

Consilience: A Biological Example

By John Khosh

The human body is a good example for demonstrating consilience which implies that what is true for part of nature is true for all of nature. A single set of laws of nature is applicable to all things in the universe, animate and inanimate. The laws of thermodynamic, electromagnetic, gravity etc. are subsets of the single set of laws.

A dynamic and holistic approach is applicable to all biosystems including cells, students and colleges. The phenomena in biosystems are not isolated events, nor stationary. For example, consider health. Our biological system attempts to be self corrective. It is dynamic. As a whole, our health is a matter of degree; and, the degree keeps changing as the biological systems get results from a dynamic process. The tendency is to move toward balance.

Each bodily system is made of organs, which are made up of tissues, which are made up of cells, which are made up of molecules etc. The complexity process in our hierarchical organizations creates some differences in properties in higher layers of organization that may not exist in the lower layer of the system, but the underlying principles are the same for a heart that pumps blood and a water pump in an automobile.

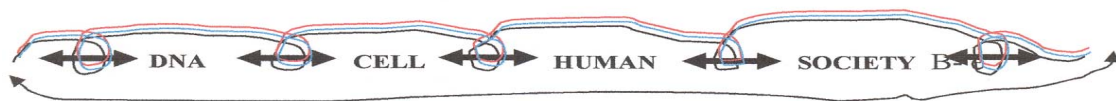
This essay provides examples from the human body as system, with its various subsystems. The concern is with the wide range of the body's scale of subsystems that are treated as systems. The synchronization of their dynamic activity is responsible for survival of a biosystem. This biosystem includes the fourteen human's biological systemsⁱ Synchronization is only possible because of information present in the DNA.

Additionally, and especially relevant to the other essays in this book, this essay explores the role of information and energy in the operation of the biosystem and the interaction with other systems. Information and energy are the lowest common denominators. They are basic for all relationships involving communications and interactions in nature, animate and inanimate. Simply put, if there is no exchange of information and energy between systems, there will be no change, no dynamism, no life, and everything in the universe will be at standstill.

Not covered in this essay is a discussion of the applicability beyond the individual human being to other humans, including family, community, and society in general at various levels, national and international. The relationship between many members creates a network of exchange information and energy. This is worthy of a separate essay, but some discussion is introduced to set the stage.

Information and Energy

As to human life, the following figure of loops and arrows represents the exchange of information and energy between different layers of human life.



Information and energy are at the foundation of all interactions. The focus of this discussion is on three layers of interactive biological systems: The top layer is society; the middle layer is a human, and the bottom layer is the cell. This concept is relevant to one set of laws in nature – consilience.

A College Student Example. As an example of the interaction, consider a college, a student, and cells as biosystems within each other in a society. The cells are part of a society as a biosystem within the student. The student is part of a society as a biosystem within the college. The college is part of a society as a biosystem within the context of a civilization.

Looking at the systems starting with the college, the College has two worlds. One is the outer world where there is a vast population of students and their parents, regulatory systems of market competition and governmental authority, and the rest of the world that impacts the college. The college itself is a separate organization within these larger layers of authorities in our society. Many are state sponsored institutions. Many are private. Many of the private institutions are church related. Whatever the sponsorship, there is a series of layers of authority above the college. The interactions involve a great deal of information and energy and significantly impact the operation of the college as part of the larger system.

Internally the college is also formed from layers of relationships. There is also an internal hierarchy among the layers. At the top is the governing board, some times called directors or trustees. Then there is an administration, usually headed by a president but involving various administrative layers with an organizational structure heavily oriented to disciplines. Accountable to administrative layers are professors and students. And accountable to professors there are students. The dynamics of the system breed interactions that bypass hierarchical

structures, but these are simply complexities of the system that may involve external forces from the larger society, much in the same way as external forces affect bodily systems.

In this context, the college is part of the student's outer world. Now, consider the student's inner world. A student's inner world is also made up of layers. These inner layers include biosystems. Within the biosystems are cells that are organized in the form of tissue and organs. They are organized into the fourteen bodily systems. These go to make up the body and mind.

The biosystems and the resulting body and mind are influenced by student's environment. This obviously includes the college, especially the other students in the college. But it also includes the student's, family, community, and culture. The communication is critical and dependent on information and energy.

