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EXTRA TERRESTRIAL

JOIN THE REAL-LIFE HUNT
FOR ALIEN LIFE

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COVER NOT
FINAL

ARE WE ALONE?

Our universe is a vast and wondrous place. There are more stars than you could count in thousands upon thousands of lifetimes. Each one a shining light calling out to us across the emptiness of space. But is there anyone looking back?

In this seemingly endless cosmic ocean, we know of just one tiny island with living things. A planet one of its lifeforms has come to call Earth. We humans have been staring up at the stars for generations, trying to work out how we fit. Asking whether there are others like us out there equally wondering if they too are alone.

You belong to the first generation of humans in the entire history of this planet with the chance to answer this ancient question.

In the last 30 years, astronomers have discovered thousands of planets beyond our solar system. Some familiar, some so utterly alien that they'll leave you astounded. We are starting to work out how like Earth they are and the chances of finding alien life there. If we are terrestrial, meaning of the Earth, that life would be **extra-terrestrial**.

We need you to join this search. The book you're holding will get you up to speed, show you what we know already and set out the things we don't know but would love to. You'll discover cutting-edge ways to find alien planets and use your imagination to guess at what creatures living there might look like based on our best scientific ideas.

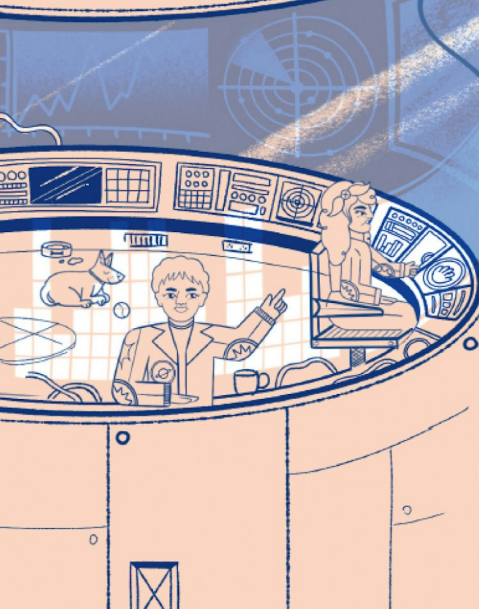
Perhaps you'll grow up to become an alien planet explorer. The first person to prove that we're not the only ones to call this mind-bendingly beautiful universe home. A place in the history books is yours for the taking. **Reach out and grab it.**



OUR BIGGEST CLUE: EARTH

The blue-green marble of Earth shines like a jewel against the blackest black. An oasis of life in the desert of the universe. As the only planet with life, it's all we have to go on. If we can work out what makes Earth special, it could help us search for similar places in our quest for extra-terrestrials.

So, what makes Earth unique?



A BIG MOON

For a smallish planet, we have a very big Moon. The pull of its gravity keeps us steady and stops the Earth wobbling around too much. This keeps the seasons steady and stops the planet getting too hot or too cold. Without the Moon, ice ages would be a lot more common. And if there's one thing life hates, it's change.

PUZZLE PIECES

The surface of the Earth is broken up into puzzle pieces called tectonic plates. They create mountains, volcanoes and earthquakes. Yet they also keep Earth's temperature steady by letting heat in and out of the planet. Earth is the only planet we know of with these plates.



A FORCE FIELD

Space is a pretty dangerous place, full of things that can kill you. Dying stars burp out particles called cosmic rays that can damage the cells inside your body and stop them working properly. Fortunately, the Earth has a force-field: our magnetic field. Formed deep inside the core of the planet, it bursts through the surface to create a protective cocoon around us. Along with our thick atmosphere, it stops cosmic rays from reaching Earth's surface and life can go about its business unharmed. But there is one thing above all others that life seems to need, and Earth has an awful lot of it: water.



EXTREMOPHILES

A cannon fires out a capsule at almost two thousand miles an hour, more than three times faster than a commercial aeroplane. The capsule smashes into a bag of sand on the other side of the room, yet the creatures inside the capsule are alive and well.

This experiment really happened. Back in 2021, scientists placed tiny, eight-legged creatures called tardigrades – also called water bears or moss piglets – within a nylon capsule and fired it out of a five-metre-long gas cannon.

Tardigrades appear to be Nature's most indestructible creation. These organisms, which are less than one millimetre long, have been frozen, baked beyond the boiling point of water, squashed, dehydrated, exposed to high levels of radiation and even sent out into the cold vacuum of space and they still survived.

