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The Systems View of Life:

A Science for Sustainable Living

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Today, it is becoming more and more evident that concern with the environment is no longer one of many "single issues." It is the context of everything else — of our lives, our businesses, our politics. The great challenge of our time is to build and nurture sustainable communities — social, cultural, and physical environments in which we can satisfy our needs and aspirations without diminishing the chances of future generations.

Sustainability

Since its introduction in the early 1980s by Lester Brown and by the Brundtland Report, the concept of sustainability has often been distorted, co-opted, and even trivialized by being used without the ecological context that gives it its proper meaning. So, I think it is worthwhile to reflect about what "sustainability" really means.

What is sustained in a sustainable community is not economic growth or competitive advantage, but the entire web of life on which our long-term survival depends. In other words, a sustainable community is designed in such a way that its ways of life, businesses, economy, physical structures, and technologies *do not interfere with nature's inherent ability to sustain life.*

The first step in this endeavor, naturally, must be to understand how nature sustains life. It turns out that this involves a whole new conception of life. Indeed, such a new conception of life has emerged over the last 30 years. In my latest book, *The Systems View of Life*, coauthored with Pier Luigi Luisi and published by Cambridge University Press, I offer a grand synthesis of this new understanding of life.

A new conception of life

At the forefront of contemporary science, the universe is no longer seen as a machine composed of elementary building blocks. We have discovered that the material world, ultimately, is a network of inseparable patterns of relationships; that the planet as a

whole is a living, self-regulating system. The view of the human body as a machine and of the mind as a separate entity is being replaced by one that sees not only the brain, but also the immune system, the bodily tissues, and even each cell as a living, cognitive system. Evolution is no longer seen as a competitive struggle for existence, but rather as a cooperative dance in which creativity and the constant emergence of novelty are the driving forces. And with the new emphasis on complexity, networks, and patterns of organization, a new science of qualities is slowly emerging.

Systems thinking

I have called this new science "the systems view of life" because it involves a new kind of thinking – thinking in terms of relationships, patterns, and context. In science, this way of thinking is known as "systems thinking," or "systemic thinking." It emerged in the 1920s from a series of interdisciplinary dialogues among biologists, psychologists, and ecologists. In all these fields, scientists realized that a living system – an organism, ecosystem, or social system – is an integrated whole whose properties cannot be reduced to those of smaller parts. The "systemic" properties are properties of the whole, which none of its parts have. So, systems thinking involves a shift of perspective from the parts to the whole. The early systems thinkers expressed this insight in the now well-known phrase, "The whole is more than the sum of its parts."

Now, in what sense exactly is the whole more than the sum of its parts? The answer is: relationships. The essential properties of a living system arise from the interactions and relationships among the parts. Systems thinking means thinking in terms of relationships.

Thinking in terms of relationships is crucial for ecology, because ecology – derived from the Greek *oikos* (meaning "household") – is the science of the relationships among various members of the Earth Household. I should also mention that systems thinking is not limited to science. Many indigenous cultures embody profound ecological awareness and think of nature in terms of relationships and

patterns.

Systems science also tells us that all living systems share a set of common properties and principles of organization. This means that systems thinking can be applied to integrate academic disciplines, as well as political institutions, or departments, by discovering similarities between different phenomena within the broad range of living systems.

Living networks

One of the most important insights of the systemic understanding of life is the recognition that networks are the basic pattern of organization of all living systems. As you know, ecosystems are understood in terms of food webs (i.e., networks of organisms), organism are networks of cells, and cells are networks of molecules. And of course, we also have social networks, which are networks of communications.

The network is a pattern that is common to all life. Wherever we see life, we see networks. Indeed, at the very heart of the change of paradigms from the mechanistic to the systemic view of life we find a fundamental change of metaphors: from seeing the world as a machine to understanding it as a network.

Systemic problems – systemic solutions

I want to emphasize that my synthesis of the systems view of life is not only theory but has very concrete applications. Systems thinking makes us aware of the fact that the major problems of our time – energy, economics, climate change, inequality – are all interconnected and interdependent. They are systemic problems that require corresponding systemic solutions – solutions that do not solve any problem in isolation but deal with it within the context of other related problems. Systemic solutions, therefore, tend to solve several problems simultaneously.

