**Reporting on discovery of life beyond Earth**

*A toolbox to help journalists to report about the search for life in space.*

Finding life beyond Earth would be one of the most profound research discoveries of all times.

Many astrobiologists now think that extra-terrestrial life exists, and some believe we will find the first evidence of it in the next couple of decades.

So, are journalists ready to cover what would likely be a Nobel-prize winning discovery in a responsible and ethical way, without hype, errors or misleading claims?

This toolbox aims to equip media professionals to do so. It is inspired by a 2026 academic white paper, The Search for Life Elsewhere: Avoiding Hype and Fostering Public Understanding, written by Danilo Albergaria from the University of Leiden, and colleagues. The toolbox is written by Mićo Tatalović, while visiting the Cavendish Laboratory, University of Cambridge, on the Maria Leptin/EMBO Science Journalism Fellowship, and was reviewed by Albergaria.

It is based on insights from several recent academic papers that have called for more effective communication in this field; on discussions with academics; and on an open consultation with international science journalists via International Science Writers Association, European Federation for Science Journalism, and European Union of Science Journalists' Associations.

Both academics and journalists are keen to communicate findings in this area responsibly and accurately, but both also have incentives – related to how academia and media work – that lead to dangers of hype and sensationalism from both sides. This has led to previous unsubstantiated and/or retracted claims about discovery of life beyond Earth, and some experts fear there will be further unrealistic expectations and false promises, overstatements, sensationalism, and over-simplification of the research effort.

This document aims to address the academic concerns, while staying relevant to the journalistic priorities and realities of working in the media. It is envisaged as a start of an important discussion in this ever-evolving field, not as a final prescription.

## Scientific principles and their media implications

Evidence of life will likely be subtle or unfamiliar, and be revealed in stages, meaning false starts and dead ends are to be expected.

Such setbacks are often a productive part of the scientific process, and even the false positives can often lead to interesting scientific discoveries that could also yield media stories.

Proving beyond reasonable doubt that ET life has been discovered will likely be a complex process spread over several years, rather than a singular event of discovery. It will require separate lines of evidence, independent verification and a lot of patience.

This gives an opportunity to portray the incremental process of science, thereby increasing the public understanding of science, while also producing interesting media stories.

Because of huge distances from Earth, astrobiology data are often poor quality and can be interpreted in different ways. So, any evidence will raise questions about the quality of data, and the uncertainties in their interpretation.

Realistically, the evidence for ET, if it emerges, will most likely not be clear cut nor detailed (such as a picture or a video of life thriving on another planet), but will instead be a faint data point on a computer screen that will be widely open to different interpretations.

The discovery may initially be based on messy and unclear data, which will require lots of processing, so it is good to ask what the actual data are and what they look like (i.e. Instead of pictures of an alien, they will more likely be something like pixelated pale dots on a screen).

It is good to ask what assumptions, filters and interpretations have been made to yield the final result that is said to be indicating life.

Such data come from complex machinery and instruments, so it is also good to ask what the detection limits and errors are on those. An important question is what can and what cannot be determined by a given set of measurements conducted, and with what confidence.

General principles of responsible science journalism apply here, too, such as critical thinking, a healthy dose of scepticism, and a questioning stance. Namely, asking what the evidence is, how it was generated, whether it has been independently verified, as well as asking about any conflicts of interests, and reaching out to other experts in the field for unbiased comment.

Key questions to consider could be: are the results presented by researchers with relevant background and track record in the field; are the results being published/presented in/at a good quality journal/conference after having been peer reviewed; and are there any vested interests that could be affecting the announcement?

Also: are the instruments used sensitive enough to detect such evidence as claimed; is the detected signal free of contamination or confounding factors from other sources or from the instruments/methods used; and have all the abiotic (non-life) explanations been ruled out; how theory-dependent is the interpretation of the data; were other competing theory-dependent interpretations ruled out after independent analysis by other researchers? Has the result been repeated or corroborated by independent observation?

