Teacher Notes

Themes

- Mars
- Space travel
- Our solar system

Key learning outcomes

- Learn what we currently know about Mars
- Discover the variety of disciplines needed to mount a mission to Mars
- Understand some of the difficulties and solutions for space exploration
- Explore the possibilities for humans living on another planet

Key curriculum areas

- **Science:** Science Understanding (Earth and space sciences); Science Inquiry Skills; Science as a Human Endeavour
- **English:** Language; Literacy
- **Mathematics:** Measurement and geometry
- **Ethical Understanding:** Understanding ethical concepts and issues
- **General Capabilities: Literacy**

Publication details

How to Survive on Mars

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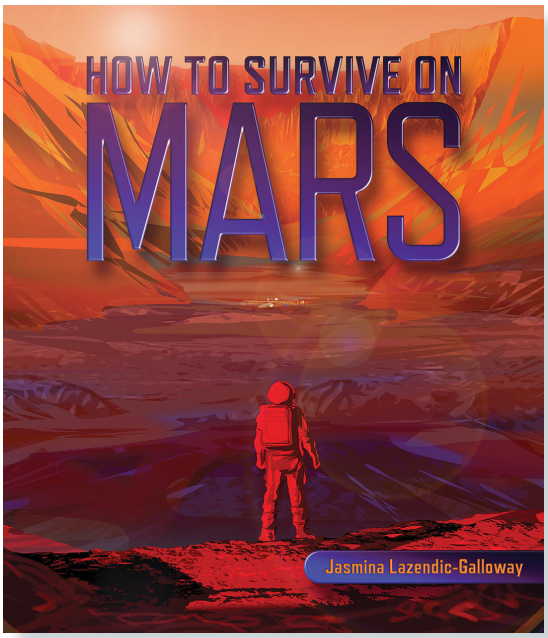


How to Survive on Mars

Jasmina Lazendic-Galloway

About the book

Get ready for lift-off on a Martian adventure!

Have you ever imagined living on another planet? What about Mars? With not enough air to breathe, sunlight to keep us warm, or any available food and water, life on Mars is going to be a challenge ... but it just might be possible!

Take a journey to the Red Planet in *How to Survive on Mars*. Discover natural wonders like ancient polar ice caps, the highest volcano in the solar system and a 45-kilometre-wide impact crater that was once a Martian lake.

Packed with stunning photographs, fun activities and quizzes, this book will show you what you need to do to survive on Mars! Join scientists, engineers, archaeologists, ethicists and science-fiction writers for a space exploration adventure.

Recommended for

Readers aged 8 to 12 (Years 3 to 6)

CSIRO PUBLISHING

Teacher Notes

About the author

Jasmina Lazendic-Galloway is an astronomer and educator. A passionate science communicator, she has appeared on numerous television and radio shows, written popular science articles and led a popular online course about Mars. She is a member of the National Space Society of Australia.

Pre-reading questions or activities

Mars is currently known as the robot planet, since machines are the only inhabitants there. Watch this short clip about preparing and landing the first airborne rotorcraft, or helicopter, on Mars. Remember that some of the images in this clip are not actual records, but are animated renditions of what it will look like on the surface. Keep an eye out for the Perseverance rover (at 2'45"), the actual device on which the Ingenuity Mars helicopter hitched a ride for its journey to the surface of the planet.

https://mars.nasa.gov/mars2020/multimedia/videos/?v=442

Can you see where the energy comes from to give this helicopter its lift? How long has it taken the scientists to design, engineer, fabricate, test and program this Mars aircraft?

Solar panels harvest energy from the Sun. It took at least 6 years to develop Ingenuity (2014 is the first labelled date, and the clip is dated 2020). Ingenuity, nicknamed Ginny, successfully landed on Mars on 18 February 2021. She has completed over 20 flights so far. For status updates on Ingenuity, check: https://mars.nasa.gov/technology/helicopter/status/

Discussion questions

Science

1. Using the information in Chapters 1, 4 and 5, discuss the differences between Earth and Mars and, as a class, create a comparison table (or illustrative mind map) on the whiteboard. Address elements such as size, length of orbit and rotation, gravity, the presence and state of water, atmosphere, moons, mass, surface temperature, sunsets, magnetosphere, geology, distance from our Sun, and seasons.

