



# What Is Life?

Surprisingly, there is no firm scientific definition of life. There is no single test that can establish the presence or absence of life nor one single characteristic that applies to all organisms. However, one can begin to define life by listing the characteristics that most living creatures share. For example, most of Earth's life forms exhibit the following traits:

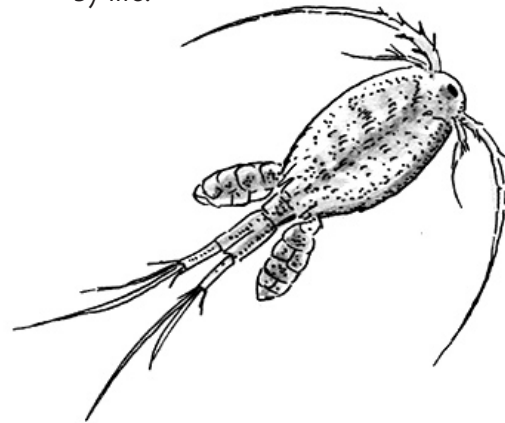
- have carbon-based chemistry.
- have a membrane or wall that creates an internal environment.
- use energy to maintain an internal state.
- require liquid water.
- are able to extract energy from the environment.
- carry out metabolic processes resulting in the exchange of gases and solid materials (i.e., consuming raw materials and producing wastes).
- exhibit some type of growth, cell division, reproduction, or replication.
- are able to undergo population evolution and adaptation to the environment.

Some nonliving objects, such as fire, possess many of these characteristics and some arguably living organisms, such as viruses, possess only a few. Are some characteristics more fundamental than others?

Two characteristics are particularly useful in helping distinguish living from nonliving things: the ability to reproduce (sexually or asexually) and the ability to produce and perpetuate genetic variation among offspring. Put another way, life is a self-contained chemical system capable of undergoing Darwinian evolution.

This large-scale, long-term view of life acknowledges that individual organisms must still carry out many of the small-scale, short-term functions listed above. In fact, many of the tests that scientists design to detect life on other planets look for byproducts related to these short-term functions. So while detecting life depends on finding many immediately recognizable characteristics, for life to persist on Earth, it must evolve and adapt to changing conditions.

Few of the characteristics on this list lend themselves to quick, one-time tests, and many require multiple observations over a period of time. Some Earth organisms leave traces after death. One way astrobiologists search for extraterrestrial life is to search for biosignatures—large-scale, telltale signs of life, such as the presence of gases produced by life.



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**Source:**

Astrobiology in your classroom: Life on Earth...and elsewhere?  
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