Over the last few decades, the research institutes and centers of learning of the

global civil society, have developed and proposed hundreds of such systemic solutions all over the world. In the book, I review these solutions in detail. They include proposals to reshape economic globalization and restructure corporations; new forms of ownership that are not extractive but generative; a wide variety of systemic solutions to the interlinked problems of energy, food security, poverty, and climate change; and finally the large number of systemic design solutions known collectively as ecodesign.

Let me give you just one example of a typical systemic solution in the area of agriculture. If we changed from our chemical, large-scale industrial agriculture to organic, community-oriented, sustainable farming, this would contribute significantly to solving three of our biggest problems. (1) It would greatly reduce our energy dependence, because we are now using, at least in the U.S., one fifth of our fossil fuels to grow and process food. (2) The healthy, organically grown food would have a huge positive effect on public health, because many chronic diseases – heart disease, stroke, diabetes, and so on – are linked to our diet. And (3), organic farming would contribute significantly to fighting climate change, because an organic soil is a carbon-rich soil, which means that it draws CO₂ from the atmosphere and locks it up in organic matter.

It is worth noting that today, carbon sequestration in soil and plants is the only known and proven strategy that can remove carbon from the atmosphere and, over time, reduce the atmospheric concentration of CO₂. That fact alone could be used to launch a broad systemic educational campaign involving all the organizations represented here.

Ecoliteracy

To conclude, I want to return to the concept of ecological sustainability. As I mentioned, a sustainable human community is designed in such a manner that its ways of life, businesses, economy, physical structures, and technologies do not interfere with the inherent ability of nature to sustain life. The first step in this endeavor, naturally, must be to understand how nature sustains life.

Over billions of years of evolution, the Earth's ecosystems have evolved certain principles of organization to sustain the web of life. Knowledge of these principles of organization, or principles of ecology – also known as "ecological literacy," or "ecoliteracy" – is crucial for designing sustainable human communities.

In the coming decades the survival of humanity will depend on our "ecological literacy" – our ability to understand the basic principles of ecology and to live accordingly. This means that ecoliteracy must become a critical skill for politicians,

business leaders, and professionals in all spheres, and should be the most important part of education at all levels – from primary and secondary schools to colleges, universities, and the continuing education and training of professionals.

We need to teach our children, our students, and our political and corporate leaders, if you wish, the fundamental facts of life – for example, that one species' waste is another species' food; that matter cycles continually through the web of life; that the energy driving the ecological cycles flows from the sun; that diversity assures resilience; that life, from its beginning more than three billion years ago, did not take over the planet by combat but by partnerships and networking.

All these principles of ecology are closely interrelated. They are just different aspects of a single fundamental pattern of organization that has enabled nature to sustain life for billions of years. In a nutshell: nature sustains life by creating and nurturing communities. No individual organism can exist in isolation. Animals depend on the photosynthesis of plants for their energy needs; plants depend on the carbon dioxide produced by animals, as well as on the nitrogen fixed by bacteria at their roots; and together plants, animals, and microorganisms regulate the entire biosphere and maintain the conditions conducive to life.

Sustainability, then, is not an individual property but a property of an entire web of relationships. It always involves a whole community. This is the profound lesson we need to learn from nature. The way to sustain life is to build and nurture community. A sustainable human community interacts with other communities – human and nonhuman – in ways that enable them to live and develop according to their nature. Sustainability does not mean that things do not change. It is a dynamic process of coevolution rather than a static state.

Ecodesign

Ecoliteracy is the first step on the road to sustainability. The second step is ecodesign. We need to apply our ecological knowledge to the fundamental redesign of our technologies and social institutions, so as to bridge the current gap between human design and the ecologically sustainable systems of nature.

From a systemic perspective, design is the shaping of flows of energy and matter for human purposes. Ecological design is a process in which our human purposes are carefully meshed with the larger patterns and flows of the natural world. Ecological design principles reflect the principles of organization that nature has evolved to sustain the web of life. To practice design in such a context requires a fundamental shift

in our attitude toward nature, a shift from finding out what we can *extract* from nature, to what we can *learn* from her.

This is an enterprise that transcends all our differences of race, culture, or class. The Earth is our common home, and creating a sustainable world for our children and for future generations is our common task.