2. Look at the posters in the book that are advertising various employment opportunities. Are you surprised at the variety of specific occupations and tasks that will be required when humans reach Mars? Which ones appeal to you at the moment, ones that already suit some of your interests and skills? Can you think of other jobs that will need to be performed there, including in STEM areas (hint: look at the Martian profiles for inspiration)?

   Surveyor (p. 61)

   Technician (p. 69)

   Farmer (p. 79)

   Construction worker (p. 93)

   Maintenance worker (p. 101)

   Explorer (p. 103)

   Teacher (p. 104)

   Tour guide (p. 105)

   Other jobs: hydrologist, chemist, historian, aerospace engineer, soil scientist, psychologist, doctor, mechanic, artist/entertainer, astrobiologist and more!

3. Living on Mars, even for only 2 years, would mean some of your five senses would need to adjust to less (or different) input. What things would you miss seeing, touching, tasting, hearing and smelling? Is there some way you can think of to accommodate this if you were on a Mars mission?

   For instance: red sunsets (bring some photos), cuddling pets (pack a soft toy), eating oranges (pack a few lollies), hearing birds (bring a recording), smelling flowers (pack an essential oil).

Mathematics

The book explains that it takes approximately 7 months to get to Mars and about 3 days to get to the Moon from Earth. Calculate how many trips to the Moon it would take to travel the same distance as Mars is from Earth. Since Mars travels in an orbit that differs from Earth's, that means it is sometimes much further away from Earth, so now figure out how many trips to the Moon it would take if the travel time to Mars was 9 months.

Assuming a month has 30 days, then a 7-month journey to Mars would be the equivalent of about 70 trips to the Moon (30 × 7 = 210, 210 ÷ 3 = 70). A 9-month journey would be equal to roughly 90 flights to the Moon (30 × 9 = 270, 270 ÷ 3 = 90).

Ethical Understanding

Chapter 9 of the book is titled 'Living sustainably and ethically on Mars'. How are the two concepts **sustainability** and **ethics** connected? What responsibilities do we have to future generations, to people who have not yet been born? In this context, what arguments are there to support the expense of sending people to Mars?

Responsibilities: We should leave our environment in better shape than we have inherited it, and not waste our resources or degrade our environment and the life that depends on it. Rationale: Mars is not planet B for us (see p. 102) so the discoveries we make from our observations and experiments there need to be applicable to living more fairly and respectfully on Earth.

Activities

Science

So far away!

It can be very difficult to get an understanding of just how far apart the various celestial bodies in our solar system are. Most drawings don't show the vast distances because there isn't a sheet of paper big enough! This activity will help. You will need a table tennis ball, a marble, a small cherry tomato and a measuring tape. At some point, you may have to head outside to the school oval or to a nearby park.

Explain to the class that the table tennis ball (4 centimetres in diameter) will represent Earth, the marble (1 centimetre in diameter) will be the Moon and the cherry tomato (2 centimetres in diameter) will be Mars. Ask students to predict where the three spheres should be placed to accurately represent their distances apart. Record their decisions.

The Moon is 30 Earth diameters away from us so it will be 30 × 4 centimetres, or 1.2 metres, away. You can place the ball on a desk at the front of the room and decide where to place the marble. Next, demonstrate that because Mars is approximately 55 million kilometres from Earth while the Moon is 385 000 kilometres away, then Mars needs to be 143 times further away from Earth than the Moon is. At this scale, Mars is 171 metres from Earth. Here is where you take the class outside with the ball, the marble and the tomato, to see if you can mount your three scale models at the correct distances from each other, with students doing the measuring. Compare the actual distances with the predictions the students made earlier.

From this activity, you can see why accurate to-scale models of the solar system are rare. One day though, students may find themselves in Melbourne, and can take the Solar System walk or bike ride along the St Kilda foreshore, where there is a fascinating to-scale model of our Solar System that stretches 6 kilometres and includes Pluto. https://stkildamelbourne.com.au/wp-content/uploads/2015/11/Solar_System_Self_Guided_Trail_web_friendly.pdf

Observe Mars with NASA's telescope

Would you like to have your own picture of Mars? You can use NASA's supported telescopes to get it!

Step 1: Go to the MicroObservatory website at: https://mo-www.cfa.harvard.edu/OWN/. MicroObservatory is a network of robotic telescopes, developed by scientists and educators at the Harvard-Smithsonian Center for Astrophysics (Massachusetts, USA) for NASA, that can be controlled over the internet.

Step 2: Click on the 'Control telescope' tab.

Step 3: You will see a list of targets, and you can click on 'Mars Observe' to request your image.

