that of Earth's. This means the rover weighs less, making it easier to tip over. Wider wheels or low centres of gravity can help prevent tipping.

Creative Ideas

Encourage students to think about unusual ideas, such as temperature regulation inspired by nature, or moving solar panels to follow the Sun. They could also invent special 'anti-tip' legs or stabilisers.

Questions to ask

- What would happen to your rover if it stayed in the shade for a whole day?
- How could your rover keep sending data to Earth if something blocked the signal?
- What shapes or designs help stop a rover from tipping over?

Assessment

Excellent: Includes clear and realistic plans.

Good: Includes some plans but missing detail in one or more areas.

Needs Support: Plans are incomplete or not relevant to the task.

Mission Checklist

Summary of task: Students review their rover design against a checklist to make sure it has everything needed for success on the Moon. The goal is for them to think critically about whether their rover can move, see, communicate, get power, stay safe, and achieve its mission. This step helps them consolidate their ideas into a complete design.

Consider running this activity in pairs or small groups to encourage discussion and thought, rather than simply checking off all the boxes. For a more interactive session, ask students to present their designs and have their peers complete the checklist for them, based on what they presented.

Facts:

- Real space missions go through structured reviews at every major step of design and build.
- These reviews check that the mission is safe, realistic, and ready for the next stage.
- Reviews are often run by independent panels of experts outside the mission team.
- Common types of reviews include:
 - Preliminary Design Review (PDR): Checks that the mission concept and design make sense.
 - Critical Design Review (CDR): Ensures the final design is sound and ready for building.
 - Qualification Reviews: Confirm the hardware can survive the harsh conditions of space.
- Just like a real mission team, students use their checklist to confirm their rover has the essentials: it can see, move, get power, communicate, stay safe, and achieve its mission.

Questions to ask

- How do you know your rover is ready to do its job?
- Is there anything this checklist is missing, do you think?

Assessment

Excellent: Checklist is complete, with thoughtful discussions.

Good: Most items are covered, but some tasks are ticked that are not complete.

Needs Support: Checklist is mostly incomplete or checked off without consideration.

Mission timeline

Summary of task: Students plan the schedule for their rover's 14-day lunar mission (one full lunar daylight cycle). They write what their rover will be doing or discovering at key points: launch, landing, early tasks, mid-mission activities, big discoveries, and the final signal before the lunar night.

Facts:

- A lunar day (sunrise to sunset in one location) lasts about 14 Earth days, followed by about 14 days of darkness and extreme cold.
- Missions must be planned carefully to make the most of the sunlight period, especially if the rover uses solar power.
- Real missions use a timeline or operations plan to schedule tasks so important goals are completed before the end of the mission.
- It can take time for the rover to drive to new locations on the Moon, so travel needs to be taken into account in the timeline.

Creative ideas

Encourage students to think like real mission planners - they could include travel time, setting up experiments, taking photos, or checking rover health. They can also invent unexpected events (e.g., a crater in the way, or a new discovery that changes the objective) and explain how the rover or mission adapts.

Questions to ask

- Why do you think scientists or engineers need a clear timeline before starting a mission?
- How might the timeline change if the rover finds something surprising?
- Which day do you think would be the most exciting for your rover?

Assessment

Excellent: Timeline is filled in for every day, with creative but logical tasks linked to the mission goal.

Good: Most days are filled in, with tasks that relate to the mission.

Needs Support: Only a few days completed or tasks don't connect to the mission.

Mission Discoveries

Summary of task: Students imagine the end of their rover's journey and show what it has discovered. They record this through a drawing or short writing task, add a "camera photo" sketch, and decide how people on Earth might use the discovery.

Facts:

- Discoveries from lunar missions help scientists understand the Moon's history, resources, and future potential for astronauts.
- Apollo astronauts brought back 382 kilograms of Moon rocks and soil, which are still studied today.
- Moon dust and rock samples may tell us about volcanic activity, impacts from asteroids, and whether water or other useful materials are present.
- Water ice is especially valuable - it can be turned into drinking water, oxygen for breathing, or fuel for rockets.

Example Answers

- *Discovery:* "My rover found a rock with crystals inside."
- *Camera Picture:* A sketch of the rover next to a crater, with a sample in its arm.

Creative ideas

- Encourage students to combine imagination with science, e.g., "The rover finds a glowing rock that helps plants grow on the Moon." Some students may want to link discoveries to helping astronauts live on the Moon; let them brainstorm practical uses. Others might prefer sharing the discovery with the public, e.g., museum, exhibition, or even a special "Moon science day."

Questions to ask

- How would your discovery help scientists or astronauts?
- What tools would your rover need to collect it?
- Why would this find be exciting to share with people on Earth?

Assessment

Excellent: Student clearly shows a discovery, adds a camera picture, and explains how it could be used on Earth or in space.

Good: Student shows a discovery and either a camera picture or how it could be used.

Needs Support: Student makes a vague drawing or doesn't link their discovery to a use.

Mission briefing card – Your lunar rover

Summary of task: This is a fun wrap-up activity for students to summarise their mission in one final 'official' card. They will record key details like the rover's name, the mission commander, the mission's main objective, and the rover's best feature. They can also draw either themselves as the mission commander or their rover.

The card acts as a keepsake for the student and can be taken home or displayed in class.

Thank you for sharing these activities with your students.

Keep an eye out for more resources, webinars and events at www.roovermission.com.au.