UNDER THE SEA

OUR MOON A PLANET SACRIFICED

FISH SCHOOL SMART SWIMMERS

Imagining the future A sneak peek

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ON THE DOUBLE

Wow! Check out these awesome entries from Double Helix readers. It has been lovely to see things that make our readers happy.

Would you like to be an eco-warrior, testing the quality of your local waterway? Flip to page 19 to enter this issue’s competitions. You could win a Global Water Quality kit from Questacon and much more.

Harmonie, age 10, QLD
We love getting back to nature too, Harmonie.

Cameron, age 9, WA
Dinosaurs, planets, maths, big equipment and LEGO, what’s not to be happy about?

Maddie, age 11, NSW
Maddie, your smile brightened our day.

Oliver, age 12, NSW
You enjoy so many exciting activities, Oliver! You’ve picked such bright, cheery colours too.

HELIX HQ

This issue comes to you from our brand-new, shiny offices in the CSIRO Discovery Centre, Canberra. We’re excited to be on site with a range of scientists, including those specialising in plants and the environment.

Since the move, we’ve been zipping around in electric cars as we run our errands. These cars don’t use petrol: instead, we plug them in to recharge their batteries once we’ve driven around. We’re aiming to use solar panels to generate enough renewable energy to charge the cars. That will make our driving emissions free. Check it out!
Imagine if a massive asteroid hadn’t wiped out dinosaurs millions of years ago. The T-rex and Brontosaurus would still be roaming Earth, right? Wrong, according to scientists at the University of Reading in England.

“Most biologists believe that dinosaurs were going strong right up until a massive asteroid hit Earth 66 million years ago,” says Dr Chris Venditti. But in their recent study, Chris and his colleagues found that dinosaur diversity was already falling for at least 40 million years before the asteroid hit. What could have caused this drop off in dinosaurs?

“The temperature was changing rapidly and there was an enormous amount of volcanic activity,” Chris explains. “Mammals might also have been eating dinosaur eggs.”

Chris says their study is important, because it shows that when animals are already in decline, they are more likely to become extinct in the aftermath of a large natural disaster.

- By Greta Kite-Gilmour

In centuries past, explorers sailed to distant shores. One day, we could set off for distant planets using sails again – but sails pushed by light, rather than wind.

Like wind, light also pushes against objects. Yet, light doesn’t pack much of a punch, so a spacecraft propelled by light would need to weigh just a few grams.

Thankfully, technology is shrinking. In a few decades, scientists might use lasers to ‘blow’ a tiny spacecraft to our closest stellar neighbour: the Alpha Centauri star system. Pushed to about one-fifth of the speed of light, a journey there could take just 20 years, rather than the 30 000 years it would take today.

The research project ‘Breakthrough Starshot’, costing more than 130 million dollars, aims to develop the necessary technology. It will be funded by Yuri Milner, a Russian billionaire. Yuri has the support of famous astrophysicist, Stephen Hawking.

“Technological developments in the last two decades and the future make [this project] possible, in principle, within a generation,” says Stephen.

- By Mike McRae
YOU MAY HAVE HEARD THAT FISH HAVE A THREE-SECOND MEMORY SPAN, AND EVERY LAP OF THEIR FISHBOWL IS LIKE SEEING THE WORLD FOR THE FIRST TIME. WRONG! IN FACT, THE OPPOSITE IS TRUE. FISH CAN REMEMBER THINGS FOR MANY MONTHS AND ARE CAPABLE OF LEARNING.

BY TANYA PATRICK

THE MEMORY MYTH

In the movie Finding Nemo, Dory is known as ‘everyone’s favourite forgetful fish’. Now, we will see much more of her in the sequel Finding Dory.

“I suffer from short-term memory loss,” Dory tells Nemo. “I forget things almost instantly; it runs in my family.”

In reality, a fish such as Dory – the royal blue tang – is unlikely to have a bad short-term memory. While no one has specifically studied this aspect of the royal blue tang, many fish species have excellent memories, so we should expect that Dory and her relatives would be just as good.