The two worlds of biosystems, whether in cells, students or colleges, are separated by a semi-permeable boundary. The regulated information can go in and out of each when they meet. The permeability is governed by the energy transmitting the information and the receptivity to the information. To survive, every biosystem in the universe (cell, student, and college in our example) has two interrelated types of activities:

1. Independent activities that relate to exchange of information within the system. These provide the internal relationships necessary for synchronization and function of its subsystems.
2. Interdependent activities that provide information about the raw materials needed for survival and stability of the biosystem (non-material relationships, chemicals and physical motion). These are essential for external relationships.

The bi-directional information exchange between two worlds of the biosystems is a continuous process. It is the foundation of sustainability and survival of every biosystem. To sustain itself, the inner world of the biosystem (cell, student, college) must have non-material, chemical and physical components of survival.

Consilience in the Systems. Consider a single cell such as a single of an ant. Such a single cell can't survive in isolation. It, and any other biosystem, must belong to a larger whole and communicate in order to survive and communicate with the system.

In the case of the student, the student's cells form tissue. Thus, the tissue is where the cells reside. Thus the system has the same kinds of relationships at the cell-to-tissue level as it has in the tissue-to-student relationship, as the student-to-college relationship, as the college-to-outer-world relationship.

Now, consider the order and disorder in two different worlds of biosystems; for example, the college-student relationship and the student-cell relationship. The idea is that order and disorder in biosystems follow similar laws of nature.

An orderly balanced interaction and cohesiveness among the layers of organization (board members, administration, professors, and students) creates a healthy atmosphere of learning for all. It relates to interacting and sharing knowledge, i.e. energy and information exchange. This exchange does not take a physical form, so it is called *non-material*. Some exchanges take a physical form, for example sharing clean fresh air, water, and food. Such exchanges are chemical and fall into the classification of *material*.

Sometimes there is disorder in biosystems. Distress or imbalance results from disorder within any of the biosystems (the college, the student, and the cells of the student). For example, there may be a variety of non-material disorganizations of the college resulting in unhappy professors or nervousness and anger of students. The result may then be a financial problem for the college.

An emotional imbalance of students, such as nervousness and anger, may lead to a material imbalance from chemicals such as drugs or alcohol. This is an example of the heavily interdependent nature of the subsystems of the human body and its interactions in its interdependent activities.

There are various methods of communication with information resulting in horizontal and vertical communication. Board members communicate with each other and the board communicates with the administration, generally through the president who in turn communicates with the rest of the administration

The horizontal communication is obviously within layers and the vertical communication is between layers. The node, i.e., the unit generating the communication, may be communicating horizontally or vertically or both.

The linkages, horizontal and/or vertical, form networks. The network reflects the extent of contacts of the node with other nodes. These other nodes in turn communicate with still other nodes through their linkages. The result is a network such as in the idea of *Six Degrees of Separation*.ⁱⁱ

Organizational Relationships

Every biosystem has three distinct yet interactive organizations (inner world, self, and the outer world). Each organization possesses three components. The two worlds (inner and outer) of the

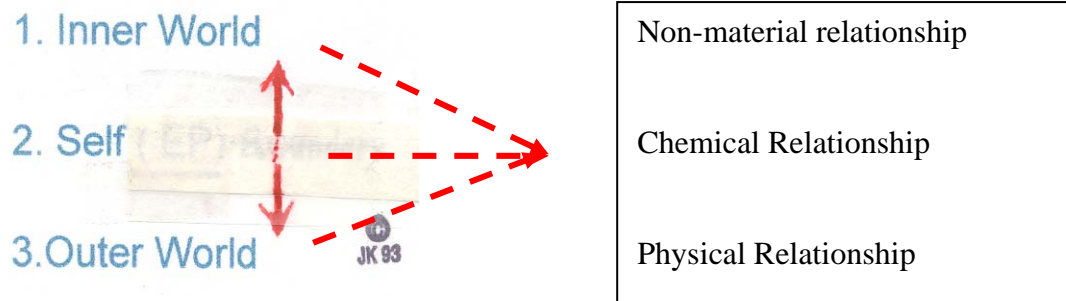
self are inextricably intertwined with self. The organization may be illustrated showing the information and energy exchange.

