# NEWS IN FOCUS



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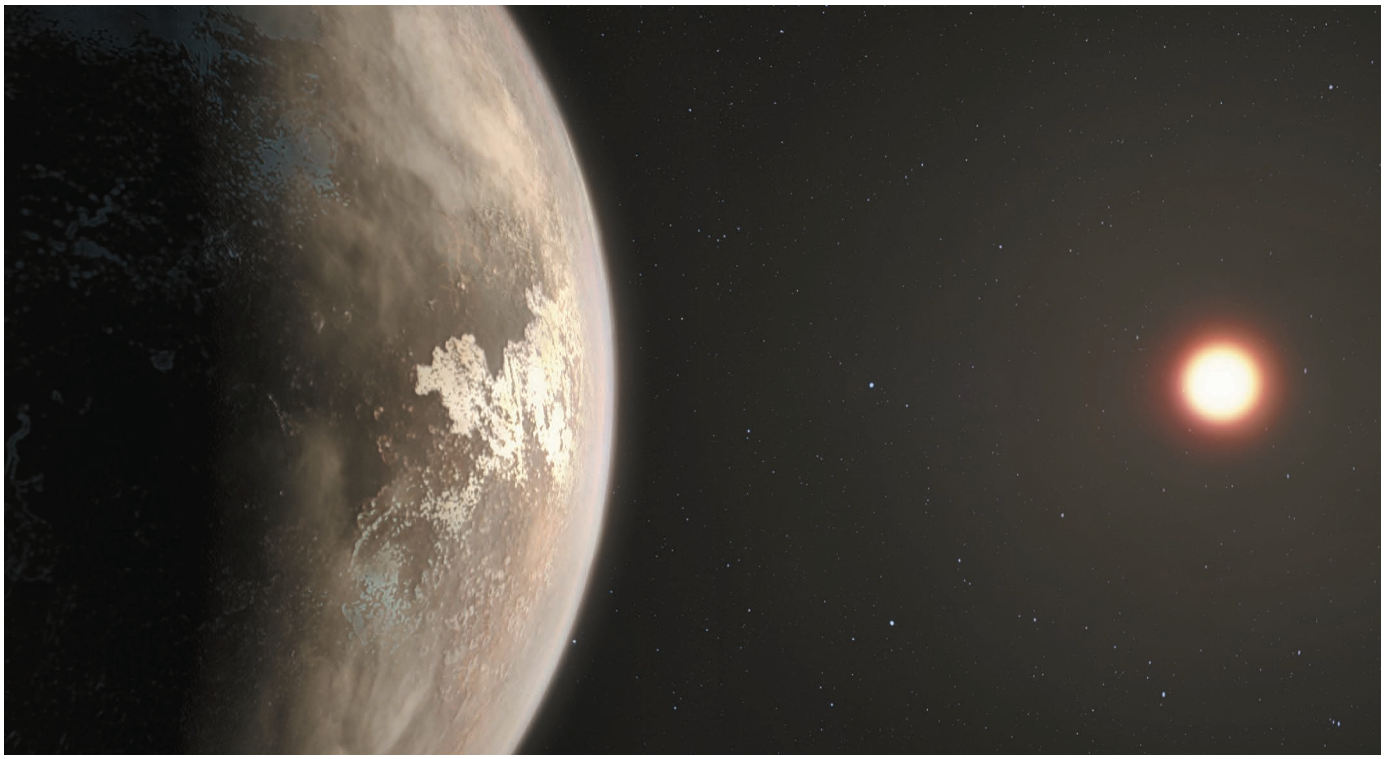


**The exoplanet Ross 128b orbits a cool dwarf star at a distance that could allow the world to have liquid water.**

ASTRONOMY

# Exoplanet hunters rethink search for alien life

*Focus shifts to how chemistry and geology could affect chances of life on other worlds.*

**BY ALEXANDRA WITZE, LARAMIE, WYOMING**

Steve Desch can see the future of exoplanet research, and it's not pretty. Imagine, he says, that astronomers use NASA's upcoming James Webb Space Telescope to scour the atmosphere of an Earth-mass world for signs of life. Then imagine that they chase hints of atmospheric oxygen for years — before realizing that those were false positives produced by geological activity instead of living things.

Desch, an astrophysicist at Arizona State University in Tempe, and other planet hunters met from 13 to 17 November in Laramie, Wyoming, to plot better ways to scout for life beyond Earth. Many are starting to argue that the standard definition of habitability — having liquid water on a planet's surface — is not the factor that should guide exoplanet exploration. Instead, the scientists say, the field should focus on the chances of detecting alien life, should it exist. "Planets can be habitable and not have life with any impact," Desch told researchers at the meeting.

It turns out that water worlds may be some of the worst places to look for living things. One study presented at the meeting shows how a planet covered in oceans could be starved of phosphorus, a nutrient without which earthly life cannot thrive. Other work concludes that a planet swamped in even deeper water would be geologically dead, lacking any of the planetary processes that nurture life on Earth.

"Habitability is not only about finding the signature of an alien life form taking a deep breath," says Elizabeth Tasker, an astronomer and exoplanet researcher at the Japan Aerospace Exploration Agency's Institute for Space and Aeronautical Sciences in Sagamihara. ▶

It's also about how a planet's geology and chemistry interconnect to create a welcoming or hostile environment, she says.

Astronomers have catalogued thousands of exoplanets, of which more than a dozen are potentially habitable. The most recent, announced on 15 November, is Ross 128b, which is 3.4 parsecs (11 light years) away from Earth. It resembles the target that scientists have spent decades hunting: an Earth-sized planet orbiting a nearby star, probably at the right distance to allow liquid water.

