# A Conceptual Foundation for Deeper Insights into Living & Nonliving Systems

By Dr. B Madhava Puri
Serving Director, Princeton Bhakti Vedanta Institute

**Abstract:** Systems biology necessarily concerns relational processes constituting all levels of organization of life, from the molecular to the cellular, organismic, and ecological, due to the energy exchange and feedback connecting these levels. Understanding the conceptual distinctions between mechanical, chemical, biological, and human (rational) bodies, determined by the interdependent dialectic dynamic between self and other (an individual and its environment), is fundamental to a deeper comprehension of such relational processes as well as distinguishing between life and nonlife. Based on G.W.F. Hegel's philosophy, we will show how the identity of each kind of natural body (being) is found in its other and that the extent to which a particular body (being) unites with otherness, where this union is the claiming of its identity, determines its kind. The limitations that one type of body (being) encounters while attempting to connect with its other sets the necessary standard for the determination of a new type of body. This conceptual development logically connects mechanical, chemical, biological, and human (rational) bodies, where the human is the most capable of integrating otherness thus truly claiming its identity. We will offer familiar empirical examples demonstrating the validity of this perspective in hopes of encouraging further applications.

## Comparing Modern & Postmodern Science

Modern science holds that matter is fundamental to reality. This privileged concept of matter is understood as an existent static being comprised of individual parts or atoms related and unified in a manner external to them, so reality is characterized as an inorganic mechanical system. Due to the lack of inner necessity, the parts of the system exist indifferently in isolation from each other, even though their collective work powers the system.

The study of the laws or principles that describe the movements and relationships of the parts of mechanical systems is what we call the science of physics. When physics is assumed to be the most fundamental science, and knowledge gleaned through it is presumptuously scaled up

to chemical and biological systems, then we end up with reductionism. Reductionism is the belief that wholes are nothing but the sum of their parts. When applied to biology, reductionism leads to the notion of abiogenesis, that life comes from matter, that is, that all living entities are just complex aggregates of material building blocks (atoms and molecules). Such a claim has never been scientifically validated, since no lab has ever been able to produce a single cell by synthesizing molecules, what to speak of organisms. With all our science, all the scientists in the world together cannot make a single blade of grass. Rather, the law of biogenesis, that life and matter come from life, is observed by all conscious people, every single day.

Instead of an ossified world with isolated parts externally unified, the organicist view, which is non-mechanistic, sees the world as a dynamic process of becoming whose constituents are fundamentally interdependent and internally related. This perspective views biology as the prominent natural science and considers that physics and chemistry should be studied in relation to biology. Becoming involves several moments that necessarily contextualize existence: the coming-to-be and ceasing-to-be of a thing, that is, whatever exists is coming from something (formal aspect of cause) and is going toward something (final aspect of cause, being-for, purposefulness, or teleology). These diachronic relationships coexist with synchronic ones like efficient causal relations. The mechanistic view is positivistic, that is, it only accounts for positive existent objects, static being, abstracted from the context of their development. On the other hand, this organicist approach is comprehensive enough to encompass being as one of the moments of the dialectical development of becoming, along with being's opposite or negation, nonbeing. Put simply, dialectic development entails the movement from thesis, to antithesis, then synthesis, where this dynamic process necessitates consideration of the negative as well as the positive. Without considering the negative, all assessments of developmental processes must remain superficial. A complete comprehension of life and consciousness must go beyond all immediate appearances, yet encompass them. This latter perspective is most adequately articulated and developed in G.W.F. Hegel's philosophy.

In contrast to most Western scientific approaches that start with the notion of matter being fundamental to a static reality – where activity only results from energy exchange through the collision of physical bodies or the influence of natural forces – Hegel suggests that reality is fundamentally an active process that encompasses matter as an infantile moment of its development. Such a processual reality necessarily sublates or integrates this underdeveloped stage (matter) in the unfolding of more comprehensive stages that accommodate static elements as a kind of function of the dynamic Organic Whole that is reality. This idea of reality as an unceasing dynamic process known as the Organic Whole – which we might further determine to be Spirit when reality's objective processual nature is simultaneously considered alongside its subjective self-conscious nature – is very close to Vedanta's conception of Brahman.

