

DoubleHelix

**PLANET POSSIBILITIES:
A NEW
HOME
ON MARS?**

**PIZZA
FOR ASTRONAUTS**

**SPACE
A TRAVEL GUIDE**

**BUILD A
NEBULA
JAR**



DOUBLEHELIX.CSIRO.AU
1 MARCH 2018
ISSUE 22

A\$8.50 (INCL. GST)

ISSN 2204-9010





ON THE COVER

We're journeying beyond planet Earth in this issue of *Double Helix*. Count down to your holiday in space (page 12), and find out if Mars will ever be a worthy destination (page 14).

There's also plenty to make and do! Eat like you're on the International Space Station with this space pizza recipe (page 32), learn to make and read star maps (page 18) and build a nebula jar (page 30).

CSIRO

From tracking spacecraft to radio astronomy, CSIRO is in the know about our universe. This issue, our experts talk about space tourism (page 12) and the possibility of transforming the landscape of Mars (page 14).

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Double Helix Issue 22
Cover image: ©iStock.com/MATJAZ SLANIC
Double Helix is a production of CSIRO.
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Design: Swell Design Group
Printing: Printgraphics Printgreen
ISSN 2204-9010



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Launch yourself into the technology behind suborbital flights



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- CHOC ASTEROIDS!





Jasmine

HELIX HQ

I love leafing through travel guides to discover my next holiday destination. Half the fun of a holiday is the anticipation, imagining the adventures I'll have. This amazing feeling was behind our theme this issue – 'Space: A Travel Guide'.

Space tourism kicked off in 2001 but came to a halt in 2009, having had only seven participants in total. It's estimated that these tourists were paying US\$20–40 million each – that's \$25–50 million Australian dollars!

But this year might see space tourism up and running once again. A jaunty trip around the Moon has been scheduled for late 2018. SpaceX plans to have two paying tourists onboard a Dragon 2 spacecraft for this journey.

With the very real possibility of a holiday in space looming nearer, where would you go? I'd be all for a week-long cruise to the Moon and back, as long as I could afford the ticket. However, an eight-month, one-way trip to Mars is a bit far for me. Maybe you'd be up for the challenge? It's good to know the sky is no longer the limit!

ON THE DOUBLE

We've been blown away by all the thoughtful and creative responses and competition entries from readers! Flip to page 38 to enter this issue's competitions. You could win planetary coins and much more.

Do you remember the article 'Typing with your mind' from Issue 19?



Exciting or scary? Facebook is researching mind-reading technologies. The device they engineer will allow you to type at talking speed, using nothing but your thoughts!

Some injuries and diseases can leave patients paralysed and unable to talk or write. Better brain-reading devices would allow these people to communicate more easily with others.

This is an exciting invention. It would be a huge time saver, and could help loads of people.

However, like anything put before humans, it can be corrupted. Even the most innocent object can be used to do evil things, and quite often, it is.

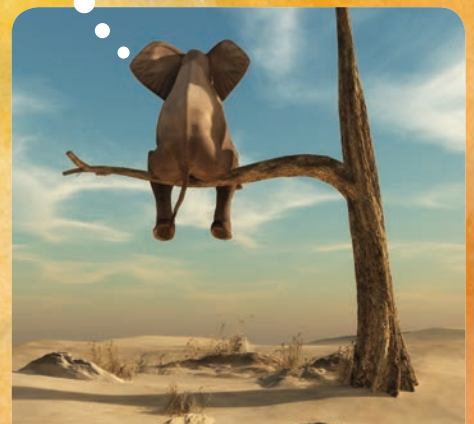
Part of what I'm trying to say is, people who do not need this invention, should not use it. We should be grateful that we have the manoeuvrability of our limbs. We have the ability to talk and write.

I do look forward to see this invention being put to good use, but I'm quite sure that I won't be one of the people using it.

