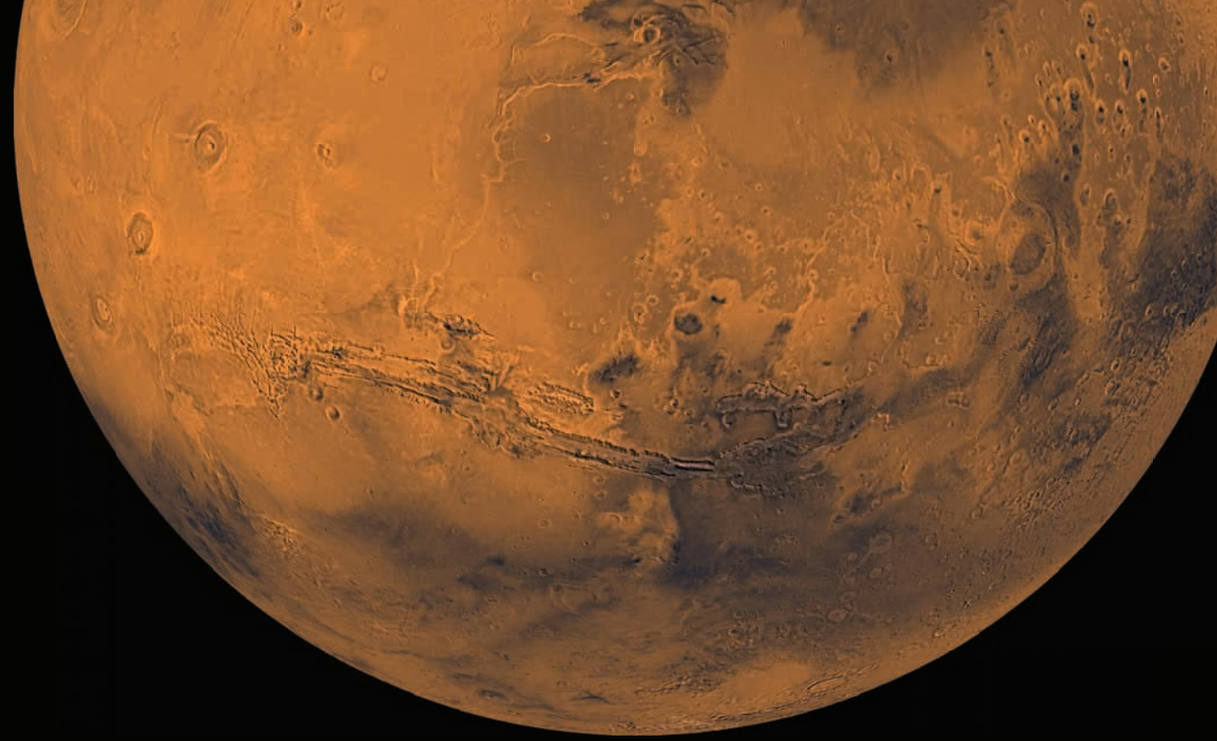
BECOMING A MARTIAN

by Clare Knighton



Seventy thousand years ago, our first ancestors left Africa to discover the world. Three thousand years ago, the first intrepid sailors began to cross the vast Pacific Ocean. In 1969, Neil Armstrong and Buzz Aldrin set foot on the moon. We have exploration in our DNA. Now, some people want to visit Mars …

Boots on Mars

On average, Mars is around five hundred times further away than our moon, and it takes eight months to get there. Any mission to Mars can only leave Earth – or return from Mars – every twenty-six months, when the two planets are at the closest point in their **orbits**. This means the first astronauts to Mars will be gone a long time. Still, plans for people to travel there are under way. Some people think "boots on Mars" will happen as soon as 2024.

These first people to Mars will be highly trained, but after that … who knows? Perhaps they'll ask for volunteers to be the first Martian settlers. Before you put your hand up, though, there are lots of problems to solve. And you'll definitely want to make sure they've been sorted! Earth has everything you need to survive: oxygen, water, food, and shelter. These things aren't so easy to find on Mars.