Relationships between Organizations of a Biosystem and Components of a Biosystem.

(Red arrows represent information & energy transfer)

ORGANIZATION (like college, student and cell)

COMPONENTS



Each organization (self) possesses two worlds, the inner & the outer worlds. In terms of information and energy exchange, each organization has non-material (radiative), chemical and physical relationships. The three components of relationships are engraved in each biosystem such as DNA, Cell, Tissue, Organ, Human, Family, Community, and Society

The totality of relationships in the student and the three components between the student's cells, her self and her society is the foundation or basis of her life and the life of every college student.

The interaction and exchange of the three organizations of college, student and her cells are shown by red arrows: Up and down arrow relates to the exchange of information between her two worlds carried out via non-material components of each organization. It is shown as three dotted red arrows.

Further detail or subdividing the organizations of the student is as follows;

The Inner World

- The inner world of includes her DNA, cells, tissues, and organs of the fourteen bodily systems. The non-material cellular relationship in cell biology is called *intercellular communication*; between systems is called *bodily systems connections*.
- The non-material relationship includes all *radiative relationship* (immaterial or emotional relationships are dynamic, intrinsic, and unquantifiable relationships within every biosystem including the student's. Under an umbrella of *radiative* relationships we may

include light, sound, electromagnetic, pressure and other non-material relationship. Radiative relationships in her daily life includes sense of friendship, animosity, love and hate, joy and sorrow etc. These non-material feelings that are processed in her brain are manifestation of her lifestyle, personality, attitude, stress, consciousness, faith, thrust, believe, etc. All the radiative are part of her genetic potentials that were evoked by her environment.

- The chemical relationship in her inner world relates to digestion, absorption, metabolism of some specific nutritious or toxic material inside or outside the cells, organs like stomach, bowel pumped by her heart to reach all her cells.
- The physical relationships in the inner world includes physical contacts between her cells, organs and fourteen bodily systems, such as inter-cellular structures, physical relationships of muscle and bones physical connection of the blood vessels in the brain with their surrounding

The Self

- As to the self of the student, her *non-material*, cultural or traditional environmental influences in her culture where the qualities of her life is perceived and attributed to. Her *radiative or non-material* relationships beside heat distribution shown in thermography include her awareness, intelligence, conscious and unconscious, intuition, choices, lifestyle, personality, attitude, faith, ethics, and belief. These human qualities do not exist in specific organ; they exist in relationships between all parts of the student. (Brain dynamically processes information & stores it based on its neuronal age & ability, so it could be retrieved by self).
- The chemical property of self is sum of all chemistry within which we call chemical homeostasis in DNA, cells, organs, and fourteen bodily systems.
- The physical properties are the morphology, pattern of relationships between DNA, cells, organs, fourteen bodily systems, patterns physical aspect of the human being include foot print, finger print,

The Outer World

- The outer world of the student includes family, friends, community, society and her environment. The all possesses the three components. Her physical pattern of relationships, includes chewing, swallowing, involuntary movements of her muscle for balance, the food going down the gastrointestinal systems, pumping activities of the heart, contractions of muscle, kidney, liver (14 bodily systems) etc. The human life & its existence including life of the student depend entirely on synchronization of function of the 14 bodily systems and her quality of life depends on how they synchronize with her environment. The synchronization of the three components occurs via exchange of information & energy.

