

**ASTROBIOLOGY AT SUMMER CAMP: COMMUNICATING SCIENCE, FIFTY MINUTES AT A TIME.**

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**Introduction:** Summer camp evokes thoughts of swimming in the lake, making friendship bracelets, and roasting marshmallows over the campfire. But is it possible to sneak in some science education in the midst of all this fun? Is it possible to make astrobiology in particular fun and accessible, while still being educational? My answer to this question is a resounding “YES”!

Camp Quest is a national organization which has expanded from one location to more than 15 affiliate locations across the country over the past 19 years [1]. Each affiliate camp has their own volunteer camp director and recruits an all-volunteer staff, with a common goal of providing a week-long summer camp experience that is catered, but not limited, to humanist families. There is an emphasis on critical thinking, philosophy, and scientific inquiry alongside more traditional summer camp activities like team games, arts and crafts, and survival skills. This is, therefore, a prime environment for astrobiology-focused activities. Most programs at Camp Quest are less than an hour in length – but much can be done with only fifty minutes to introduce and complete an activity.

*Two Camps, Four Years:* My Camp Quest experience has been in the role of volunteer camp counselor and program staff, and I have had the privilege of being a member of the staff at both Camp Quest Chesapeake (2011 and 2012) and Camp Quest Arizona (2013, 2014, and 2015). With my own strong interest in astrobiology, Camp Quest has been an opportunity for me to develop and run activities geared towards the children who attend these camps, who range in age from 8-17. Here, I will focus on two programs that I have developed and led for several groups of campers.

**Activity #1, Alien Evolution:** Our solar system is full of potentially-habitable planets – and we have even discovered planets orbiting other stars that may be habitable as well! This activity encourages campers to think about what habitability is, what the requirements for life are, and how the environment helps to determine the evolutionary process. After some group discussion about habitability and evolution, campers are divided into teams and presented a “Habitat Profile”, a blank sheet of paper, and an assortment of colored pencils. The teams are given the opportunity to discuss how the environment on their assigned world would have impacted the kinds of life that could hypothetically exist there, draw some of the creatures in their natural habitat, and then present it to the larger group. A creative implementation of scientific concepts engages campers on multiple levels, and teamwork amongst

children over a range of ages enhances the experience for all. The figure below depicts the “gold shark”, armed with orange fur and an appetite for the nutrients of inorganic materials in the ocean of Europa, a creature developed by campers during the summer of 2014.



**Activity #2, The Drake Equation:** This activity has seen both failure and success in its attempt to introduce campers to the Drake Equation (shown below), which is used to estimate the number of intelligent, communicating alien civilizations in the galaxy.

$$N = R_* \times f_p \times n_s \times f_i \times f_c \times L \quad [2]$$

The probabilistic and mathematical nature of the Drake Equation makes it challenging to communicate to a large audience, and especially to younger campers. However, when presented to a small group of older campers, the activity proved more successful – in 2014, I led the activity with the six Counselors-In-Training (CITs) at Camp Quest Arizona, who were all between the ages of 15-17. This provided the opportunity to discuss each of the terms of the Drake Equation in some detail, and every CIT had the chance to express their thoughts on them before individually settling on a value for factors such as the likelihood that a habitable planet developed life, or the longevity of communicating civilizations. We explored both optimistic and pessimistic estimates of the total number of extraterrestrial civilizations in the Milky Way galaxy and the implications of those results – and the CITs continued their discussion even after our fifty minutes had ended.

**Future Work:** Camp Quest has recently established several curriculum committees, including SENSE (Science, Evolution, Nature, and Space Exploration). As a member of the SENSE curriculum committee, I will have the opportunity to share these and other astrobiology activities with Camp Quest affiliates across the country.

**References:** [1] <https://campquest.org/history> [2] Shklovskii I.S. & Sagan C. (1966), Dell, New York.