

# Reflecting on Our Present Self-Awareness of Not Having Found Any Life Beyond Earth

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The quest for finding extraterrestrial life has been a fascination for humanity for centuries, yet we have not yet found any concrete evidence of life beyond our planet, except for some hints of methane on Mars. It is essential to document this time of not having found any life to fully describe our perspective to other civilizations, anticipate how these events may change humanity, and appreciate the uncertainty of our knowledge about the universe.

It is crucial to understand that the distances between stars are vast, thus the lack of finding life around other stars may be due to the difficulty of performing such far-off observations, as well as an actual absence of other life. Moreover, any signals which may be received from other civilizations would be incredibly weak due to the immense distance those electromagnetic waves must travel. The statistical probability of other civilizations existing may be low due to the time it takes for intelligent civilizations to evolve, combined with the distance factor, resulting in only a small number of civilizations co-existing in the galaxy or even among nearby galaxies.

Despite the absence of evidence, humanity maintains a keen interest in extraterrestrial life. However, the lack of findings has caused some to doubt the possibility of life elsewhere, while some others still cling to unsubstantiated claims of observing visits from extraterrestrials.

What we do know is that life in the universe is rare and intelligent life even more so. Each time we peer further into the universe we learn more about how special life is here on Earth.

The theme of these endeavors sits in the middle of the vastness of space with the story of, arguably, one of the most interesting phenomena in it: life. Everyone who participates in projects like these feels connected, and part of the story of a precious life-bearing planet in our Milky Way galaxy. This also adds to feeling responsible for that world's survival.

Recent developments in finding planets around many stars is a promising step towards finding life elsewhere. This progress is particularly significant as it was only 30 years ago, before the first of these exoplanets had been found, many leading researchers emphasized how we did not know if there were even planets beyond our Solar System. Given this revolution in planetary astronomy, the odds have improved for eventually finding all kinds of life in the universe - perhaps much like what we have on Earth.

If we develop a space-based civilization, we may have planet-sized telescopes that could scrutinize planets far off in the galaxy. However, there may come a day when we will obtain evidence of the absence of life elsewhere. This day may only arrive after humanity's future is better secured through establishment of a space-based civilization, thus may never come if humanity fails to secure our future.

The universe is immense, hence even an infinitesimal chance of intelligent life arising can arguably be compensated for by an almost infinite number of potentially life-hosting exoplanets.

44 However, the possible number of worlds is necessarily finite, even if it is vast. Still, if we have to  
45 look too far beyond the Local Group of galaxies the cosmic speed limitation of light in vacuum  
46 and the very expansion of the universe may preclude communication back to any civilization  
47 whose signal we receive. Furthermore, as observation distances get larger, we are looking further  
48 into the past. Given that it has taken 4.5 billion years for the Earth to develop a technological  
49 civilization, plus the fact that Earth was only formed after our region of the galaxy had  
50 accumulated enough heavy elements, there is some distance beyond which the universe will have  
51 been too young for life to have evolved to the point of developing inter-galactic communication  
52 capability. That said, we may still hope that in larger Local Group galaxies such as Andromeda,  
53 the process of starting life on Earth-like worlds might have begun sooner, increasing the chances  
54 of life and communication with other civilizations.

55 The “occurrence rate” of intelligent civilizations is not only one of the most interesting  
56 questions that science can answer, it also is of practical importance for evaluating how  
57 surmountable are the barriers – i.e., “Great Filters”, which can destroy civilizations such as ours.  
58 If civilizations do communicate with each other, one of the most intriguing questions to address  
59 will be, “How many other civilizations do you know of?” It would matter a great deal if we  
60 received a message from a much more advanced civilization who reported not finding other  
61 civilizations.

62 The Message in a Bottle (MIAB) article [Jiang *et al.* 2023], published in this issue of Earth  
63 and Space Science, proposes a universal yet contextual understanding of modern human society,  
64 evolution of life on Earth, and challenges for the future. This effort is a bold approach towards  
65 representing humanity in all its complexity. A civilization receiving our MIAB would certainly  
66 want to hear that we have not yet found any clear sign of life anywhere off Earth. We should  
67 record this fact, as it currently stands, for our descendants as well, in anticipation of a possible  
68 future where we have both found simple life on other worlds and even have received and  
69 decoded messages from other civilization(s) elsewhere.

70 Considering the possibilities of extraterrestrial life has essential implications for how we act  
71 on Earth. Our species is less peaceful than others, such as bonobos, and we do not know how  
72 well, for instance, a "bonobo-personality" civilization elsewhere will develop technology. It is  
73 worthwhile to our own future that we channel the enthusiasm for searching out answers beyond  
74 Earth to as well urging humanity to unite in better understanding how we can survive to achieve  
75 our most fulfilling potential futures among the planets and stars, and here on Earth.

## 76 77 **Reference**

78 Jiang et al., Message in a Bottle – An Update to the Golden Record, in Press, *Earth and Space*  
79 *Science*, 2023EA003042, 2023.