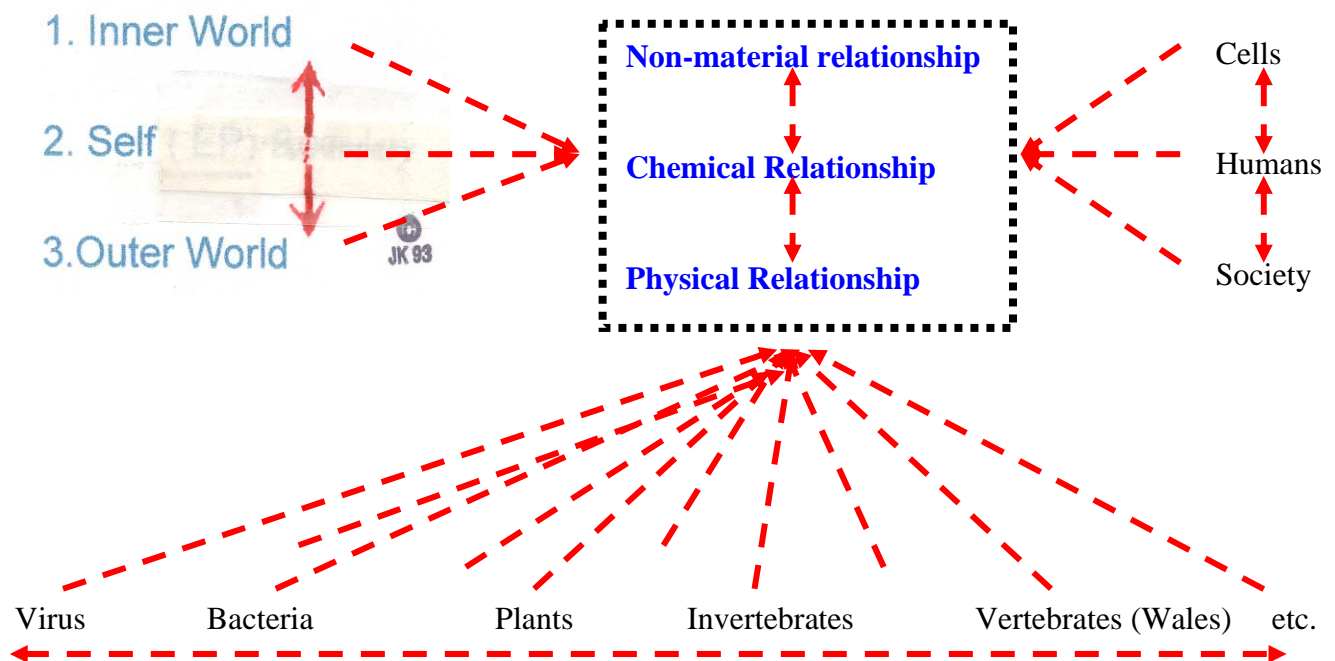
Exchange of Information and Energy

The exchange of information and energy, horizontal or vertical, may provide balance and harmony or they may provide imbalance and disharmony. The flow of the information or misinformation relates to order or disorder, balance or imbalance in the biosystem. There are the parallels of the order or disorder amongst and within college, human and cell. Order or disorder in the college (society), wellness or sickness in human being (self) or health and disease of the cell are related to the order and harmony of the biosystem and its exchange of information with the layers above and below its layer as well as with nodes within its layer.

The synchronization of cells and organs relates to transformation of one form of energy to another. Human emotions are chemically translated and physically expressed. Such physical expression generates reactions that may be chemically translated and emotionally aired.

Behind every order or disorder, behind every health and disease, there are non-material intercellular relationships, chemical alterations of enzymes and hormones as well as physical expression which results in motion, activity and so forth. Pain is a physical signal from cells to self (human being).

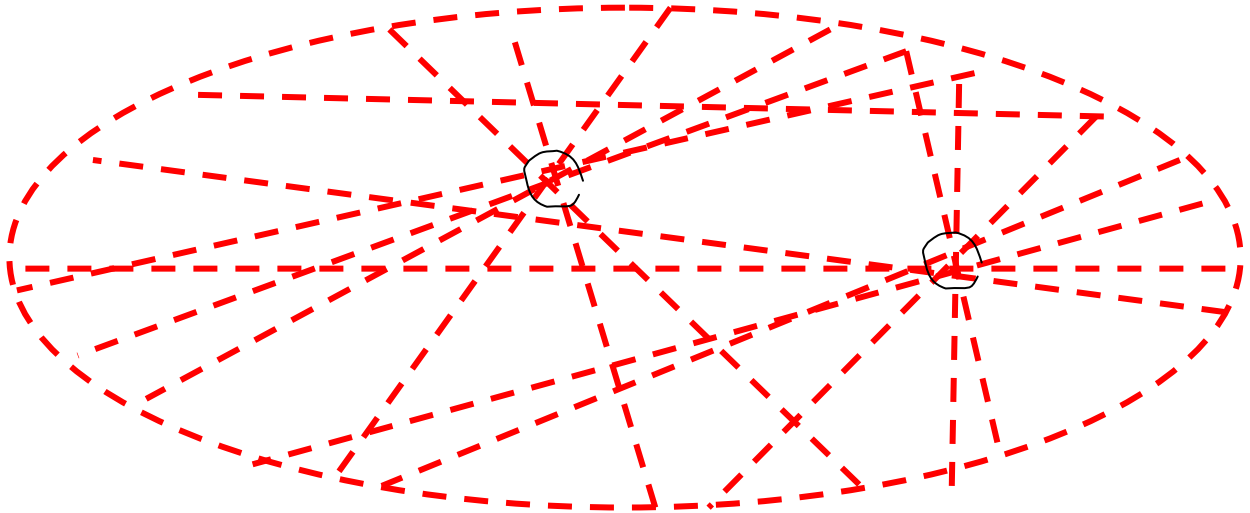
The Exchange of Information and Energy: The Non-material Relationships, Communications, and Interactions