Most of these planets have some qualities that stop them being true Earth twins (see 'Looking for life'). But Tasker says the usual metrics that scientists use to rank how habitable a world is, such as its location relative to its star, are misguided (E. Tasker *et al. Nature Astron.* 1, 0042; 2017).

To figure out how to parcel out valuable observing time, some scientists suggest targeting planets that are thought to have both ocean and land. Worlds whose surfaces are covered by water may not have key nutrients available in forms that can support life — if that life is based on the same chemistry as Earth's.

"We have this stereotype that if we have oceans, we have life," says Tessa Fisher, a microbial ecologist at Arizona State. But that is not what she and her colleagues found when they studied a hypothetical "aqua planet" with a surface almost or completely covered by enough water to fill Earth's oceans five times.

On Earth, rainwater hitting rocks washes phosphorus and other nutrients into the oceans. But without any exposed land, there is no way for phosphorus to enrich water on an aqua planet over time, Fisher reported at the Laramie meeting. There would be no ocean organisms, such as plankton, to build up oxygen in the planet's atmosphere, she says — making such a world a terrible place to find life.

The wettest planets would run into another sort of trouble, says Cayman Unterborn, a geologist at Arizona State who analysed the planet-wide effects of having as much as 50 Earth oceans' worth of water. The sheer weight of all that liquid would exert so much pressure on the sea floor that the planet's interior would not melt at all, Unterborn found.

Planets need at least some internal melting to sustain geological activity, such as plate tectonics, and to provide the right chemical environment for life. In this case, Unterborn says, "too much water is too much of a good thing".

Water-rich worlds are easy to make. Many planets are likely to have formed far from their parent star, Tasker says, in chilly temperatures where they could have coalesced from fragments of rock and lots of ice. If such a planet later migrated closer to its star, the ice would melt and cover the surface in vast oceans.

Instead of instinctively studying such water worlds, Tasker says, astronomers need to think more deeply about how planets have evolved through time. "We need to look carefully at picking the right planet," she says.

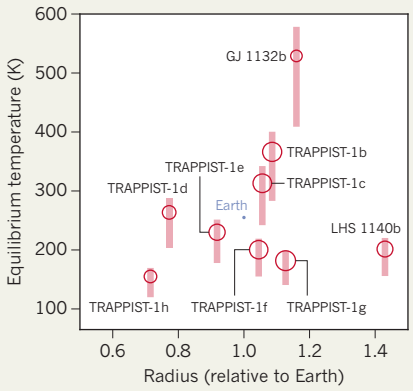
The James Webb Space Telescope is set to launch in 2019. Once in space, it will spend much of its time studying potentially Earth-like worlds. Researchers have already begun to analyse how oxygen or other 'biosignature' gases in exoplanet atmospheres might appear to the telescope's view (C. V. Morley *et al.* Preprint at https://arxiv.org/abs/1708.04239; 2017).

Towards the end of the Laramie meeting, attendees voted on whether scientists will find evidence of life on an exoplanet by 2040. Forty-seven said no and twenty-nine said yes. But a greater share was willing to bet that life would be found in the 2050s or 2060s.

That's presumably enough time to work through the debate over which worlds are the best to target. ■

**LOOKING FOR LIFE**

Astronomers are debating how to definitively detect life on planets outside the Solar System. Here's a look at how nine promising candidates compare to Earth.




SOURCE: C. V. MORLEY *ET AL.* PREPRINT AT HTTPS://ARXIV.ORG/ABS/1708.04239 (2017)

REPRODUCIBILITY

# Tool spots DNA errors in papers

*Online software scrutinizes research papers to identify mistakes in gene sequences.*

**BY NICKY PHILLIPS**

Two scientists have rolled out a program that spots incorrect gene sequences reported in experiments — and they have used it to identify flaws in more than 60 papers, almost all of them studies of cancer.

Jennifer Byrne, a cancer researcher at the Kids Research Institute of the Children's Hospital at Westmead in Sydney, Australia, and Cyril Labbé, a computer scientist at the University of Grenoble Alpes in France, made public an early version of the program, called Seek & Blastn, in October. Now, they want other researchers to test the program and help to improve it. They plan eventually to offer it to journal editors and publishers as an addition to the tools that most already use to check papers, such as software to detect plagiarism.

Byrne has been working on identifying errors in human-cancer papers since 2015, when she noticed problems with five papers on gene function in cancer cells. The authors of the papers described performing a common experiment in which they had inactivated a gene using a short targeted nucleotide sequence, to observe its effects on tumour cells.

***"You do get concerned about how the results were produced."***

Byrne was familiar with the gene because she was part of the team that reported it in 1998. And she realized that the 2015 papers reported using the wrong nucleotide sequences for the experiment they claimed to conduct. Two of these papers have since been retracted. Another two are expected to be retracted on 21 November.

After noticing similar errors in another 25 papers, Byrne and Labbé developed the Seek & Blastn tool to discover more papers with incorrectly identified nucleotide fragments. The software extracts nucleotide sequences from uploaded papers and cross-checks them against a public database of nucleotides, called the Nucleotide Basic Local Alignment Search Tool (Blastn).

"Seek & Blastn tries to find mismatches between the claimed status of a sequence — what the paper says it does — and what the sequence actually is," says Byrne. A mismatch is flagged, for instance, when a sequence described as targeting a human gene doesn't find a match in the Blastn database. Sequences described as non-targeting that do have a match in Blastn are also detected.

So far, the program detects only misidentified