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# On extraterrestrial life

Since everybody seems so interested about the possibility of finding extraterrestrial life, I spent a couple of lectures per semester on this subject. Given the enormous vastness of the cosmos, with estimates of over $10^{11}$ galaxies, it appears easy to reach a conclusion in favor of the existence of extraterrestrial life. Indeed, the search for extraterrestrial intelligence (SETI) has become a respectable academic pursuit. As a premise, it is reasonable to accept the existence of extraterrestrial life. However, my guess is that this life is most likely in bacterial forms and morphologies yet unknown to the human experience.

To estimate the likely probability of finding *human-like* extraterrestrial life, in our own galaxy, I engaged in a simple approach using published astronomical figures while ignoring temporal issues. The approach adopted was based on the usual multiplication of probabilities. However, the question that I posed was quite specific: "What is the rough probability of finding a planet *almost exactly like Earth* somewhere else in our galaxy?" Asking that rather restrictive question means that, as an initial step, a series of conditions have to be met in order to determine the likelihood of finding a star with the same mass and luminosity as our Sun. Also, this star would have to be positioned approximately at the same radial distance on the disk, as our Sun, from the center of the galaxy (a very restrictive condition). That is, it would have to be positioned on a ring with a thickness about twice the diameter of the solar system. Then, that G-class star would have to have a planetary system. Next, our candidate planet would have to have similar mass and volume, as Earth, and would have to orbit within the habitable zone, around the Sun-like-star. This rough back-of-the-envelope exercise yields a number of possible candidates near the double-digit area. Certainly, relaxing the conditions imposed earlier leads to larger numbers. Also, it would be interesting to repeat this particular calculation using the latest available data in a formal context.

A crucial element, not included in the previous discussion, is the fact that the Moon plays an essential role in regulating the climate on Earth. We also know that the Moon ended up there following a very unique cataclysmic event. What is the probability for that event? That decreases the odds even further.

As discouraging as this seems it gets even worse if you extend the question to consider *humanoid life forms*. Thanks to the genius of physicist Luis W. Alvarez (1987), we know that the Earth was struck by a giant asteroid some sixty five million years ago. It was

that collision, that wiped out the dinosaurs, it was that collision that eventually gave us a chance. Without that miraculous collision the Earth would belong the reptiles. Finding a planet like ours won't be easy, finding extraterrestrial life like ours, will be even harder.

Thus, it can be argued that our galaxy might not be teeming with human life forms albeit this argument does not exclude other life forms. Further, it can be argued that even if planets like our Earth are found out there they might well be populated by alternative life forms… like ferocious alligators, for instance. Nevertheless, given the total number of galaxies (~ $10^{11}$) there is a distinct probability of humanoid species out there, albeit separated by enormous and increasing distances. Although I made it clear that all this was just a conjecture, the students kind of liked it.

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## Reference

Alvarez, L. W. (1987). Mass extinction caused by large bodily impacts. *Physics Today* **41** (7), 24-33.