The way these systems work is through the processing of information and the use of energy to take action.

- 1- On the left: The Inner and Outer World of the all biosystems in biosphere have potential to exchange information & energy with their environment
- 2- On the right: The DNA, cell, tissue, organs, 14 systems, human, family, community & society
- 3- On the bottom it shows the relationships of the organisms in the biosphere.

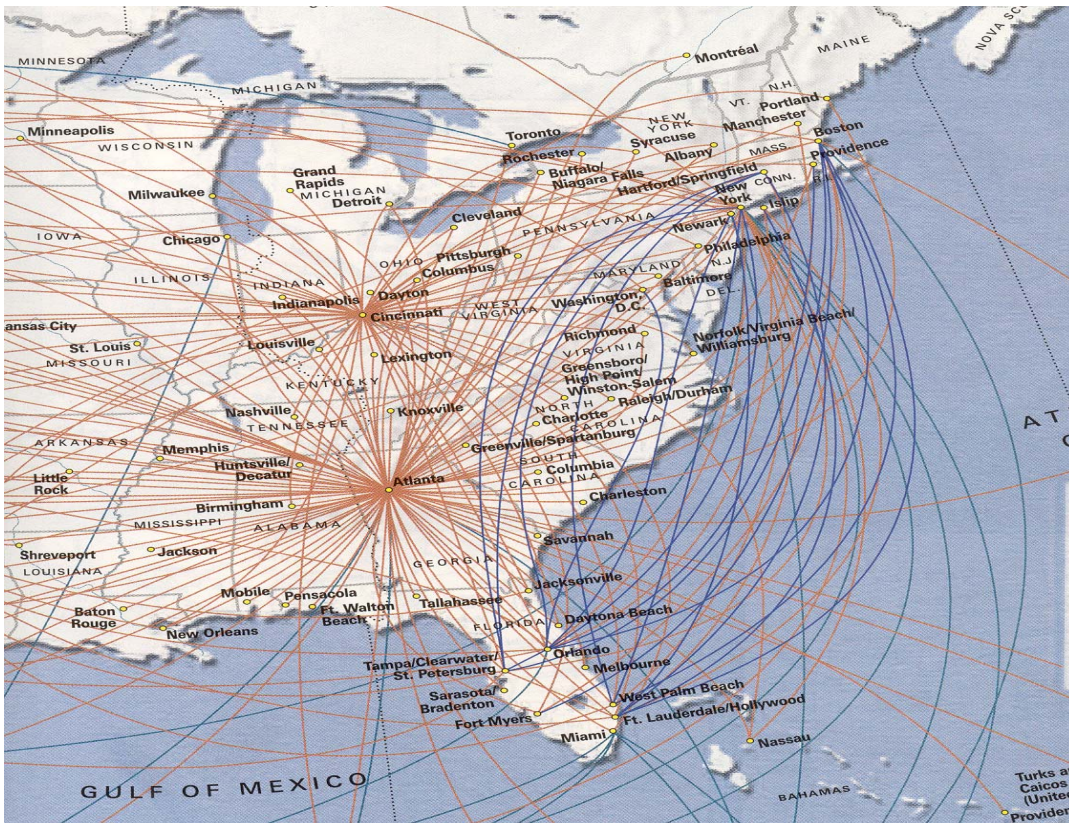
The dynamic relationships (non-material relationships) between three forms of information & energy in the interdependent web of life within the biosphere are unique to each individual. They form a unique form of dynamic relationship like a dynamic spider web, airline map, (with pathways & hubs) etc.