Eadlin, age 15, NZ

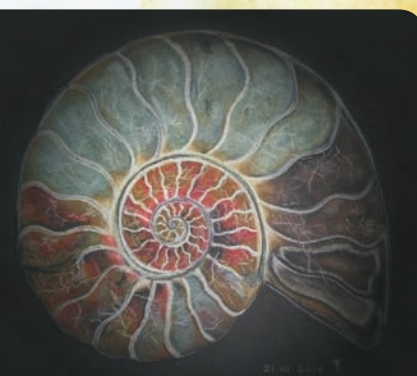
Eadlin, thanks for your thoughtful response. We think the future is in safe hands with upcoming scientists like you!

Why should birds get all the fun?



Jemma, age 12, VIC

Our thoughts exactly, Jemma! Oh, to be an elephant up a tree.



Chelsea, age 15, NSW

We love your ammonite! The colours and texture are amazing. We hope you enjoy the fossil collection you won.

SEEING PHOTOSYNTHESIS FROM SPACE

Photosynthesis is a process plants use to turn sunlight into energy so they can grow. The process also releases oxygen – essential for us all to live and breathe on Earth. This is just one of the reasons scientists have a keen interest in monitoring photosynthesis.

Some of the sunlight plants absorb during photosynthesis is re-emitted, giving off a fluorescent glow detectable with technology. Using remote-sensing technology on a satellite called Orbiting Carbon Observatory-2 (OCO2), researchers from the University of Sydney and NASA worked together to measure photosynthesis from space. They collected larger quantities of data in the form of satellite images and of better quality than ever before!

Their work means plant growth measurements can be compared between locations on Earth and over periods of time. In the satellite images, plant fluorescence indicates plant health. If a plant is actively performing photosynthesis it glows brighter, whereas a plant with little or no fluorescence may be stressed or dying.

This new technique can be used to monitor climate change and the health of ecosystems, maintain biodiversity, and help manage land use.

- By Montana Coombes

The equation for photosynthesis is:
 carbon dioxide + water + light energy
 → carbohydrate + oxygen

This image represents changes in the glow of Earth's plants



.....
 Add ultraviolet light to get scorpions glowing

GLOW-IN-THE-DARK SCORPIONS

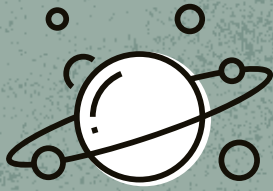
Could there be a freaky new breed of scorpion scurrying around the Aussie bush? No – most scorpion species glow a brilliant blue when they're viewed under ultraviolet (UV) light, a type of electromagnetic radiation that can't be seen by the human eye.

Owen Seeman from the Queensland Museum says that when scorpions are viewed under UV light, the chemicals in their outer shell absorb and then re-emit light at a lower wavelength. This makes them appear blue-green.

Scientists are puzzled as to why scorpions have evolved to emit a blue-green hue. Some think it could be a kind of homing beacon so they can find each other. Others say it's so they look even fiercer to warn off predators. Whatever the reason, using a UV torch is a handy trick to help scientists spot scorpions in the wild.

- By Carrol Baker

PLANET



CHANGE

BY GRETA KITE-GILMOUR

You've read about it in books and seen it on movie screens. Yet, the idea of terraforming – transforming another planet to make it suitable for humans to live on – is not limited to science fiction.

CSIRO astronomy and space science's Glen Nagle explains how and why terraforming planets like Mars could become a reality, and what important issues we humans should consider before attempting to do so.

SPACE EXPLORERS

"The idea of terraforming Mars has been around for a long time," says Glen.

"What if there was a disaster on Earth, climate change, pollution, a plague or the threat of a huge asteroid crashing into us? We'd want somewhere else to go, right?"

"Or we may just want to settle on another world as explorers, the same way that people have sailed around the world to discover new lands.

"Any of these ideas could be reason for expanding the human frontier to a planet like Mars."

If we needed to evacuate Earth, we might look to Mars





Mars is currently cold, dry and desert-like – but this could be changed

WHAT ARE WE WAITING FOR?