Step 4: You will be asked to select some settings for the telescope – experiment with the settings to see what is different between the images. Then click 'Continue' and 'Submit' and wait a few days to get an email pointing you to your data. Exciting!

On the website, under 'Analyze Images', you can also find instructions on how to view the telescope images and create finished images. You can practise on existing images while you're waiting on your data.

Original concept for this activity by Jasmina Lazendic-Galloway.

English

Useful index

The index at the back of a book is a very handy way of helping you find information on a particular topic that may be sprinkled throughout the text. In this activity you will practise using an index.

Step 1: The teacher will write the following topics on pieces of paper, duplicating enough so that each student (or group of students) can pick one out of a hat:

- asteroids
- atmosphere
- bacteria
- chemical energy
- dust
- elements
- food
- fuel
- heat
- hydrogen
- International Space Station
- minerals
- orbiter
- regolith
- rovers
- water

Then students are to find that topic in the index and go to the pages in the book to locate the information.

Step 2: Ask students to combine and summarise that information into a couple of paragraphs and report back to the class on what they've gathered.

An example would be the topic **magnetic field**, and information on this subject will be found on pages 21, 47 to 49, and 91. Some of the topics may also appear in the glossary.

Teacher Notes

Space words

Using the worksheet provided on the next two pages, complete the crossword puzzle. You may find the glossary in the book quite helpful. At least three of the words have distinct meanings in other contexts. Can you find two of them?

Solutions:

ACROSS

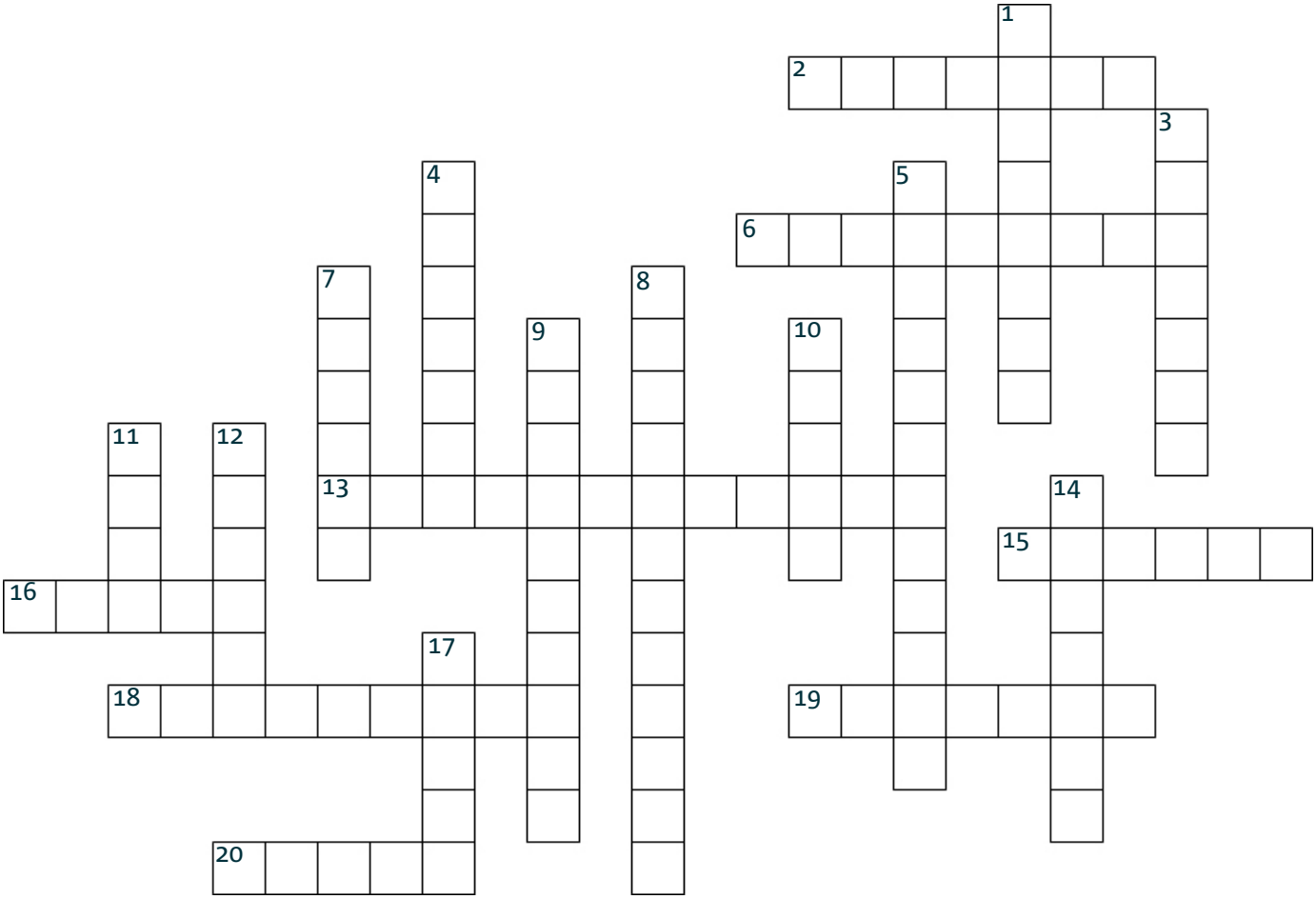
2. Payload
6. Sublimate
13. Extremophile
15. Galaxy
16. Comet
18. Scrubbing
19. Gravity
20. Ozone