Following the example given by the ancient *Vedanta-sutra*, which begins with the aphorism "*athato brahma jijnasa* – Now, therefore, inquire about Spirit (Brahman)," we need to reimagine modern science in a manner that starts with the Organic Whole and then seeks to understand how matter is one integrated aspect of the whole, along with other aspects such as life and consciousness. This is where Vedanta and science meet. It is necessary to clarify that by calling reality the Organic Whole, we are not claiming that it is a biological organism. Just as matter is an immature moment of the Organic Whole's development, organism is a slightly more mature stage. Just as matter is not the foundation of reality, neither is organism.

Humbly contributing to the advancement of modern science in this direction, we will now offer a conceptual framework that shows the logical distinction and relation between mechanical, chemical, biological, and human *bodies*, based on Hegel's philosophy. We will also discuss how this framework helps to distinguish between life and nonlife.

## The Logical Development of Self-Other Dynamics in Nature

The logical distinctions between mechanical, chemical, biological, and human bodies are determined by the interdependent dialectic dynamic between *self* and *other* or, more concretely, an individual and its environment. The identity of each kind of natural body is found in its other and the extent to which a particular body unites with otherness, where this union is the claiming of its identity, determines its kind. The limitations that one type of body encounters while attempting to connect with its other sets the necessary standard for the determination of a new type of body. This conceptual development logically connects mechanical, chemical, biological, and human bodies, where humans are the most capable of integrating otherness and thus truly claiming their identity.

Before explaining the logical development of our claim that "the identity of each kind of natural body is found in its other and the extent to which a particular body unites with otherness, where this union is the claiming of its identity, determines its kind," let us briefly consider an empirical example demonstrating the first half of the claim, that natural bodies require something outside of themselves to exist. The second half becomes clear once the first part is developed. Amino acids are fundamental constituents of proteins throughout living bodies that support biological processes such as growth, healing, and digestion. Out of the 20 amino acids required for protein synthesis, 11 are made by the living body. These are termed "nonessential amino acids." The remaining nine are called "essential amino acids" because the body cannot make them. These essential amino acids must come completely from diet. This is one empirical example of how the self constitutionally relies on its other.

This logical development of self-other dynamics in nature begins with the concept of externality, as discussed in Hegel's *Encyclopedia of Nature*. This complements the Vedic view of

the *bahiranga-shakti* (external potency) or *maya-shakti* (illusory energy) of the Absolute. In an immediate sense, everything exists external to each other in nature, although the development of nature shows that everything is actually intimately connected. In the case of natural bodies, externality refers to the identity of the body being outside of itself. The degree to which a body successfully overcomes externality and claims its identity determines its superiority to the other kinds of natural bodies. This development reveals a spectrum of states of integration between self and other where inferior bodies cannot sustain this integration, thus giving rise to the logical necessity for a kind of body that can. The human body is the only kind of natural body with the potential for permanently maintaining the unity between self and other, which is due to the exclusively human capacity for thought (different from the cognition found in cells, plants, and animals). Ultimately, this capacity for thought manifests as the prospect for attaining self-knowledge. We will try to show how the human body necessarily emerges to overcome the inadequacy of mechanical, chemical, and non-human biological bodies in overcoming externality and claiming their identity.

**Mechanical Bodies**

According to Descartes, a corporeal body is an extended substance (*res extensus*). This abstract notion of extension may be more concretely understood as space or spatial extension. This means that its identity is external to itself. In other words, its substance at one point is identical to itself at each point beyond or external to itself. An individual body consists of X number of points. Although each of those points inheres in a single body, each point is external to every other point. This externality of each point from every other is what makes it an extended object. The limit of the body is the boundary where the self of the body ceases and otherness begins. However, the boundary or other determines the figure or shape of the self. This means that the other is essential for determining the identity of the self. This means that the self of the body or its identity is external to itself as the other of itself.

Such a body determined purely by spatiality is called a mechanical body. Interactions between mechanical bodies are merely external relations where individuals don't change. There is no internal impetus inspiring the relationship. Thus, mechanical unities are just aggregates. A mechanical body remains the same whether or not it interacts with other bodies, which indicates an indifference to otherness, contradicting that the identity of all natural bodies lies in otherness. This is how modern science typically views mechanical systems. However, as explained above, mechanical bodies fundamentally depend on their other.