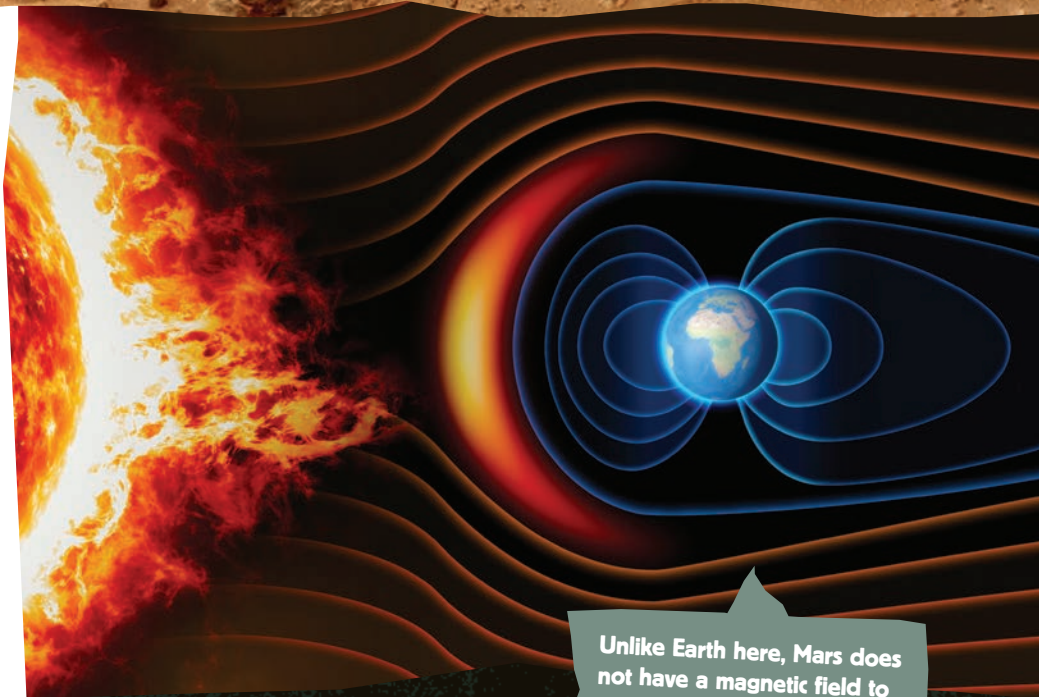
So why haven't we terraformed Mars yet?

"Mars is a cold, dry, desert-like planet. It has high radiation, a non-breathable atmosphere, it's extremely cold, has massive dust storms, and is bombarded by meteorites," says Glen.

"However, changing its climate is possible. You could add the gases you need on Mars, like methane and carbon dioxide. It's already there, locked up either underground or in the form of ice.

"You could potentially release water and oxygen also locked up as ice by crashing asteroids and comets at Mars' north and south poles. A less destructive way would be to bio-engineer bacteria, algae or lichen and introduce it into Mars' polar regions, releasing the water ice there.

"We have a good example of how these processes would work, because that's the way Earth's atmosphere developed billions of years ago. If it worked here, then it could work on Mars."



Unlike Earth here, Mars does not have a magnetic field to protect it from solar wind