Peer review, while important, is not a fault-proof process, and the true test of the results is likely to come in the weeks and months following the initial publication, through open scientific discussion and peer criticism.

Initial discoveries of signs of life will likely need to be followed by more data, or even by more advanced detection instruments (that may not yet exist, prolonging the uncertainty over results).

This will likely involve corroboration of the initial result by independent lines of evidence, and the dismissal of alternative hypotheses developed in response to the initial result.

It is important to treat any follow-up results, whether they are in agreement or disagreement with the original, with the same degree of scepticism and attention to detail.

Even if the data are judged by the relevant community of researchers to be good enough, they may still not be able to rule out a non-living – abiotic – source of that data, which points at current limitations of knowledge and uncertainty in science. For example, just because we don't know of any abiotic processes that can produce certain bio-signatures does not mean that there aren't such processes yet to be discovered.

Another limitation is epistemological: we still don't have the full understanding of life nor of how and where it emerges, which limits our conceptions of the necessary and sufficient conditions for life on other worlds.

Indeed, some experts point out the problem of unconceived alternative explanations: the unknown unknowns which limit our confidence in detecting alien life, as well as our ability to quantify our level of uncertainty. Just because there is no known abiotic explanation for a potential bio-signature, for example, does not mean that such an explanation does not exist – it might just mean we haven't discovered it yet. It would then be premature to jump from saying 'we don't know of abiotic processes that can produce such a signature' to the conclusion 'it must be life'.

So, life detection is unlikely to be instantaneous or unambiguous.

To help avoid sensationalism, media could take care to portray appropriate nuance and uncertainty in the data, as well as the complex nature of the scientific process behind the data, especially when the data are preliminary, or not yet published in a peer review paper or exposed to independent verification.

History of science abounds with claims of discoveries of alien life, including high-profile hoaxes, which highlight the need to be sceptical and questioning about such claims, and also to provide examples of how initially credible results are often disproved with further inquiry.

Scientists often worry about the accuracy of the reporting and about being misquoted, especially in such sensitive stories. There are ways for journalists to fact-check technical parts of the story and to show the scientists their quotes, without sharing the entire article or agreeing to unnecessary changes.

Visuals of exoplanets and hypothetical alien life forms can help explain complex science, but it is helpful for this to be clearly marked as fictional and/or artists' impressions, and acknowledge when they were produced using AI. It could be useful to present also the real data/imagery the visuals are based on, as well as to explain what rendering has been done to come up with the visual in order to avoid misunderstandings. One could also present the public with different artistic impressions that are equally consistent with the exoplanet being covered – e.g. an Earth-mass exoplanet could resemble Earth, but also Venus, or Mars, or something even more alien and inhospitable.

If life is detected, initial details will likely be scant and it will be hard to get more information, which might be unsatisfactory and will leave room for speculation which might be fun but is different to serious, data-based discussions.

Another relevant question is: how will the public react to such news and what will it mean for our societies and the way we think about life and our place in the universe? Some evidence suggests many people already believe that aliens have visited Earth, and previous false positive reports about life beyond Earth have left us largely unfazed, suggesting many may find a real discovery anti-climactic, too.

## Scenarios of life detection

Different scenarios for life detection beyond Earth exist, each with its own set of issues. For example, bio-signatures in atmospheres of exoplanets or on icy moons of our solar system, signs of life in samples returned from Mars or other space bodies or those from meteorites, and techno-signatures such as radio signals from other worlds. But two basic initial questions apply to all of them: 1) is the signal real (rather than being an artefact of a contamination), and if so, 2) does it really indicate life (or can it be explained in another way without invoking life).

Also, scientists distinguish between 'life-as-we-know-it' which would be organic life with processes similar to those seen by life on Earth, and 'life-as-we-don't-know-it' which by definition could be very exotic and perhaps even more difficult to detect and interpret.

Academics are working on a set of procedures that would help them evaluate claims of life detection, as well as the level of confidence we can have in such claims, in a systematic way.