Let's briefly consider some familiar examples. The orientation of a gear's teeth is determined by the relation to another gear so that the teeth interlock and rotate. Thus, the mechanical body's identity lies outside of it. To an extent, it is what it is not. The necessity for the particular shape of a gear depends on its relation to other gears and the shape of a pool ball is determined by its relation to the pool table and other balls. The figure of a rock is a byproduct of erosion, that is, its mechanical relationship with air and water. The figure of a surface is

completely dependent on its relationship to otherness; its boundary simultaneously indicates where itself stops and otherness begins, and vice versa.

Although the selfhood of a mechanical body is mediated through its other, the nature of these bodies is such that mechanical encounters result in collision and rebounding in opposite directions. The tragic fate of a mechanical body is that unity with its other is never realized. Even if two or more mechanical bodies were to remain stationary, situated next to each other such that their surfaces were touching, this would still not qualify as a unity with otherness in any meaningful way when compared to the significant and progressively dynamic unities demonstrated by the other kinds of bodies. The self of a mechanical body proves to be in its other – since the limit of its figure is determined by its relationship with something else – yet the body can never unite with that other, it can't claim its identity, due to its indifference and lack of transformation in that relationship.

The discrepancy between the mechanical body's immediate identity of indifference to otherness and the mediated identity of dependence on otherness reveals its conceptual inadequacy. Thus, the explanatory value of mechanism is dependent on being contextualized within a more coherent conceptual framework of which it is a valid yet incomplete perspective. Thus, certain aspects of chemical, biological, and human bodies can be described mechanically, but it won't completely explain these more sophisticated phenomena.

**Chemical Bodies**

A chemical body has all the properties of a mechanical one, plus it overcomes the tragic fate of not uniting with its other. Chemicals are polar bodies that attract and bond with one another, producing a compound. Bonding refers to an intrinsic affinity between two chemical bodies that does not exist with mechanical bodies. Despite this affinity, the bond can be broken and each reactant can return to its previous state. The affinity also remains in chemical products and compels them to continually bond with other bodies forming other compounds, in which the two sides retain their identity while existing in that unity. These perpetual actions prevent chemical bodies from ever becoming a real identity since otherness keeps opposing successive compounds without assimilating to a lasting unity. This is distinguished from a biological body, which takes the other and transforms it into itself, which is beyond just being a compound produced through internal affinity. Ultimately, the inadequacy of a chemical body's self-other dynamic comes from being in a constant state of flux due to their fundamentally polar nature. Chemicals overcome the inadequacy of mechanical bodies, but their unity does not endure and is not as stable as biological and human bodies.

Consider a water molecule ($H_2O$). Although water is considered a very stable product, it may still react with other chemicals to become a hydrate. Here, the other chemical absorbs water onto its surface or into its structure. A familiar mineral hydrate is Epsom salts (magnesium sulfate heptahydrate – $MgSO_4 \cdot 7H_2O$), used in therapeutic baths. Epsom salts are chemically bonded, thus a new chemical body has formed.

As the next logical stage of development for natural bodies, chemical bodies also encompass lower-level mechanical relations with each other, such that two chemical bodies can

combine with each other without becoming chemically bonded. Methane hydrates ($CH_4 \cdot 5.75H_2O$) are an example, where a methane molecule ($CH_4$) becomes encaged within interlocking water molecules. This creates an ice-like substance that emerges in conditions of low temperature and high pressure, like in the deep ocean.

So, the identity of the chemical body's self is in its other. This is why individual chemicals have the propensity to bond. They naturally seek unity with otherness because their very constitution depends on it. This is not cognitive seeking, however, which requires an individual to have the capacity for decision-making and managing goal states. While stable chemical products represent a state of existence where the self of a chemical body is momentarily claimed through the bonding of reactants, the inadequacy of the chemical body is that it never reaches a substantial unity that persists despite encountering other bodies. Biological bodies demonstrate the capacity for persistent, self-maintained unity with otherness.