MARS' COLD HEART

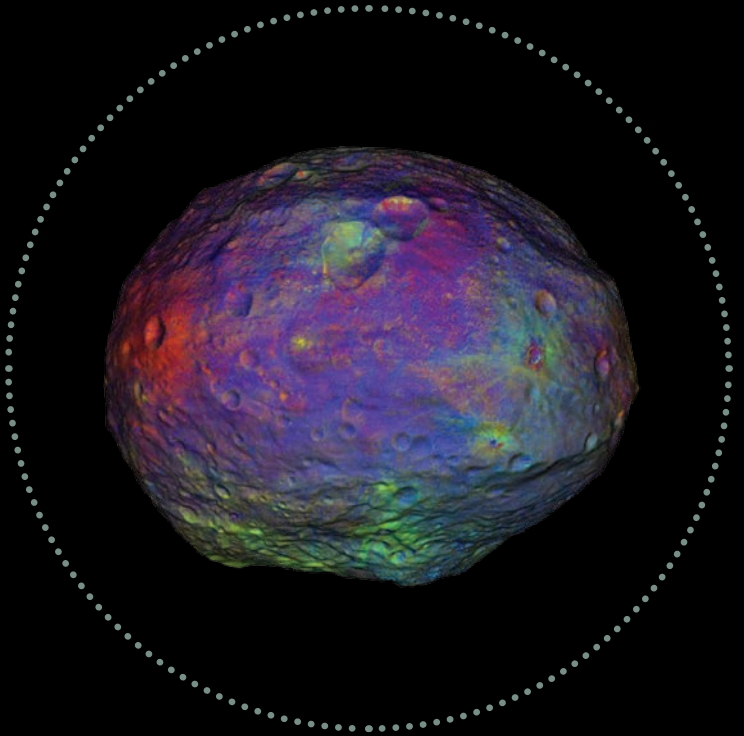
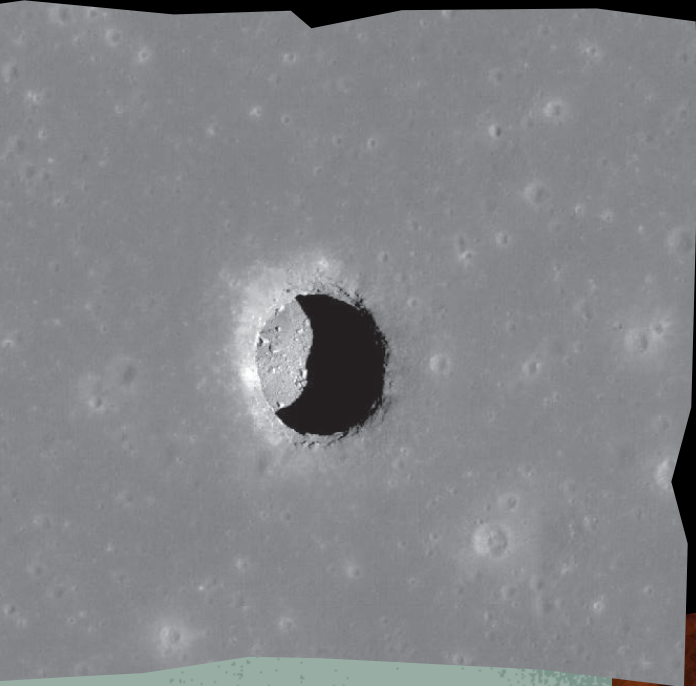
There's one big problem: the lack of a magnetic field.

"A planet's magnetic field is generated from deep within its hot molten core," explains Glen.

"The magnetic field acts like a shield around the planet, protecting it from the solar wind created by the Sun's energy. Without a magnetic shield, this 'wind' can blast a planet's atmosphere away into space.

"Mars' core has long turned cold, so it doesn't have a strong shield to protect it. We don't know of any way to restart a planet's core, but maybe there are other ways to shield a planet that we just haven't thought of yet."

It might not look like much, but this crater could lead to protection inside one of the Moon's lava tubes



WHERE TO, CAPTAIN?

Of course, Mars is not the only place in space that we could transform to be more Earth-like.

"There are also lots of other 'small scale' places in the solar system that we could potentially terraform," says Glen.

"Lava tubes on the Moon or the insides of asteroids offer lots of potential as places we could live, work and play. It may even be possible to take a large asteroid, hollow out the inside and terraform all of the available interior to create towns, cities and farms to support a large population.

"Add some rocket engines to the outside of the asteroid and you've created a home in space that could travel anywhere in the solar system – or perhaps even take us on longer journeys to distant stars."



Would you live in a city inside an asteroid?

LIFE OR DEATH DECISIONS

But just because it may be possible to terraform other planets, does that mean that we should? Glen believes there are some important issues we need to consider first.