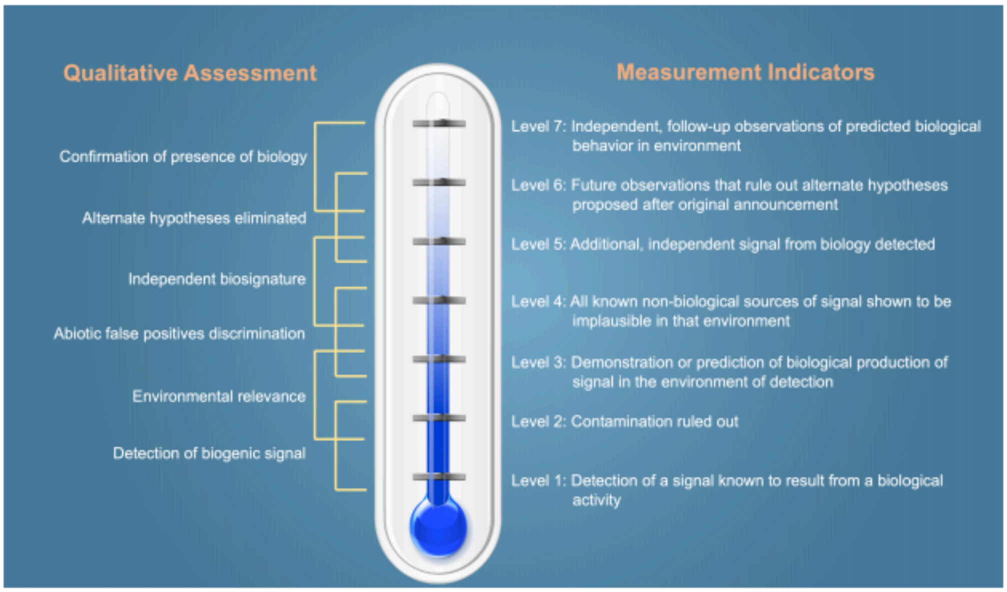
One of these is called a Ladder of Life Detection, a set of proposed rules to help determine whether the evidence represents life or not. This includes several steps and requirements, such as that measurements are sufficiently sensitive, free of contamination and repeatable. And that the signs of life are sufficiently detectable, preserved, different from abiotic signals, and compatible with what we know about life, as well as there not being a known abiotic way of explaining them.

Another one of these is called Confidence of Life Detection scale, an example of which is shown below (from Green et al. 2021), which illustrates the different steps one would need to go through to claim detection of life at high levels of confidence.

There are other similar frameworks, one has been proposed by the Network for Life Detection and the Nexus for Exoplanet System Science, which sets five questions as guidelines to help determine if any bio-signature has in fact been detected, and if so, whether it has been properly interpreted.

These are not universally accepted, but they all underscore the complexity and difficulty of determining whether any new evidence does actually come from life, and point to some questions to consider when reporting on the issue.

In other words, life detection results may likely be a matter of probability, not a purely yes or no proposition.




(Image credit: Green et al. 2021; see reference below)

Helpful definitions

**Bio-signature:** A detectable sign of biological life (either current or extinct), not proof for its existence. It can easily be mistaken for natural phenomena unrelated to life. The uncertainty in using it as a definitive sign of life comes from possible measurement errors, contamination of samples, and lack of understanding of the environment and abiotic processes.

**Techno-signature:** Any sign of technology that can be used to infer the existence of intelligent life. Many such signs could easily be mistaken for natural phenomena unrelated to life. They could also come from extinct life.

**Habitable:** A feature meaning that a space body may have conditions conducive to life, but this doesn't mean it has life or that it is habitable to humans.

**Earth-like planet:** an exoplanet similar in size and composition to Earth, sometimes referred to as Earth-sized planet, Earth twin, Earth 2.0, or Earth analog, but conditions may be wildly different to anything we know on Earth and may not be hospitable to life, especially not to humans.

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