**Biological Bodies**

Biological bodies are distinguished through their self-determined ability to assimilate otherness with themself. Recall that chemical bodies form compounds that can either be broken or perpetually bond, which is why they are deemed less sophisticated than biological bodies, where the standard for sophistication is the capacity for an enduring unity between self and other. Biological bodies, on the other hand, subsist through the absorption of otherness. When a grass consumes sugar, or a cow consumes grass, only the food is transformed, not the consumer. The food's original constitution disintegrates into basic units that are integrated and repurposed by the consumer's body to fuel biological processes. Whether eating food, breathing air, or absorbing sunlight, biological bodies maintain their integrity by assimilating otherness.

To further assess the integrity of different kinds of biological bodies, it is relevant to consider the difference between the unity of animal bodies and plant bodies. In his *Critique of Pure Judgement*, Immanuel Kant described an organism as an entity where (1) the whole depends on the parts, (2) the parts depend on the whole, and (3) the parts depend on each other. This dynamic and interdependent threefold conception is a great place to start our comparison. For most animals, the loss of a limb or an organ is a devastating and possibly lethal experience. Although there are exceptions where limbs and sometimes organs regenerate in fish and amphibians – even some reptiles can regrow their tails, and deer regrow antlers – limb and organ regeneration is not the norm in the animal kingdom. This suggests that Kant's organismic standard is clearly present in animals. The integrity of animal bodies is strong, the whole and parts are profoundly integrated and cannot exist without one another.

Plants do not demonstrate such strong integrity. Whether large or small, parts of plants can be removed without any significant interference with the functioning of the whole. The removed part may even generate a whole new plant, or it can be grafted to a plant of a different species and live a healthy life. Plant cells are largely considered "totipotent" because each individual cell contains information about the entire genome of the plant, thus, under the right conditions, many plants can be grown by taking a single cell from an existing mature plant. This is called "somatic embryogenesis." The totipotency of plants underlies methods for propagating hundreds of plant species by taking leaf or stem cuttings from an existent mature organism.

Consider that removing the arm of a monkey or even of a regenerating starfish will not lead to a new organism growing from that arm. Further, we can not transplant a vital part of one animal onto or into another animal and expect a healthy organism. Current work on xenotransplantation tries to achieve this, but only as an experimental end-of-life treatment. Conversely, limbs of plants can be liberally attached to plants of a different species and continue to thrive. People have created so-called "fruit cocktail" trees through grafting. They can grow cherries, plums, and peaches all on one tree, even apples and pears, or lemons, limes, oranges, and grapefruits, can be grafted onto a single tree. Grafting is possible for any plant with a cambium. These facts demonstrate that the parts of plants are less integral to the whole. A plant can be dismembered without missing a beat, but that calls into question whether such parts were members to begin with, or actually implicit wholes in and of themselves. Further, plants are stationary in the environment. While they absorb otherness like sunlight, water, and minerals with themselves, plants do not assimilate the spatiality of the other into itself – it just remains a compound or conjunction of self and other – thus it fails to fully integrate otherness with itself. These are points for further discussion that won't be addressed here.

Returning to the determinations of biological bodies in general and how their deficiency leads to the necessity for the human body, we can understand that living entities are eager to possess and assimilate what is other from themself in order to maintain their basic individual needs. In many cases, they literally absorb otherness and transform it into themself, as seen through the consumption of food, air, and sunlight, demonstrating the claiming and maintaining of their identity. There is one critical aspect of the biological experience, however, that similarly triggers taking possession of otherness, yet it cannot be satisfied by simply absorbing the other. This is reproduction. Two mates satisfy this urge through sexual unity with each other, where both individuals remain as they are. Neither is transformed into the other. This frustrates the living entity's tendency to absorb otherness, thus, sexual acts, at least for animals, can be quite abrupt and aggressive. To clarify, this sexual need of the biological body cannot be satisfied by assimilating otherness, so it interrupts the integration of self and other. This deficiency is overcome in the human body.