“The biggest concern of all would be if some form of life – even simple bacteria – were ever discovered on the body we wanted to terraform.

Would we want to potentially destroy that planet’s natural environment, where that life has managed to survive? We could wipe out an entirely unique species. Just think: how would we feel if aliens came to Earth and decided to terraform our planet to be suitable for them?

“Another thing to consider is the potential that an unknown lifeform, bacteria or disease found on Mars could wipe out human life, or – if it found its way back here – could destroy all life on Earth. The risk in both scenarios is very high, and we should care about all life, wherever it is found.”



Imagine Mars as an interplanetary ‘national’ park

PLANETARY PARKS

Glen believes the potential of terraforming other planets is a long way off, if it is ever achievable. However, as this idea becomes increasingly possible, should we be focusing more heavily on efforts to protect and preserve parts of these planets and the potential lifeforms inhabiting them?

As Glen points out, protecting the environment on Mars should be as important as protecting it on Earth.

“There is an agreement called the ‘Outer Space Treaty’, to which most countries have signed and agreed, that prevents nations from claiming any celestial object as their own.

“NASA and other space agencies currently also abide by special ‘planetary protection’ rules, which mean we can’t send spacecraft and robots to other worlds unless they are free of bacteria that could damage that world’s environment and its potential for life.”

Despite these policies, there are currently no international or interplanetary laws to either allow or prevent terraforming specifically.

“If we do decide to terraform another planet one day, we will definitely have to create some new laws to ensure that we do it safely and responsibly,” says Glen. “We may even decide to protect it completely and declare Mars as the first interplanetary ‘national park’, preserving it forever.”

HOME SWEET HOME

Before we get caught up in the issue of protecting other planets, however, Glen reminds us that our own planet should remain at the centre of our attention.

“Right now, if something were to happen here, there’s little we could do to go to Mars. It’s hard enough right now to get three people off Earth on a rocket, let alone 7.5 billion of us.”

“So, most importantly, we must look after Earth, because, for the foreseeable future, it’s all we’ve got. Even our own survival as human beings is not guaranteed unless we look after our planet.”

First priority: protect Earth



TRASH TO TREASURE

You might think recycling is easy. But spare a thought for people living in remote areas. On Yurrwi, also called Milingimbi Island, the weekly barge takes three days to get to the nearest recycling centre in Darwin, and it's far too expensive to use for rubbish. Luckily, the locals have a high-tech solution.

Yurrwi is Yolgnu Country

Yurrwi's recycling program is called Plastic Fantastic, and it's run by the Arnhem Land Progress Aboriginal Corporation.

The first step is rubbish collection. Everyone in the community, from kids to adults, helps collect plastic rubbish for recycling.

After the rubbish is collected, it needs to be sorted. The locals are looking for just the right sorts of plastic and anything else won't do.

The selected bottles and containers are fed into a machine that shreds them and melts them down to liquid. Out the other end of the machine comes a thin string of recycled plastic.

A plastic string doesn't sound that useful, but it's not the final product. There's still one more step in this recycling story.

MAKING THINGS

Although it's long and bendy, the 'string' that comes out of the recycling machine isn't actually string. It's 3D printing filament – an 'ink' for making solid shapes. And that's where Ernest steps in.

Ernest Gondarra is a Yolngu Elder who is working out of Galiwin'ku community. He is also a 3D printing expert. And that means Ernest can turn this recycled plastic string into just about anything. Ernest uses 3D modelling software to design shapes, and then other computer programs turn those designs into instructions for 3D printers.

There are plenty of things that Ernest has to pay attention to.

"The models change in size during 3D printing," he says. "So I have to allow for the shrinkage when I am developing the model."

When you're printing a case for your mobile phone, that allowance could be the difference between a good case and one that doesn't fit.

Time to design!



