

# Civilization-bearing planets in the Milky-Way Galaxy; 50 necessary conditions must be satisfied in order

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## <Purpose>

Is there any life in the Universe, or specifically civilization-bearing planets? Recent popular answer for this basic question is easy-going “Yes”, which was also trendy answer 100 years ago. They think there are so many stars in the Universe, e.g.,  $10^{11}$ , so it is reasonable to think the possibility of the presence of life in the Universe. However, is it right scientifically?

## <Method>

If the number of necessary conditions to make civilization-bearing planet is 50, simple estimate of presence or absence is  $(1/2)^{50}=1/(10^{11})$ , indicating that it is only one in the Milky Way Galaxy. To discuss the presence of life in the Universe, the best example with the most detailed research information is the Earth and its history. Other examples are planets, asteroid and meteorites in the solar system. Applying those data to the Universe, we can lead to general aspects of necessary conditions to infer life in the Universe.

## <Result>

Based on the data set inferred from the research of Earth and life, 48 requirements are listed up. Those necessary conditions are mainly categorized into the following four. First group has 11 planetary conditions to be a life-sustaining planet; for example, “Chemical composition of central star”, “Mass of central star”, and “Circular orbit”. Second Group has 14 conditions of rocky planets to prepare the cradle of life; such as “Formation of bimodal continental and oceanic lithospheres to initiate plate tectonics”, “Restricted amount of initial mass of ocean to supply of nutrients for life”. Third group has 9 conditions to emerge and evolve life; such as “continuous and strong outer energy by natural geyser”, and “well-balanced nutrients source of landmass”. Forth group has 10 conditions to evolve into civilization bearing planet; such as “Survival over 2 billion years until birth of Eukaryote”, “A way to Eukaryote from Prokaryotes”, “A way to metazoans and Plant”, “Acceleration of life evolution”. There are other important 4 conditions; such as “Galactic habitable Zone”

## <Discussion>

If we simply calculate the probability of presence of life in the Universe, civilization-bearing planet is only one (Earth). It is also emphasized that the requirements mentioned above is treated as presence of absence for all requirements, but several requirements are definitely less than 50% probability, e.g., extremely strict constraint for the amount of ocean volume  $3\text{km}\pm 1\text{km}$ . Moreover, it is emphasized that the number 51 is combinations and not permutations. This strongly indicates that we are alone in the Universe, even including whole Universe beyond our Milky Way Galaxy.

Keywords: habitable planet, civilization bearing planet, condition