DOWN

1. Polymers
3. Element (also feature, point or component)
4. Solvent
5. Planetesimal
7. Lander
8. Astrobiology
9. Wavelength
10. Orbit (also range, sphere of influence, domain)
11. Atom
12. Crater
14. Habitat
17. Fibre (also material, thread or textile)

Worksheet

Space words



ACROSS

2. What a rocket carries
6. Turn from a solid directly into a gas
13. Something that lives in an extreme environment
15. The Milky Way is one
16. A small celestial body
18. Removing harmful gases
19. The force that keeps our feet on the ground
20. This atmospheric layer is protective

DOWN

1. The building blocks of some human-made materials
3. A group of two or more atoms
4. Something that dissolves substances
5. Tiny planet-like body
7. A space craft that lands
8. The study of life on planets
9. The distance between two peaks of a wave
10. The path Mars takes around the Sun
11. The smallest part of an element
12. What's left after a meteorite hits Mars
14. Natural living environment
17. Indigestible part of a plant

Source: https://puzzlemaker.discoveryeducation.com/

Australian curriculum links

Year level	Learning area: Science	Other learning areas
Years 3/4	**Science Inquiry Skills: Processing and analysing data and information** • Use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends (ACSIS057) • Compare results with predictions, suggesting possible reasons for findings (ACSIS215)	**Mathematics: Measurement and Geometry** • Use scaled instruments to measure and compare lengths, masses, capacities and temperatures (ACMMG084) **Ethical Understanding: Recognise ethical concepts** • Identify ethical concepts, such as equality, respect and connectedness, and describe some of their attributes
Years 5/6	**Science Understanding: Earth and space sciences** • The Earth is part of a system of planets orbiting around a star (the sun) (ACSSU078) **Science as a Human Endeavour: Use and influence of science** • Scientific knowledge is used to solve problems and inform personal and community decisions (ACSHE100)	**Mathematics: Measurement and Geometry** • Solve problems involving the comparison of lengths and areas using appropriate units (ACMMG137) **English: Language** • Understand the use of vocabulary to express greater precision of meaning, and know that words can have different meanings in different contexts (ACELA1512) **English: Literacy** • Navigate and read texts for specific purposes applying appropriate text processing strategies, for example predicting and confirming, monitoring meaning, skimming and scanning (ACELY1702)
All	**General Capabilities: Literacy** • Levels 3 and 4: Navigate, read and view learning area texts.	

Related books from CSIRO Publishing

For younger readers (aged 5–8):

- *Shine, Star, Shine!* (https://www.publish.csiro.au/book/8089/)

For older readers (aged 8–12):

- *AmAZed! CSIRO's A to Z of Biodiversity* (https://www.publish.csiro.au/book/7984)
- *Bots and Bods: How Robots and Humans Work, from the Inside Out* (https://www.publish.csiro.au/book/8013)
- *Imagining the Future: Invisibility, Immortality and 40 Other Incredible Ideas* (https://www.publish.csiro.au/book/7344)

Other CSIRO resources

CSIRO has developed and delivered a broad range of high-quality STEM education programs and initiatives for nearly 40 years. Our programs aim to inspire the pursuit of further STEM education among students and the community, to equip the emerging workforce with tomorrow's skill sets, and to strengthen collaboration between industry and classrooms across Australia. For more information visit: https://www.csiro.au/en/Education