SHARING HIS TALENTS

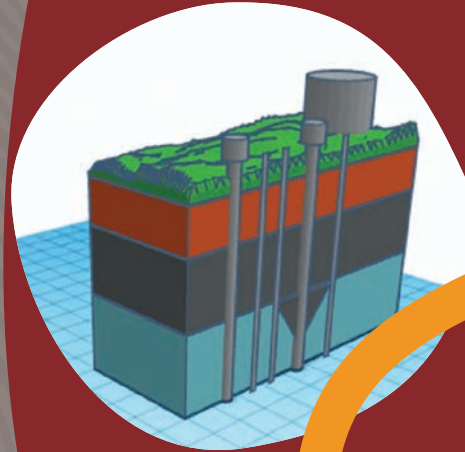
Ernest's 3D printing story started with a song.

"When I was about 19 years old, I heard my Elder sing a song in his band about how it's a computer world," he says. "I remembered this song when I heard a 3D printing program was being delivered at my community in Yurrwi."

"I attended the 3D printing program and I decided to keep doing it each time the trainer came as I enjoyed it. Eventually I started teaching other Yolngu people in other communities."

Ernest now teaches people to make bubble wands, phone covers and key holders. But he also has his own projects to really stretch his creative talents. Ernest has designed and printed culturally significant objects for the Gatjirrk Cultural Festival and geological models for mining companies!

Celebrating his talent and leadership, Ernest recently won the Indigenous Digital Excellence award for Digital Elder of the Year.



This model shows local ground water



THE SPORTS TECH RACE



In a few short weeks, the 2018 Commonwealth Games will start on the Gold Coast. Records will be smashed as athletes compete to be the best ever at their sports. But behind the athletes, scientists are developing new technology to keep improving human performance.

◀ What does the future hold for athletes?

RIGHT NOW

Technology has improved athletic performance before. At the 2008 Beijing Olympics, world records were smashed by athletes wearing special 'fast suits', developed with assistance from the Australian Institute of Sport. These swimming costumes trapped a layer of air on their surface, making it easier to push through the water. The suits were so effective, they were banned from competition.

It's not just swimsuits, either. The Winter Olympic sport of curling recently moved to regulate high-tech brooms!

SOON

There's only so much tech you can use in a race. But when you're training, you can use as much as you want. Already, athletes use heart-rate monitors, and CSIRO's Wireless Ad hoc System for Positioning (WASP) technology tracks athletes much more accurately than GPS. Soon, we might be able to measure the electrical activity in individual muscles too.

All this information lets coaches find any weaknesses in an athletes' performance, and develop new training programs to fix them. But as technology gets better, the feedback will get quicker. A fitness app could change exercises during a workout to make sure every muscle gets worked out evenly. It could detect early signs of injury, and stop workouts before something bad happens.

EVENTUALLY

If there's one place where technology has most revolutionised sport, it's the Paralympics. New materials and designs are developed every year, and mean that Paralympic records are improving much faster than Olympic records.

Already, the men's T52 wheelchair record for the 1500-metre sprint is faster than the Olympic 1500-metre record. And New Zealand para-athlete Liam Malone, who runs on special springs known as 'blades', aims to beat the 100-metre sprint world record in the next three years.

JUST IMAGINE

It's finally here! After three weeks of warm-up events, the opening ceremony is in full swing. Leading the Australians is Kylie Kusuma, the first woman to run 100 metres in under nine seconds. Next up are our world-beating basketball team, in their tough, carbon-nanofibre wheelchairs. Why would anyone watch the Olympics, when the Paralympics are so much more exciting?



I HATE HAVING A COLD.

sniff!

WHAT YOU NEED IS A HOLIDAY.

TO A NICE BEACH?

NO - A CRUISE.

OKAY!