“There’s no way a fish could survive in the real world, with all its challenges, if they didn’t remember things,” says Dr Culum Brown, a fish researcher from Macquarie University in Sydney.
Fish school

Culum has spent the past 20 years putting fish through learning and memory tests. His research has shown that in many ways, fish are just as clever as us – and certainly as intelligent as birds and many mammals.

One of his early experiments involved placing rainbowfish – a native Australian freshwater species – into a two-metre-long tank containing a net with a single escape route. Then he watched how long it took the fish to escape.

“Without any prior experience, the fish learned where the hole was in about five runs,” Culum says.

A year later, the same fish managed to find the hole on its first try. Rainbowfish only live for two or three years in the wild. Culum compares this to a human remembering a lesson from 40 years ago!

Tidal maze

In another study, Culum and fellow researcher Gemma White looked at intertidal gobies – fish that are common in rock pools. Marked in the wild with a fluorescent tag, these fish tend to stay in the same rock pool for weeks. But if they were picked up at low tide and moved 30 metres away, they were found back in their home pools within a few days.

“This suggests fish are able to form mental maps similar to those people use when planning a route to a familiar place,” says Culum.

Cod culture

Fish are so clever, Culum says, that those schooled in survival skills can even teach their captivity-raised friends how to get by in the sea. They learn to escape and feed by watching others do it, and they do it a lot quicker if their teachers are already trained. This suggests that fish use social learning, which can lead to culture and cultural knowledge.

Cultural knowledge can be lost when older fish with all the wisdom get dragged out of the school. An example of this is the North Sea cod fishery, which collapsed because too many mature fish were caught. The cod no longer migrate to the same places to feed and breed.

“We have messed with their biology … now the juvenile fish effectively have to figure it out for themselves,” Culum says.

Krefft’s gobies know the way home

In contrast, Culum says, the gobies in his study are very good at navigation. He suggests that this is because they do not need to rely on migration patterns.

Dr Culum Brown studies fish intelligence
TROPICAL SEA JELLY

BY DAVID SHAW

This tropical treat will have you dreaming of the beach. But this jelly isn’t made with gelatine. Instead, it uses agar: a jelly of the sea.

EQUIPMENT

- Measuring cups and spoons
- Small saucepan
- Wooden spoon
- Tablespoon
- Small plastic container that holds one cup of liquid
- Dishwashing gloves

FOR THE PINEAPPLE LAYER

- ½ cup pineapple juice
- ¼ teaspoon agar (available from Asian supermarkets or health food stores)

FOR THE COCONUT LAYER

- ½ cup coconut milk
- ¼ teaspoon agar

RECIPE

WHAT TO DO

THE PINEAPPLE LAYER

1. Pour the pineapple juice into the saucepan.
2. Put the pan on a low–medium heat.
3. When the pineapple juice starts to simmer, add the agar and stir well to mix.
4. Keep simmering the mixture for two minutes, to make sure the agar is dissolved.
5. Take the pan off the heat and wait for one minute.
6. Carefully pour the pineapple mixture into the container.
7. Wearing dishwashing gloves, carefully wash the saucepan and wooden spoon in hot water to get rid of the last of the pineapple jelly.
THE COCONUT LAYER

8. Put the saucepan back on the heat, and pour in the coconut milk.

9. Once again, bring it to a simmer, and then add the agar.

10. Simmer for two minutes while stirring.

11. Take the coconut milk off the heat and let it cool for a minute or two.

12. Put the saucepan and container next to each other, then use a tablespoon to carefully layer the coconut mixture on top of the pineapple jelly.

13. Leave the jelly to set for half an hour.

FINISHING TOUCHES

14. To get the jelly out of the container, run a knife around the edge, and turn it upside down on a plate. (If the two layers come apart, just put them back together.)

15. Cut your tropical sea jelly into small pieces, and enjoy!

WHAT’S HAPPENING?

From red frogs to jelly desserts, there are lots of jelly foods to choose from. In Australia, the most common gelling agent is gelatine, which is an animal product. But it’s not the only way to make a gel.