**Human Bodies**

The human body encompasses all of the previous kinds of bodies and relationships – mechanical, chemical, and biological – and matures beyond them. While some people call humans "rational animals," this is misleading. No animal can be rational; animals do not think, and that's precisely why they cannot overcome the disintegration of self and other during sexual reproduction. This isn't denying the cognitive capacities of animals, but enunciating the nuanced distinctions between cognition, consciousness, and thought is not the purpose of this talk. In general, we refer to thought as the capacity for an intentional development of self-conscious experience. Nonhuman living entities have the capacity for cognitive experience where they make decisions, cooperate, and solve problems, but only humans demonstrate awareness of cognitive experience while it's happening. This self-aware experience is what allows us to inquire about our identity and purpose, which has given rise to the sciences, humanities, and civilized life. So, humans are not rational animals, we are in a different category altogether.

Animals have no way to assimilate their mate since all other assimilation is accomplished through physical consumption, which would prevent the reproductive act from occurring. Humans overcome this dilemma by assimilating their mate through thought. Sexual reproduction becomes a thoughtful and loving act – as opposed to an aggressive animalistic one – where the partners form a unity through their shared self-reflective affection. Animals instinctually feel that otherness – the environment – is for them, and they try to take and forcefully assimilate it. When this is unsuccessful, aggression arises. From a conceptual perspective, animals can only integrate otherness by destroying or dissolving differentiation. The other stops being what it was and conforms to the needs of the animal. While this also applies to humans regarding biological processes such as eating and breathing, the sophistication of thought allows humans to integrate with otherness *without* dissolving differences. The development of thought accommodates recognition of unity-in-diversity and identity-in-difference. Human partners can assimilate one another without destroying each other's bodies. This also extends to the relationship between humans and the environment. Humans assimilate nature not only by consuming it but by knowing it. Humans can even assimilate themself through self-knowledge. Hegel's philosophy offers a robust development of this line of thought, which is deeply complementary to the Vedic view.

## Conclusion

This conceptual development connecting mechanical, chemical, biological, and human bodies through considering self-other dynamics can serve as a foundation for deeper insights into living & nonliving systems. In summary, the identity of each kind of body lies in their other. Self and other are external to each other in nature, because externality itself is one of the fundamental determinations of nature as immediately conceived, as Hegel explains. This corresponds to the Vedic conception of *bahiranga-shakti* (external potency) or *maya-shakti* (illusory energy) because this externality between self and other is not adequate to their truth. In truth, self and other are a deeply and dialectically connected identity-in-difference. This starts to become clear through the development of the sophistication of different kinds of natural bodies. The sophistication of each body is determined by its capacity to unify with otherness thus claiming their identity, where the disintegration of this unity demonstrates that particular body's deficiency and lack of adequateness. Each higher grade of sophistication encompasses or sublates the lower kinds of bodies while maintaining a distinct superiority to them.

Mechanical bodies prove to rely on their other in that the boundary of their determinate figure – which is their essence – depends on its relationship to other bodies. When these bodies meet, however, they only repell each other such that any meaningful unity is not achieved. Chemical bodies successfully unite with other bodies through chemical bonding due to their fundamentally polar nature. This same nature is what forces them to perpetually seek another body to react with, thus the unity of self and other never maintains. Biological bodies can sustain their union with otherness. Plants and animals absorb and assimilate otherness in such a manner that eradicates the other's previous existence in order to perpetuate their self-maintained existence. The wholeness of plants proves to be less integral than the wholeness of animals, indicating that the unity of self and other is more fully realized in animals. The only biological activity that demonstrates the deficiency of the animal body is reproduction since they cannot

physically absorb their mate and still engage in intercourse with them. The human being overcomes this dilemma by mentally assimilating their partner, the natural environment, and even themselves.

We hope that the value of this conception has been clearly presented and that it might encourage further development and applications, such as in systems biology, which necessarily concerns relational processes constituting all levels of organization of life, from the molecular to the cellular, organismic, and ecological, due to the energy exchange and feedback connecting these levels. Further discussion can be had by comparing specific aspects of the nature of each kind of body with the others to emphasize exactly why the more developed bodies can inegrate otherness more cohesively. Explicitly comparing the categorical difference between mechanical and biological unities and relationships is very useful for the current paradigm shift occurring in 21st-century biology.