

# What Is The Statistical Probability Of Life On Other Planets?



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*[What is the statistical probability of life on other planets?](#) originally appeared on [Quora](#): the place to gain and share knowledge, empowering people to learn from others and better understand the world.*

**[Answer](#) by [David Christian](#), Cofounder the Big History Project, author of [Origin Story](#), on [Quora](#):**

When I first began teaching big history, almost 30 years ago, most scientists seemed pretty sure that life was extraordinarily rare. And it might be that it

existed only on planet earth. But science moves on, and today I suspect most astrobiologists, the scientists who study the possibility of life in the universe, would guess that the Universe is crawling with life, at least with bacteria-like life. We don't know for sure because we have not yet identified life anywhere else. But there are really three reasons for this shift.

First, in the 1990s, astronomers learnt how to detect planets around other stars and now we know that most stars have solar systems, so there may be billions of planets quite like planet Earth just in our own galaxy, the Milky Way, so there seem to be lots of places where life could possibly live. Second, on our own planet, Earth, life appeared quite soon after the planet formed. And that seems to suggest that where there exist the right "Goldilocks" conditions for life it can pop up quite easily. Finally, we have now found bacteria existing in very harsh environments, inside scalding hot springs, or inside rocks, and we know they can even survive short journeys in space. So they are tougher than we thought.

But that's bacteria. Big creatures like ourselves are probably much rarer. After all, on planet Earth it took just a few hundred million years to create the first bacteria, but it took almost 3 billion years to create the first large creatures, like worms or trilobites. So the chances of meeting creatures like us still seem very remote. And would we want to meet them? If we did, the odds are that they would be much more powerful than us so they might treat us a bit the way we treat chickens or sheep. Not a nice thought!

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# Elon Musk says a new study about aliens gives humans even more reason to colonize other planets

[Dave Mosher](#)



Elon Musk and a SpaceX illustration of its Big Falcon Spaceship on Mars.  
SpaceX; Kevork Djansezian/Getty; Shayanne Gal/Business Insider

- **[Elon Musk](#) says we need to colonize space because we may be the only intelligent civilization.**
- **His comments were inspired by a draft study from Oxford University researchers that looks at the Drake equation, a formula that explores the possibility of other intelligent [alien life](#) in our galaxy.**
- **The research suggests there's a 41% chance we're alone in the [Milky Way](#) and a 32% chance we're alone in the visible universe — and those are the optimistic numbers.**

Elon Musk, the founder of SpaceX, has long proselytized for the cause of interplanetary colonization.

If Earth gets whacked by a [giant space rock](#), a cataclysmic [solar storm](#) cripples electronics, or we cleanse ourselves of the planet in nuclear fire ([accidentally](#) or [otherwise](#)), it could help to have a backup civilization on a world like Mars.

To that end, SpaceX has rallied [thousands of employees](#) to design and build a next-generation spaceship, the [Big Falcon Rocket](#), capable of ferrying 100 people and 150 tons of cargo [to the red planet](#).

Now, researchers at Oxford University's Future of Humanity Institute have given Musk even more reason to preach his cosmic gospel: A draft of [a new study](#) suggests there's a roughly 2-in-5 chance we're alone in our galaxy and a 1-in-3 chance we're alone in the entire cosmos.

"It is unknown whether we are the only civilization currently alive in the observable universe, but any chance that we are is added impetus for extending life beyond Earth," [Musk tweeted on Monday](#), referring to the study.

He added: "This is why we must preserve the light of consciousness by becoming a spacefaring civilization & extending life to other planets."

## **A 100-billion-fold difference in alien estimates**

The study, titled "Dissolving the Fermi Paradox," was published on June 6 on Arxiv, a server for sharing science papers that have yet to be peer-reviewed.

The research begins by questioning the Fermi paradox, an idea attributed to the physicist Enrico Fermi (though [perhaps incorrectly](#)) that asks: Why haven't we heard from intelligent aliens if there are hundreds of billions of stars in the Milky Way galaxy, plus hundreds of billions of galaxies in the

visible universe?

