



Ludwig von Bertalanffy

**Austria / Canada / United States, Theoretical Biologist and General Systems Theorist,
1901–1972**

Ludwig von Bertalanffy was born at Atzgersdorf near Vienna in 1901. He studied at Innsbruck and Vienna and received his doctorate at the University of Vienna in 1926 under the philosopher Moritz Schlick. His early work developed an organismic approach to theoretical biology: living organisms were to be understood as organised wholes rather than explained solely by analysing isolated parts.

He taught at the University of Vienna until 1948 and subsequently worked in Canada and the United States, including appointments at Ottawa, Southern California, the Menninger Foundation, the University of Alberta and, from 1969, the State University of New York at Buffalo. His movement between biology, philosophy and the behavioural sciences helped broaden his search for principles that could apply across disciplines.

Bertalanffy became one of the principal founders of General System Theory. He argued that similar structural principles and mathematical forms recur in different fields and that science therefore needed a theory of systems in general, not merely theories of particular kinds of system. His biological work on open systems, steady states and equifinality was especially influential, but these concepts should be distinguished from the more general programme of GST because their applicability depends on particular system conditions.

With Anatol Rapoport, Kenneth Boulding and Ralph Gerard he helped found the Society for General Systems Research, the predecessor of the International Society for the Systems Sciences. He died in Buffalo, New York, in 1972.

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Notes

DG = General Systems Definition; **PG** = General Systems Proposition; **DS** = Special Systems Definition; **PS** = Special Systems Proposition. Each item is identified by the researcher's surname followed by its category and number (e.g. **Bertalanffy DG.1**). (*Explicit*) indicates that the definition or proposition is directly stated in the researcher's work. (*Reconstructed*) indicates that it has been reconstructed from the researcher's work but is not explicitly stated in that form.

Definitions Relevant to General Systems Theory

Bertalanffy DG.1

System (*Explicit*): A system is a set or complex of elements standing in interrelation.

Common idiom: A system is an assembly of entities whose relationships and interactions make the assembly relevant as a whole.

Explanation: Bertalanffy's formulations vary slightly between "interrelation" and "interaction". The defining emphasis is relational: the elements alone do not specify the system.

Bertalanffy DG.2

General System Theory (*Explicit*): General System Theory seeks principles, models and laws that apply to systems generally or to broad subclasses, irrespective of the particular nature of their elements.

Common idiom: GST seeks propositions that remain applicable across fundamentally different kinds of systems.

Explanation: This is a statement about the scope of a research programme, not a claim that every systems proposition applies to every system.

Bertalanffy DG.3

Isomorphism (*Reconstructed*): Isomorphisms are structural correspondences in which similar formal relations or laws occur in different fields.

Common idiom: Different kinds of systems can share the same relational or mathematical structure even though their components and mechanisms differ.

Explanation: Bertalanffy treated such correspondences as a principal reason for developing GST and for transferring models cautiously between disciplines.

Propositions Relevant to General Systems Theory

Bertalanffy PG.1

Relations are constitutive (*Reconstructed*): The behaviour and properties of a system depend not only on the nature of its elements but also on the relations among them.

Common idiom: Configuration and relationships can change system behaviour even when the kinds of component remain the same.

Explanation: This captures Bertalanffy's rejection of explanations that treat components as if their properties were independent of the organised whole.



Bertalanffy PG.2

Wholes cannot always be explained by isolated parts (*Explicit*): For organised systems, investigation of elements in isolation is insufficient where interactions among them are significant.

Common idiom: Analysis of components must be complemented by analysis of their relationships and interactions.

Explanation: Bertalanffy did not reject analysis; he rejected the assumption that decomposition alone is always sufficient for explanation.

Bertalanffy PG.3

Cross-domain isomorphism (*Explicit*): Similar models, principles or laws may occur in different scientific fields despite differences in the nature of the systems concerned.

Common idiom: Relational patterns can recur across physical, biological, psychological and social systems.

Explanation: This proposition underpins the possibility of a general systems science while not implying that mechanisms are identical across domains.

Bertalanffy PG.4

Unity without reduction (*Reconstructed*): Scientific unification can be sought through common system principles without reducing all sciences to the concepts of one lower-level science.

Common idiom: Disciplines can coordinate through shared systems relationships while retaining domain-specific entities and mechanisms.

Explanation: This was a major motivation for Bertalanffy's GST programme and distinguishes it from a simple programme of physical reduction.