Meet Mars

Place in solar system: Fourth planet from the sun

Mass: One-tenth of Earth's mass

Diameter: Half of Earth's diameter

Length of day: 24 hours, 39 minutes

Length of year: 687 Earth days

Gravity: One-third of Earth's gravity

Surface pressure: 0.6 **kPa** (1 percent of Earth's)

Temperature: –55°C on average (but varies from –133°C at the poles in winter to 27°C at the equator in summer)

Atmosphere: Carbon dioxide (95.3 percent), nitrogen (2.7 percent), argon (1.6 percent), oxygen and other gases (less than 1 percent)

Fresh water: A tiny amount flows on the planet's surface

Moons: Two (Phobos and Deimos)

Geological features: Mars is known as the Red Planet because of its colour (caused by large amounts of **iron oxide**). Other features include polar ice caps, Olympus Mons (the largest volcano in the solar system), and Valles Marineris (one of the largest canyons in the solar system).

1. The Oxygen Challenge

The air on Earth contains a lot of oxygen (around 21 percent). Your body uses this oxygen to burn fuel to make energy. On Mars, the atmosphere is 95 percent carbon dioxide. Breathing this would mean certain death because the carbon dioxide would replace the oxygen in your red blood cells. You would last around two minutes.

Possible Solutions

Carbon dioxide (CO_2) is made up of both carbon and oxygen. NASA has a machine called MOXIE, which uses electricity to split carbon dioxide into carbon monoxide (CO) and oxygen (O). NASA intends to send this machine to Mars in 2020. The Mars One mission (an organisation that wants to see a permanent human settlement on Mars) has another plan: to split water (H_20) into hydrogen gas (H) and oxygen.

Both these methods can provide oxygen, but they require lots of energy. There are ways to get this energy, like using a special kind of solar panel that can make electricity from the sun. However, this idea isn't trouble-free. Mars has dust storms, which can last many months. These storms would seriously affect the amount of electricity the panels could make.

There's also the option of magma in one of the volcanoes on Mars – although it's doubtful any are still active. The magma's heat could be used to make steam. Steam is a source of energy used by geothermal power stations on Earth. But perhaps the easiest solution is to just rely on bacteria and plankton. Over millions of years, these living organisms would eventually convert CO_2 into oxygen – just like they did on prehistoric Earth.

2. The Water Challenge

It doesn't rain on Mars. This means the planet has no rivers or lakes. Water is found as ice in the polar ice caps, but these ice caps are covered in a thick layer of frozen carbon dioxide. **Martian rovers** have discovered more ice – underground. A tiny amount of water flows on the planet's surface, but only when the temperature is warm enough, and this water is full of **toxic salts**. Don't think you can just bring a supply of fresh water from Earth. Water is very heavy and takes up a lot of space. It would be an impossible task.

Possible Solutions

You could look for water by drilling deeper into the ground. Another option is to dig up the underground ice and use heat to turn it into vapour. This vapour could be condensed back into drinking water. Even though it's too cold to rain, water vapour is also present in the atmosphere on Mars. One energy-efficient way to get this vapour would be to extract it straight from the air. Then there are the polar ice caps, although water from these would need to be treated using a **desalination plant**. Of course, once you had drinking water, you'd need to recycle as much as possible. A good place to start would be to do what astronauts already do. They purify and drink their urine.

1. Desalination plant
2. Glasshouses
3. Mars buggy
4. Power plant with solar panels
5. Drilling rig
6. Habitation modules

3. The Food Challenge

If settlers brought their own food, it would need to last for twenty-six months until the next supply rocket arrives. Each person's supply would weigh around 5 tonnes. Again, that's not a good use of space or rocket fuel. One obvious solution would be to grow food on Mars, but there's no soil. Instead, the planet's surface is covered in ground-up rock. This has too few of the nutrients that plants need. There's also the problem of the atmosphere, which contains too much carbon dioxide. And Mars is extremely cold. Plants won't grow.

Possible Solutions

On Earth, we already have a way to grow crops without soil. It's called hydroponics. Martian crops could also be grown in special nutrient-rich water. However, if you're serious about living on the Red Planet, you'd need to make the climate more like Earth's. A warmer Mars would mean a better chance of more flowing water. Plants could grow without lots of special equipment.

So how do you change a planet's climate? One idea is to use giant mirrors. These could orbit Mars and direct sunlight onto the polar ice caps, thawing all that carbon dioxide. Why would you do this? Because carbon dioxide is a greenhouse gas, which traps heat. The gas would act like a giant blanket. Eventually it would be warm enough for plants to grow. Just be prepared to wait thousands of years …

4. The Shelter Challenge

The atmosphere of Mars is a hundred times thinner than Earth's. As well as being poisonous to breathe, a thinner atmosphere means very little air pressure. Without air pressure pushing against us, the gas in our organs would swell up and stop our blood flowing. If that's not enough to put you off – don't forget Mars is also very cold.