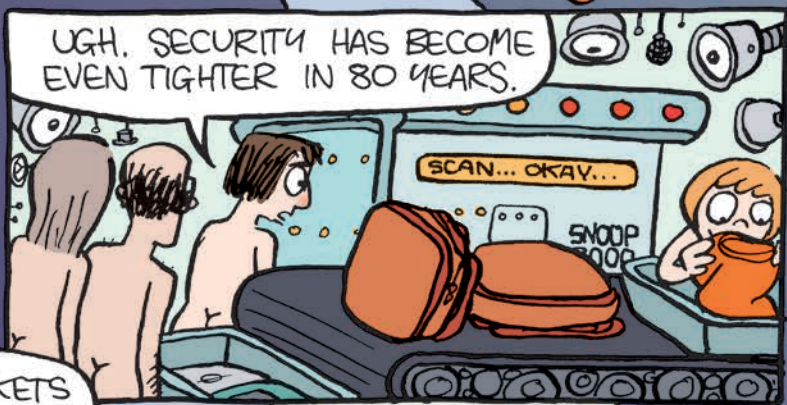
Jack & Joni's Time-Travelling Shed



THE YEAR 2098

THAT LOOKS MORE LIKE A SPACE SHIP THAN A CRUISE SHIP.

WE'RE GOING ON A SPACE CRUISE.



UGH. SECURITY HAS BECOME EVEN TIGHTER IN 80 YEARS.

SCAN... OKAY...

SNOOP SNOOP

Wow! THE VIEWS ARE AMAZING!

THESE TICKETS MUST'VE COST A FORTUNE.

I WENT BACK TO 2009 AND BOUGHT A COUPLE OF BITCOINS...

... WE'RE BILLIONAIRES NOW.



DAY 3

THE FOOD IS GREAT.

sniff!

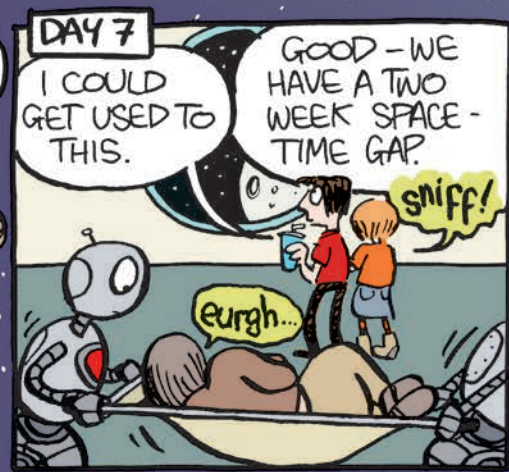


DAY 4

I LOVE THE INFLIGHT ENTERTAINMENT.

zero g room

cough!



DAY 7

I COULD GET USED TO THIS.

GOOD - WE HAVE A TWO WEEK SPACE-TIME GAP.

sniff!

eugh...



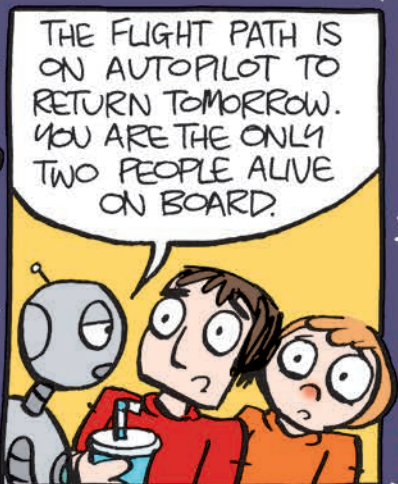
DAY 13

I DON'T WANT TO GO HOME.

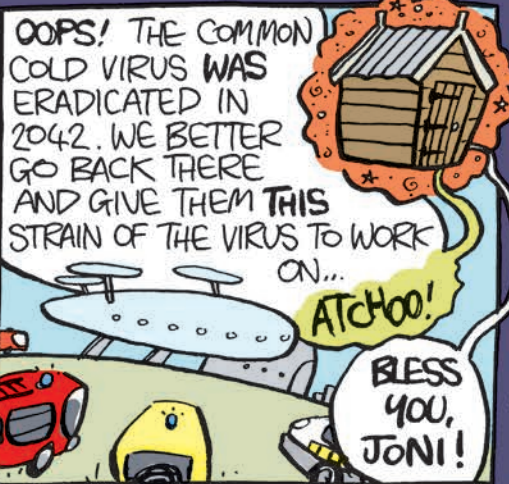
AATCHOO!

