



What does it mean to be alive? A review on the concept of the living in the context of existence

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Abstract. The concept of life remains one of the most profound and debated topics across scientific and philosophical disciplines. This review explores the multifaceted nature of what it means to be "alive", bridging biological definitions, systems theory, and existential philosophy. It discusses classical biological criteria such as metabolism, reproduction, and evolution, while highlighting their limitations when applied to borderline cases like viruses and prions. The paper examines contemporary frameworks including autopoiesis, Living Systems Theory, and dissipative structures, which frame life as a dynamic, self-sustaining process. Philosophical approaches introduce ontological and existential dimensions, suggesting that life is not merely a biological condition, but an emergent and purposive mode of being. By integrating insights from biology, philosophy, and systems theory, this work argues for a pluralistic and layered understanding of life, emphasizing its relational, self-organizing, and entropic-resisting properties.

Key Words: artificial life, autopoiesis, life, biological definitions, entropy, existentialism, living systems, ontology, prions, systems theory, viruses.

Introduction. The concept of "life" has challenged philosophers, biologists, and physicists for centuries, with ongoing debates about what distinguishes living from non-living entities (Ghorbani 2018). Historically, ideas ranged from ancient notions of anima and vital force to modern theories emphasizing self-organization and complex systems. Contemporary frameworks, such as Living Systems Theory, propose that life can be understood as a hierarchy of systems, ranging from cells to societies, each characterized by critical subsystems that process matter, energy, and information, and exhibit properties like self-organization, autonomy, and emergence (Miller 1971; Miller & Miller 1990; Swanson 2007). Recent models suggest that life is best defined not by a single property, but by a combination of features such as energy flow, information processing, and the ability to maintain far-from-equilibrium states, which can apply across molecular, cellular, and ecological levels (Caetano-Anollés et al 2021; Mistriotis 2021; Plante 2025). Some perspectives argue for a continuum between living and non-living, highlighting the collaborative and metabolic interactions among entities, and challenging the notion of strict boundaries or autonomy as the sole criterion for life (Dupré & Malley 2013; Plante 2025). Others propose that living entities are distinguished by their capacity to generate meaning or to manipulate matter and energy for goal-directed behavior (Brown 2023; Ball 2024). This review explores these diverse theoretical frameworks, treating the living

not merely as a biological state but as an existential condition shaped by both empirical criteria and philosophical interpretation (Miller 1971; Dupré & Malley 2013; Caetano-Anollés et al 2021; Plante 2025).

Philosophical Perspectives: Life as an Existential Category. Philosophers have long debated whether life is a purely biological phenomenon or something more fundamental. Existential thinkers like Heidegger distinguished between existence (Dasein) and mere presence (Vorhandenheit), arguing that only beings who are aware of their own being, humans, in this case, truly exist, while other living things merely persist biologically (Malachowski 2017). Under this view, life has degrees or dimensions: a bacterium "lives" in the biological sense, but a human "exists" in the ontological sense (Malachowski 2017). Similarly, Hans Jonas, in 'The Phenomenon of Life', proposed that life should be understood from the inside, as a striving for continued being, seeing organisms not merely as mechanical systems, but as purposeful beings who maintain their own identity against entropy (Eshenkulova 2024). Life, in this sense, is resistance to dissolution, emphasizing the existential and purposive aspects of living systems beyond mere biological criteria (Eshenkulova 2024).

Systems Theory and Autopoiesis. In the 1970s, Chilean biologists Humberto Maturana and Francisco Varela introduced the concept of autopoiesis, the self-producing organization (Maturana & Varela 2012). According to this theory, a living system is one that continuously regenerates and maintains its own components and boundaries. An autopoietic system is organizationally closed but structurally open, it exchanges matter and energy with its environment, but preserves a self-defined identity.

This concept moved the discussion away from individual traits (e.g., reproduction) and toward systemic integrity. It also opened the door for thinking of living systems as informationally autonomous: life becomes less about having specific parts and more about maintaining a certain kind of self-referential organization (Maturana & Varela 2012).

Living Systems in the Context of Existence. In the broader context of existence, life appears as an emergent property of matter under certain conditions. However, the living also redefines matter, from passive substrate to active agent. Living systems embody intentionality, even at simple levels. A bacterium moves toward nutrients; a plant bends toward light.

Moreover, life can be interpreted as a counterforce to entropy: it builds complexity in a universe trending toward disorder. Erwin Schrödinger, in his 1944 book 'What is Life?', proposed that living beings feed on "negative entropy," or negentropy, maintaining order by exporting disorder into the environment (Schrödinger 2025).

In cosmological terms, life may be a rare island of organized complexity, possibly a transitional phase between pure energy and pure information. Some speculative physicists and astrobiologists, such as Paul Davies, have suggested that life might not be just an accident of chemistry, but an intrinsic property of matter under the right constraints, perhaps even a fundamental aspect of the universe (Davies 2009).

The Ontological Status of Living Systems. Is a living system a thing or a process? Process philosophy (e.g., Whitehead 2018) suggests the latter: living beings are better described as ongoing events or relational fields rather than static entities. This aligns with contemporary views in theoretical biology, which emphasize dynamic regulation, feedback loops, and co-evolution.

Furthermore, the boundaries between living and non-living are increasingly seen as fuzzy rather than strict. Artificial life research, prebiotic chemistry, and synthetic biology all challenge the traditional binary. For example, protocells (artificial assemblies of lipids and catalytic molecules) display aspects of life, but are not considered fully alive.

Conclusions. The concept of the "living" is not confined to biology, it is a deeply philosophical, systemic, and existential question. Living entities are dynamic, self-sustaining systems that actively preserve their own identity in the face of entropy. They are not isolated but interdependent, both materially and informationally.

Understanding life as a category of existence, rather than a list of traits, opens new avenues for exploring the origin of life, consciousness, and our place in the cosmos. As science progresses, the boundary between living and non-living continues to blur, challenging us to rethink what it means *to be alive*.

Conflict of Interest. The authors declare that there is no conflict of interest.

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Received: 17 November 2024. Accepted: 05 December 2024. Published online: 30 December 2024.

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How to cite this article:

Bordea D., Păpuc T., Coroian C., Balint C., Oroian C., Bora F. D., Popescu M., Petrescu-Mag I. V., 2024 What does it mean to be alive? A review on the concept of the living in the context of existence. *ELBA Bioflux* 16(1):40-43.