HOSTILE ENVIRONMENTS

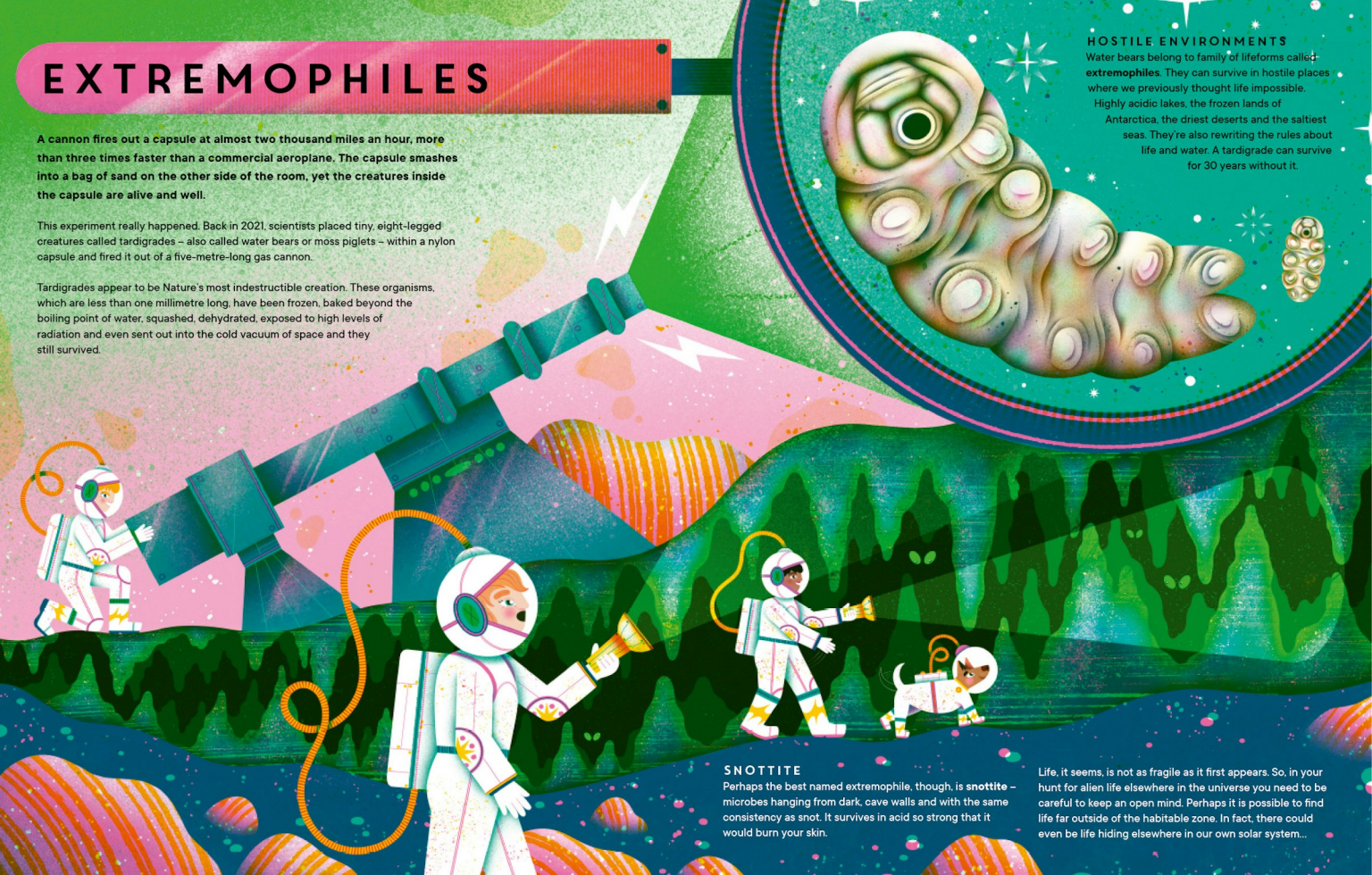
Water bears belong to family of lifeforms called **extremophiles**. They can survive in hostile places where we previously thought life impossible.

Highly acidic lakes, the frozen lands of Antarctica, the driest deserts and the saltiest seas. They're also rewriting the rules about life and water. A tardigrade can survive for 30 years without it.

SNOTTITE

Perhaps the best named extremophile, though, is **snottite** – microbes hanging from dark, cave walls and with the same consistency as snot. It survives in acid so strong that it would burn your skin.

Life, it seems, is not as fragile as it first appears. So, in your hunt for alien life elsewhere in the universe you need to be careful to keep an open mind. Perhaps it is possible to find life far outside of the habitable zone. In fact, there could even be life hiding elsewhere in our own solar system...



WATER, WATER, EVERYWHERE...

You're flying over a craggy ice sheet when suddenly you see it rising over the horizon. You're stunned into complete silence and can't look away. Saturn and its majestic rings appear almost 150 times wider than the Full Moon does in our night sky.

You are searching for life on Enceladus, one of Saturn's 117 known moons. Beneath its cracked, icy surface is an ocean of liquid water that's almost as big as the Arctic Ocean here on Earth.

OUTSIDE THE GOLDILOCKS ZONE

Enceladus is a long way from the Sun, more than five times farther than the outer edge of the solar system's habitable zone. And yet there's plenty of liquid water here despite Enceladus's surface temperature of minus 200 degrees Celsius.

How can this be? The secret is tidal heating. Enceladus orbits around Saturn in just 33 hours, meaning it's very close to the planet. During this orbit Enceladus gets severely stretched and squeezed by Saturn's strong gravity. This constant flexing warms up the inside of the moon, which is enough to keep the water liquid under its surface ice.

With its global ocean and internal heat, Enceladus could be a good contender for alien life.

A robotic spacecraft called Cassini discovered Saturn's ocean during a 13-year space mission.

Jets of icy particles and explosions of water and chemicals continuously spurt into space from its surface.

A TRIP TO JUPITER

The same thing is happening on Jupiter's moon Europa which NASA estimates has a sub-surface ocean containing twice the amount of water in Earth's oceans. Future missions such as NASA's Europa Clipper, scheduled for arrival in 2030, could help us work out if the conditions there are right for life.

Under its thick crust of ice, Europa's oceans of salty liquid reservoirs could be habitable.

One rover discovered a type of silica which exists in hot springs on Earth. These sorts of springs might have been home to ancient microbes.

THE RED PLANET

Even our next-door neighbour, Mars, could be a living planet. Data from our Mars rovers tell us that the Red Planet, which today is cold and dry, used to be a lot more like Earth with oceans, lakes and rivers. If life got started when liquid water was everywhere on Mars, extremophiles could still be clinging on to this day in hard-to-reach places like underground caves. Imagine Martian snottitell!

ANOTHER EARTH

Despite these possibilities, Earth remains the only place we've ever found life. There's only one planet like ours around the Sun, so to find another Earth we may have to widen the search. It's time we looked towards the other stars twinkling away in the night sky!