YOU ARE GOING TO HAVE TO.

WHY?



THE FLIGHT PATH IS ON AUTOPILOT TO RETURN TOMORROW. YOU ARE THE ONLY TWO PEOPLE ALIVE ON BOARD.



OOPS! THE COMMON COLD VIRUS WAS ERADICATED IN 2042. WE BETTER GO BACK THERE AND GIVE THEM THIS STRAIN OF THE VIRUS TO WORK ON...



ATChoo!

BLESS YOU, JONI!

SPACE PIZZA

..... BY DAVID SHAW

Although it's truly amazing to be in space, sometimes astronauts get a little homesick. So in December last year, they held a pizza party on the International Space Station!

SAFETY: When preparing food, always use clean hands and equipment. Be careful using the oven, have an adult present!

YOU WILL NEED

- Oven
- Teaspoon
- Scissors
- Aluminium foil
- Small pizza bases
- Spreadable cheese
- Tomato paste
- Optional toppings:
 - Pepperoni
 - Olives
 - Anchovies
 - Anchovy paste

WHAT TO DO

1. Use a spoon to spread the sticky toppings on first – tomato paste, spreadable cheese and anchovy paste.



1

2. Add the other toppings, using the sticky ones to prevent pieces from floating away.



2

3. Wrap the pizza in aluminium foil.
4. Put the pizza in the food warmer, and wait until warm. (If you're on Earth, stick it in an oven at 120 °C for 20 minutes.)



4

5. When it's ready, unwrap the pizza and carefully cut it into slices with scissors. Enjoy!



5

WHAT'S HAPPENING?

The International Space Station only gets about one cargo shipment per month, and there's no fridge for food. So astronaut food needs a long shelf life. A lot of space food comes in cans or is dehydrated in vacuum pouches. This diet can get boring, so every now and then, astronauts get a treat.

Being in space presents lots of other food challenges. One of the biggest problem is crumbs. On Earth, crumbs fall to the floor and can be swept up. But further away from Earth's gravity, in free fall, crumbs fly everywhere and can get into important equipment. That's why astronauts don't eat many crunchy or crumbly foods.

Cutting is tricky too. If you try to chop things with a knife, without gravity holding you to the floor, you'll end up pushing yourself away. Astronauts tend to use scissors instead!



PRIZES



STARGAZING COINS

Foster a fascination with the wonders of our solar system with this exciting planetary coin collection. Featuring special coloured and bimetallic (two-metal) coins in a pop-up display pack, stargazers will be over the Moon with this spectacular prize.

Find out more about the collection here:
<https://eshop.ramint.gov.au/Planetary-Coins-Collection/311022.aspx>

For your chance to win a planetary coin collection from the Royal Australian Mint, send us a colourful drawing of a coin you have designed for 2018 celebrating Australian astronomy.



OUT OF THIS WORLD

Explore the wonders of the universe from the comfort of your own home with this solar-powered solar system! This is your opportunity to learn all about the planets orbiting the Sun.

Enter to win a solar-powered solar system from www.yellowoctopus.com.au by sending us your funniest space joke.



CELEBRATING WOMEN IN SCIENCE

Be inspired to reach for the stars with these Women of NASA LEGO® kits. The set features figurines of Margaret Hamilton (software engineer), Sally Ride (first American woman in space), Mae Jemison (first African-American woman in space), and Nancy Grace Roman (Hubble Space Telescope). Role-play space exploration from planning to Moon landing – just like these women who have made groundbreaking contributions to NASA and space exploration.

To be in the running for a Women of NASA LEGO® kits from www.purpleturtlet toys.com.au, answer the following questionnaire. The most interesting answers will win.



1. When did the first woman travel into space? a) 1963, b) 2006, c) 2017, d) women haven't traveled in space yet.
2. Who is your role model and what is it you admire about them?
3. What contribution would you like to make to space exploration?