This recipe uses agar, a gelling agent common in many Asian cuisines. Agar is made from red algae, which is a type of seaweed.

Gelling agents set because they contain protein molecules. The proteins tangle up as they cool down. The intertwined molecules hold the water in place, stopping it from flowing like a liquid. Instead, it forms a flexible solid.

You may not realise it, but it can be tricky to make pineapple jelly. Pineapple contains an enzyme called bromelain, which gives jelly a hard time. Bromelain attacks many proteins, including those in jelly, whether it’s made from agar or gelatine.

So why does this jelly set? Bromelain doesn’t like heat. It starts to break down at temperatures above 50 degrees Celsius. Boiling the pineapple juice destroys the bromelain, and allows the agar to do its work.

REAL-LIFE SCIENCE

Agar isn’t just people food: it’s also food for all kinds of organisms. For more than 100 years, scientists have used agar to grow microbes on. Agar is used because it stays solid at the higher temperatures needed to keep bacteria warm and happy. If you try to heat gelatine jelly up to body temperature, it turns to liquid!

Agar has been the key to many of the biggest discoveries in science, including Howard Florey’s discovery of the antibiotic penicillin.
The North Sea cod fishery collapsed because too many mature fish were caught.

I suppose people didn’t know that the older fish’s memory of where to feed and breed was important.

What if we went back and told them?

How?

By attaching lots of these tags to the cod.

We’ll go back to the future and find out.

How will we put tags on the fish?

Grandad installed robotic arms.

Will it work?

1956: North Sea

Wow! There are so many big fish now.

Let’s go home and celebrate!

2016: North Sea

2016: Australia

Mum, can we go out for fish and chips?

You mean jellyfish and chips – people haven’t eaten fish since the 50s.
ESSENTIAL WATER

Water is essential for life on Earth. But what do you really know about the water you drink? Can dirty water become clean again? Have you ever wondered where all our water comes from? Find out the answers with the Global Water Quality kit from www.questacon.edu.au/qshop!

Want a chance to win this Global Water Quality kit? Tell us five ways you could contribute to keeping plastic out of our oceans.

DEADLY PREDATORS

Packed with jaw-dropping facts about animal behaviour and anatomy, the Super Shark Encyclopedia reveals the ocean’s secrets. This book from www.dk.com.au includes record-breaking animals, including the most venomous creatures and the deadliest predators.

To be in the running to win this informative book, write us a haiku poem about sharks. (Hint: a haiku is a poem with three lines. The first line has five syllables, the second has seven syllables, and the third has five syllables.)

AQUA DRAGONS

Hatch and grow your own live pets in an intriguing underwater world with aqua dragons from www.madaboutscience.com.au. Although these creatures resemble tiny swimming dragons with a curly tail and three eyes, they are not fierce and definitely don’t breathe fire!

The famous author JRR Tolkein wrote: “Alive without breath, as cold as death; never thirsty, ever drinking, all in mail never clinking.” To be in the running to win an Aqua Dragon kit, solve the riddle, and then send us a drawing of your answer.

HOW TO WIN

To be in the running to win a fantastic prize, send us your entry with your name, age, address and Double Helix subscriber number*. Get a parent’s permission and ask them to sign each piece of paper, then send it to Double Helix Competitions, CSIRO Publishing, GPO Box 1700, Canberra ACT 2601 by 14 July 2016. Or email your entries with your details to helixassist@csiro.au. The best entries in each competition will win the prize.

*Don’t know your subscriber number? Check the address label that came with your magazine or subscribe at www.doublehelix.csiro.au.