Definitions Relevant to Special Systems Theories

Bertalanffy DS.1

Open system (*Explicit*): An open system exchanges matter with its environment, involving import and export and continual change of material components.

Common idiom: A matter-dependent system remains organised through continuing material flows across its boundary.

Explanation: Bertalanffy developed this concept principally for physical and biological systems. It should not be treated as a defining property of all systems.

Bertalanffy DS.2

Closed system (*Explicit*): A closed system is one in which no material enters or leaves.

Common idiom: A materially closed system has no matter flow across its boundary.

Explanation: The definition concerns material exchange. Other uses of "closed" in later systems literature may employ different boundary criteria.



Bertalanffy DS.3

Steady state (*Explicit*): A steady state is a maintained macroscopic condition of an open system in which continuing processes and exchanges occur without requiring thermodynamic equilibrium.

Common idiom: Ongoing flows can maintain relatively stable system variables while constituent matter and processes continue to change.

Explanation: This is especially relevant to open physical and living systems and is therefore classified as Special Systems.

Bertalanffy DS.4

Equifinality (*Explicit*): In certain open systems the same final state may be reached from different initial conditions and by different paths.

Common idiom: Some organised open systems can converge on a similar outcome despite differences in starting state or trajectory.

Explanation: Bertalanffy associated equifinality particularly with open systems attaining steady states and organismic regulation. It should not be interpreted as a property exclusive to open systems or as a universal property of all open systems.

Propositions Relevant to Special Systems Theories

Bertalanffy PS.1

Living organisms are open systems (*Explicit*): Living organisms maintain themselves through continuous exchange of materials with their environment and continuous building-up and breaking-down of components.

Common idiom: Biological viability depends on continuing matter and energy throughput rather than material closure.

Explanation: This is a proposition about living systems, not systems universally.

Bertalanffy PS.2

Living order is maintained away from equilibrium (*Reconstructed*): Living systems persist in non-equilibrium steady states rather than in the true thermodynamic equilibrium characteristic of a closed system at rest.

Common idiom: Continuing environmental throughput can maintain biological organisation in a dynamically sustained state.

Explanation: Bertalanffy used open-system thermodynamics to explain why organismic order does not contradict thermodynamic principles.

Bertalanffy PS.3

Equifinality in open systems (*Explicit*): Open systems can, under appropriate conditions, approach the same steady state from different initial conditions and by different routes.

Common idiom: Some open systems have dynamics that reduce dependence of later state on their precise starting state.

Explanation: The qualification “under appropriate conditions” is important: equifinality is not a universal property of every open system.



Bertalanffy PS.4

Open systems can maintain or increase organisation (*Explicit*): Because open systems exchange matter and energy with their environment, local maintenance or increase of order is compatible with thermodynamics.

Common idiom: A system can preserve or build internal organisation by exporting entropy and drawing on environmental flows.

Explanation: The common-idiom wording uses later thermodynamic language to clarify the implication; it should not be read as a claim that Bertalanffy supplied a complete modern nonequilibrium thermodynamics.

Bertalanffy PS.5

Progressive differentiation (*Reconstructed*): In organismic development, an initially less differentiated whole can develop increasingly specialised parts while retaining integration.

Common idiom: Some developing biological systems increase functional differentiation while maintaining coordinated organisation.

Explanation: This is important to Bertalanffy's organismic biology but is not justified as a proposition about all systems.

Bertalanffy PS.6

Organismic explanation (*Reconstructed*): Biological phenomena should be explained in terms of organised, dynamic wholes as well as the properties of their component parts.

Common idiom: Understanding living systems requires component-level mechanisms to be related to the organisation of the organism as a whole.

Explanation: This is a methodological proposition for biology and related organismic sciences, rather than a universal law of systems.

Student Exercise

1. **Understanding:** In your own words, describe one of this researcher's principal contributions to systems science.
2. **Generalisation:** Select one General Systems proposition. Give an example of it operating in a different kind of system from those studied by this researcher.
3. **GST or Special Systems Theory?** Select one item classified as a Special Systems Definition or Proposition. Explain why it should not necessarily be generalised to all systems.
4. **Critical evaluation:** Select one proposition and identify evidence or an example that would support it, challenge it, or indicate limits to its applicability.
5. **Translation:** Choose one of this researcher's original concepts and compare it with its common-idiom translation. What information, if any, is gained or lost in the translation?