Radiation is another danger. Earth's atmosphere and magnetic field protect us from **solar particles**, but Mars doesn't have an atmosphere, and its magnetic field is very weak. Martian settlers would be exposed to harmful levels of cancer-causing radiation.

Possible Solutions

Any shelter built on Mars would need to be **pressurised** and have airlocks. These would separate indoors from outdoors. The first settlers could live in their landing module. Extra inflatable modules could be added for more space, but these modules would need to be buried to protect them from radiation. Another option is to live in caves or underground lava tubes. When they go outside, settlers would need to wear spacesuits. NASA is already working on the next generation of spacesuit. These will keep astronauts comfortable – and alive!

Your Boots on Mars?

Now that you know the facts, do you still want to be a Martian? How would you feel about spending eight months in a tiny space with a bunch of strangers – and that's just getting there! How long could you stand living in a colony that contained just a handful of people? It can take up to twenty-two minutes for a signal to travel from Mars to Earth. There would be no phone calls or Skype. Could you cope with just texts and email?

The biggest question of all: would you be willing to put your faith in machines – the ones that make all your oxygen, grow all your food, and supply all your water? The ones that stand between you and death! What if they broke? Does the excitement outweigh the danger? For some people it will. After all, exploration's in our DNA.

Glossary

desalination plant: a place where water containing salt (usually sea water) is turned into fresh water

iron oxide: a compound that contains iron and is similar to rust

kPa (kilopascal): a unit of measurement for pressure

Martian rovers: robotic vehicles that travel across the surface of Mars

orbits: the curved "flight paths" that objects follow in space around a star or planet

pressurised: using artifically controlled air pressure so that people can breathe

solar particles: particles that come from the sun and contain radiation

toxic salts: chemicals containing metals and acids that are poisonous to people

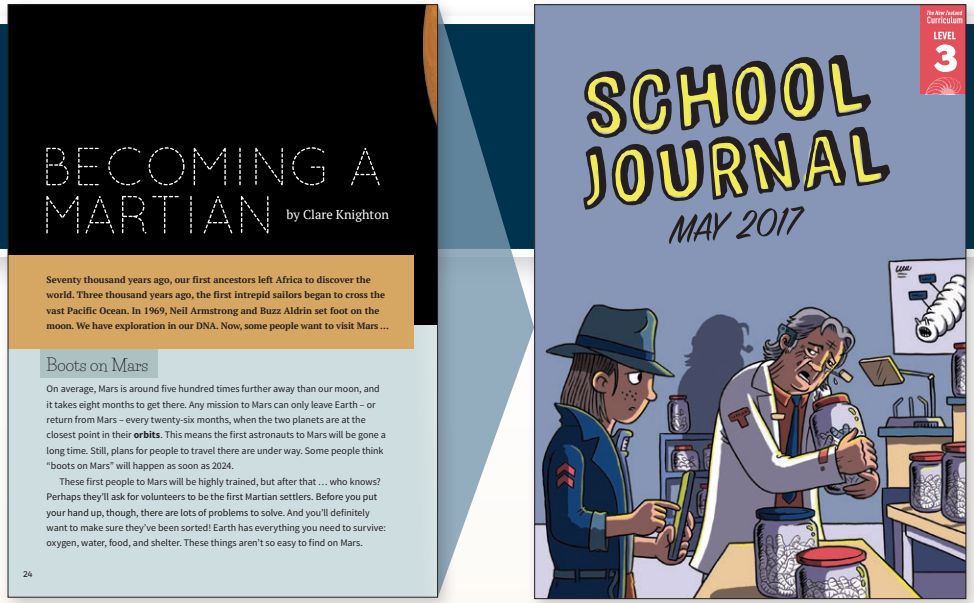
Becoming a Martian

by Clare Knighton

Published 2017 by the Ministry of Education
PO Box 1666, Wellington 6140, New Zealand.
www.education.govt.nz

ISBN 978 0 478 16942 3 (online)

Publishing Services: Lift Education E Tū
Editor: Susan Paris
Designer: Jodi Wicksteed
Literacy Consultant: Melanie Winthrop
Consulting Editors: Ross Calman and Emeli Sione



SCHOOL JOURNAL LEVEL 3 MAY 2017

Curriculum learning areas	English Science
Reading year level	Year 6
Keywords	astrobiology, astronauts, astronomy, challenge, colonisation, environment, exploration, extreme conditions, Mars, science, space, space stations, space travel, survival, water

MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

New Zealand Government