There are some [deeply unsettling solutions](#) to the Fermi paradox. One suggests that intelligent civilizations wipe themselves out too quickly to be heard by other species, perhaps because of [climate change](#), resource overuse, or [nuclear weapons](#). A more frightening solution is that, like predators at the top of an interstellar food chain, intelligent civilizations wipe out alien races before they can pose a threat.

However, Oxford's [Anders Sandberg](#), [Eric Drexler](#), and [Toby Ord](#) think there might not be a paradox at all.

The three researchers focused their work on the Drake equation, a formula written by the astrophysicist Frank Drake in 1961. The equation takes a stab at the Fermi paradox by suggesting [seven variables](#) that would affect the chances of life, then multiplying them. The result, "N," is an approximate number of humanlike races that might be broadcasting signals into space within the Milky Way.

Frank Drake and his famous equation, which is a way to estimate the likelihood of intelligent alien life in the Milky Way galaxy.

[SETI Institute](#)

But the Oxford researchers argue that the deep uncertainty of some Drake equation variables — such as the fraction of planets on which life appears ( $f_l$ ) or the fraction of life that becomes intelligent ( $f_i$ ) — is rarely or properly addressed.

"It is common to see carefully estimated astrophysical numbers multiplied by these ad hoc guesses," they said. "It has been noted that the final results seem to depend heavily on the pessimism or optimism of the authors."

For example, about two-thirds of studies that use the Drake equation suggest that about 100 advanced alien civilizations exist per [Milky Way galaxy](#). But other estimates are wildly different, ranging from 100 million civilizations per



galaxy down to just three per 10,000 galaxies — a 100-billion-fold difference.

## **'We find a substantial probability that we are alone in our galaxy'**

The Milky Way galaxy photographed through a crystal ball.

[Courtesy of Juan Carlos Muñoz-Mateos](#)

The Oxford researchers tried to capture these uncertainties with their new paper. Their goal was to see whether the Fermi paradox ("Where are they?") is a mathematically valid question to ask, based on what we know about the universe today.

The researchers did this by rounding up and analyzing studies on the seven Drake equation variables. Next, they reformulated each variable as a range of uncertainty based on those studies as a whole, as opposed to an individual scientific group's best guesses.

The work produced a bell-curve-like distribution of results that Musk grabbed onto. And they were bleak.

According to the study, the average probability (toward the middle of the bell curve) that we're alone in the Milky Way came to about 52%, with a 38% average chance that we're alone in the entire observable universe.

Even the most optimistic, better-than-average values were depressing. The authors say there's a 41% chance we're alone in the galaxy and a 32% chance we're alone in the visible universe.

"This result dissolves the Fermi paradox, and in doing so removes any need to invoke speculative mechanisms by which civilizations would inevitably fail to have observable effects upon the universe," they said, adding: "We find a substantial probability that we are alone in our galaxy, and perhaps even in our observable universe."

# Why the study fuels Musk's ambitions to colonize space

[SpaceX/Flickr](#)

The study authors don't suggest we stop looking for alien life.

"This conclusion does not mean that we *are* alone (in our galaxy or observable universe), just that this is very scientifically plausible and should not surprise us," they wrote. "It is a statement about our state of knowledge, rather than a new measurement."

If we are alone, however, that raises the stakes for Musk's push to [rocket humans to Mars](#) and later [establish a colony](#) on the red planet as a "backup drive" for humanity. By not settling space before a cataclysmic accident, war, or natural calamity kills most or all of us on Earth, we'd risk not only the erasure of the human race, but the destruction of the only intelligent civilization in the known cosmos.

Regardless, Musk also thinks we should keep looking for Them.

"It would be amazing to encounter an alien civilization," [he tweeted Monday](#), "provided it is not their invasion fleet!"