**Four organisms living in extreme conditions**

It doesn’t seem to matter how inhospitable an environment, there is an organism adapted to live there.

Scientists have found life in every extreme environment you can imagine, from volcanic cauldrons to highly alkaline seas. These extremophiles are not just curiosities; they could show us how life might exist on other planets with more hostile conditions than Earth.

Some have led to innovations in materials science, pharmacology and energy generation. Here we look at four organisms that live in conditions that would kill most other forms of life and learn what they could teach us.

1. Heat-seeking microbes

Heated by a subterranean supervolcano, the bubbling hot springs of Yellowstone can exceed 90°C, too hot for ordinary organisms.

In 1969, while studying the extremophile microbes that do live in Yellowstone’s hotsprings – and give them their colour – Thomas D. Brock and Hudson Freeze of Indiana University discovered Thermus aquaticus. This microbe went on to underpin almost every genetics discovery ever made.

T. aquaticus contains a heat-tolerant DNA-polymerising enzyme that, once isolated, became a cornerstone of the polymerase chain reaction. PCR is how tiny DNA samples are amplified for analysis – crucial for everything from crime scene analysis to genome reading.

It’s just one of the uses scientists have already, or hope soon, to develop by studying extreme organisms.

2. A frosty reception

When winter arrives in Alaska, the local wood frogs freeze solid. Some seven months later, when spring finally arrives, the thawed-out frogs hop away.

Freezing once would kill almost any other vertebrate, their organs pierced by ice crystals. Yet as autumn sets in, Alaska’s wood frogs can survive two weeks of night/day freeze-thaw cycles before finally freezing solid. The frogs, like certain other freeze-tolerant fish and insects, produce chemicals that stop ice crystals forming.

Researchers hope that by studying these species they’ll learn how to mimic this ability to store human organs for transplant. Currently organs are destroyed by freezing, and can only be kept for a few hours in refrigeration.

3. Conan the bacterium

*Deinococcus radiodurans* can survive blasts of gamma radiation 3,000 times the lethal dose for humans.

In 1999, the US Department of Energy funded research to sequence the bacterium’s genome, in the hope of developing waste-consuming microbes to clean extremely contaminated nuclear sites.

Surprisingly, *D. radiodurans*’s DNA has proved just as susceptible to radiation damage as a regular *E.coli*. The bacterium’s secret is a set of antioxidants that protect its proteins from radiation damage. These proteins can then rapidly repair damaged DNA.

Last year, researchers showed that a peptide based on these antioxidants could protect mice from usually lethal doses of radiation – a promising first step toward developing an effective radiation recovery pill for humans.

4. Multi-extremophiles

The microscopic tardigrade, or water bear, can survive heat, cold, desiccation, lack of oxygen [and radiation](https://cosmosmagazine.com/biology/hardy-tardigrade-protein-fortifies-human-cells). The tiny animal has even been shown to survive a 10-day trip into space, prompting some to suggest it’s the kind of creature that could live on Mars.

Not so. To survive these conditions the tardigrade puts itself into a form of non-reproductive suspended animation.

Some extremophiles, however, really do seem equipped for life on the Red Planet. Subterranean micro-organisms found in Earth’s deepest mines and caves seem to have what it takes to survive below the surface on Mars. Studying Earth’s extremophiles offers a possible glimpse of what alien life may look like – and where to look for it.

<https://cosmosmagazine.com/biology/four-organisms-living-in-extreme-conditions>