

Life Outside Our Solar System

The Drake Equation

The Drake Equation

- One of the tools used to predict the prevalence of life outside the solar system
- Created by Frank Drake in 1960
- Creates an estimate for the number of galactic civilizations that could potentially communicate with Earth



The Equation

$$N = R^* \times f_p \times n_e \times f_\ell \times f_i \times f_c \times L$$

What Does It Mean?

$$R^*$$

- R^* is the average rate of star formation per year in the Milky Way
- In his original trials, Drake set this number at about 10/year, based on the astronomical data available at the time
- Recent calculations place this number closer to 7/year
- This is the least disputed figure of the equation, as it is supported by actual data

$$f_p$$

- f_p is the fraction of those stars that have planets
- Drake estimated this number to be .5, meaning half of discovered stars would have planets
- Recent discoveries show that this number could vary from .2 to .6, or 20 to 60 percent of stars having planets

$$n_e$$

- n_e is the average number of planets that can potentially support life per star that has planets
- Drake guessed that this number would be 2 per star system
- Because most discovered planets are Gas giants with orbits very close to their stars, confidence in this number is not as high as it used to be

$$f_{\ell}$$

- f_{ℓ} is the fraction of those planets that develop life at some point
- Drake estimated this to be 1, or half of the potential planets
- Recent estimates of this number are around 1/3, based on how long it took life to develop on Earth

$$f_i$$

- f_i is the fraction of the above that actually go on to develop intelligent life
- Drake estimated this to be .01, or 1 percent. This estimate was based on no real evidence.
- Because data is only available from one source, Earth, there is no good way to estimate this figure

$$f_c$$

- f_c is the fraction of civilizations that develop a technology that releases detectable signs of their existence into space
- Drake also put this number at 1 percent
- It is also an estimate with no available data

L

- L is the length of time those civilizations release detectable signals into space
- Drake estimated this to be 10000 years
- Recent estimates, based on civilizations throughout the history of human life, place this number at around 300-400 years
- However, 10000 is still the most popular estimate

$$N = R^* \times f_p \times n_e \times f_\ell \times f_i \times f_c \times L$$

So What Does This Really Mean?

- According to Drake's first experiment, it means that there are 10 potential civilizations with the capacity to communicate with Earth
- More recent estimates using this formula are around 2 or 3 potential civilizations

Criticism

- Because many of the parts of the equation are based solely on estimates, any solutions produced are unreliable
- Because of this, any result could be achieved, from zero to billions of possible planets based on what possibilities one uses
- Though these criticisms exist, the equation is still used because it stimulates discussion on the topic of life outside the solar system