Terms and conditions of entry
1. To be valid, all entries must include name, address, age of entrant and Double Helix subscriber number. 2. All entries become the property of CSIRO and will not be returned. 3. Entering the competition assigns copyright to CSIRO. 4. Entries will be judged on creative merit, not by chance. 5. Age will be taken into consideration when judging. 6. All decisions on competitions are final and will not be discussed further. 7. Winners will be notified by mail and the names of competition winners only will be published three issues later. 8. CSIRO shall not be liable for any damage or loss suffered in connection with any of the prizes. 9. Any change in value of the prize between the publishing date and the delivery date is not the responsibility of CSIRO. 10. In the case that prizes become unavailable after the publishing date, CSIRO will send an alternative prize. 11. The closing date for this issue’s entries is 14 July 2016. 12. Competition entries must be the entrant’s own work. 13. It is the responsibility of the entrant to ensure copyright of their entry is not assigned elsewhere. 14. Winners should allow six weeks for prize delivery. 15. Your privacy is important to us. For information on how CSIRO uses your personal details, see page 2.

COMING UP IN THE NEXT ISSUE OF DOUBLE HELIX

We’re getting our tech on with the next magazine on 15 July.
- Drones and robots to the rescue
- CSIRO celebrates 100 years of innovation
- Top tips on how to become a scientist

Stay updated between issues with our Double Helix email newsletters. You can choose Science by Email or Maths by Email (or both) and get a free news article and fun activity on Fridays. Sign up at www.doublehelix.csiro.au.

What did you think of our underwater theme this issue? If you have an idea for a story or experiment you want to see in Double Helix, write to us at Helix.Editor@csiro.au or Double Helix, GPO Box 1700, Canberra ACT 2601. We’d love to hear from you.

INVISIBILITY, IMMORTALITY AND 40 OTHER INCREDIBLE IDEAS

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A NEW BOOK FOR KIDS!
IMAGINING THE FUTURE

By Simon Torok and Paul Holper

We’re living in a rapidly changing world. Hardly a week passes without an exciting technological breakthrough. That’s the power of human innovation – it never stops happening. Inventors keep inventing.

Mind reading, invisibility, instant transportation and lots of gadgets were once the dreams of science fiction … now they might become science fact! Imagining the future is the first step in arriving there. If you can dream it, perhaps one day you can invent it.

Strap yourself in and get ready for the future!

This article is an excerpt from Imagining the Future, a new book from CSIRO Publishing. Get prepared for the fantastic future with this guide to the unbelievable and incredible inventions just over the horizon.

Flip to page 23 to see this book reviewed by Double Helix reader, Nick Bouletos.
Siena Stubbs is a 14 year old with a keen eye for photography. She’s a Yolngu girl, and is documenting birds near her home of Yirrkala, in the Northern Territory. Siena’s observations, combined with Indigenous science knowledge, reveal the beauty and balance in the local environment.

The photos in this article come from Siena’s book, *Njilimurrunggu Wäyin Malanynha*. It means *Our Birds* in the Yolngu language. Magabala Books, an Australian Indigenous publisher, is thrilled to be working with Siena to publish her story.

In the book, Siena shares her photos as well as Yolngu bird names and classification.

“The birds give themselves their Yolngu names by the sounds they make,” she says.

In Yolngu culture, everything is divided into one of two groups: Yirritja and Dhuwa. These groups are known as moieties (MOI-eh-tees).
In many ways, Earth is pretty unusual. For one thing, it has just one big, round moon. There are signs that this massive natural satellite had a rather explosive birth. And, if it wasn’t for our moon, Earth would be a very different place.
Theia, mother of the Moon

Today, our Solar System has eight objects that are big enough to be called planets. But a few billion years ago, the Solar System was much more crowded. Orbits came close together, often crossing paths. Objects would collide in cataclysmic events, melting and evaporating rock and metal. One such event is thought to have given birth to Earth’s moon.

Roughly 4.4 billion years ago – soon after the Solar System began to gather from a cloud of dust and gas – two massive bodies of rock collided. One was about the size of Mars, and the other was a little smaller than Earth. The massive energy of this impact would have caused the two planets to disintegrate and form a single, giant, molten blob.

Astronomers call the Mars-sized planet Theia, after the Greek goddess who gave birth to Selene: the goddess of the Moon. This is a rather fitting name, because evidence suggests that our Moon was created from this collision.