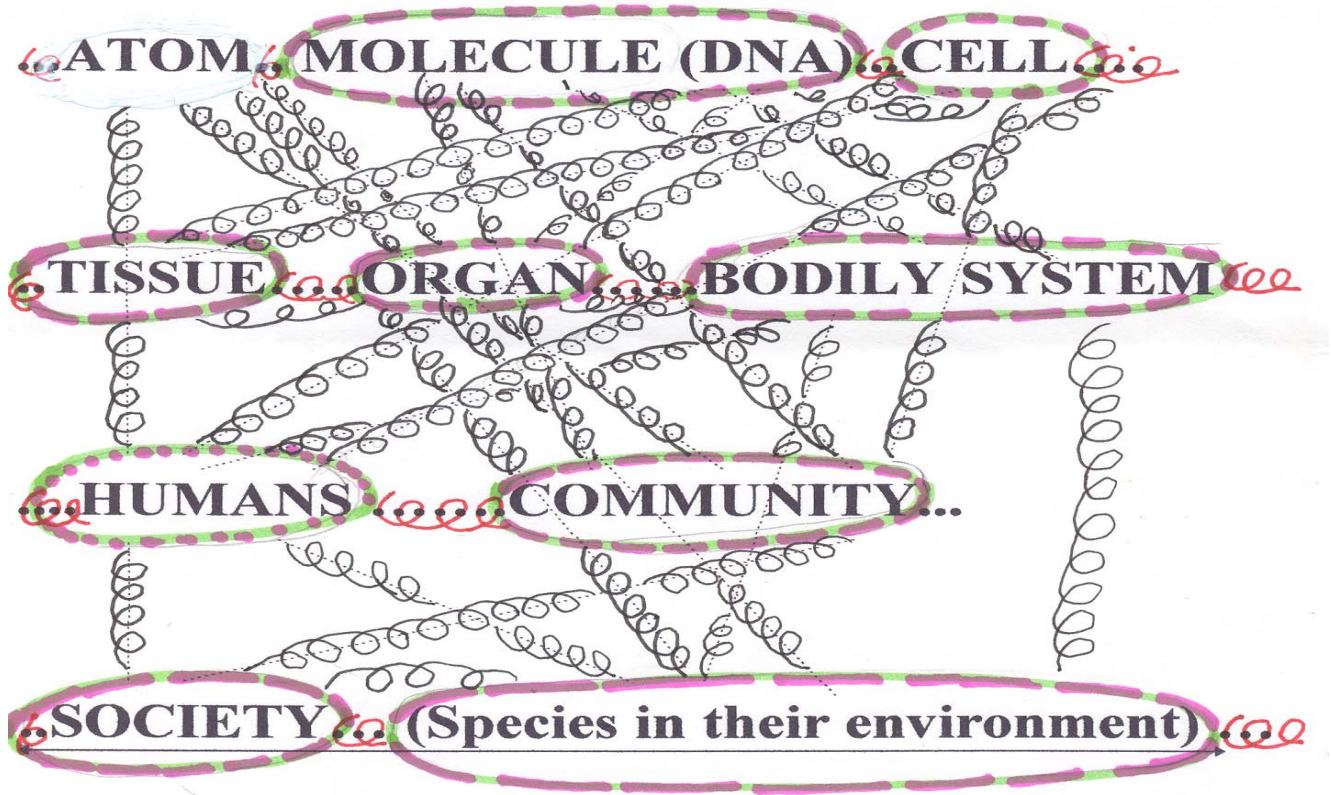
The network of relationships within a biosystem, guides, regulates and synchronizes the chemical, composition, physical pattern and also pattern of the behavior and response to the environmental stimuli.

Every biosystem has a unique structure and function. For example, the cardiac system that we call heart is made of muscular, internal conduction regulatory nerves systems and external nervous system communicating with the brain and vascular systems. It also secretes a hormone (called Beta Naturetin) that instructs kidneys like & how much hormones to secrete to maintain the blood pressure ?

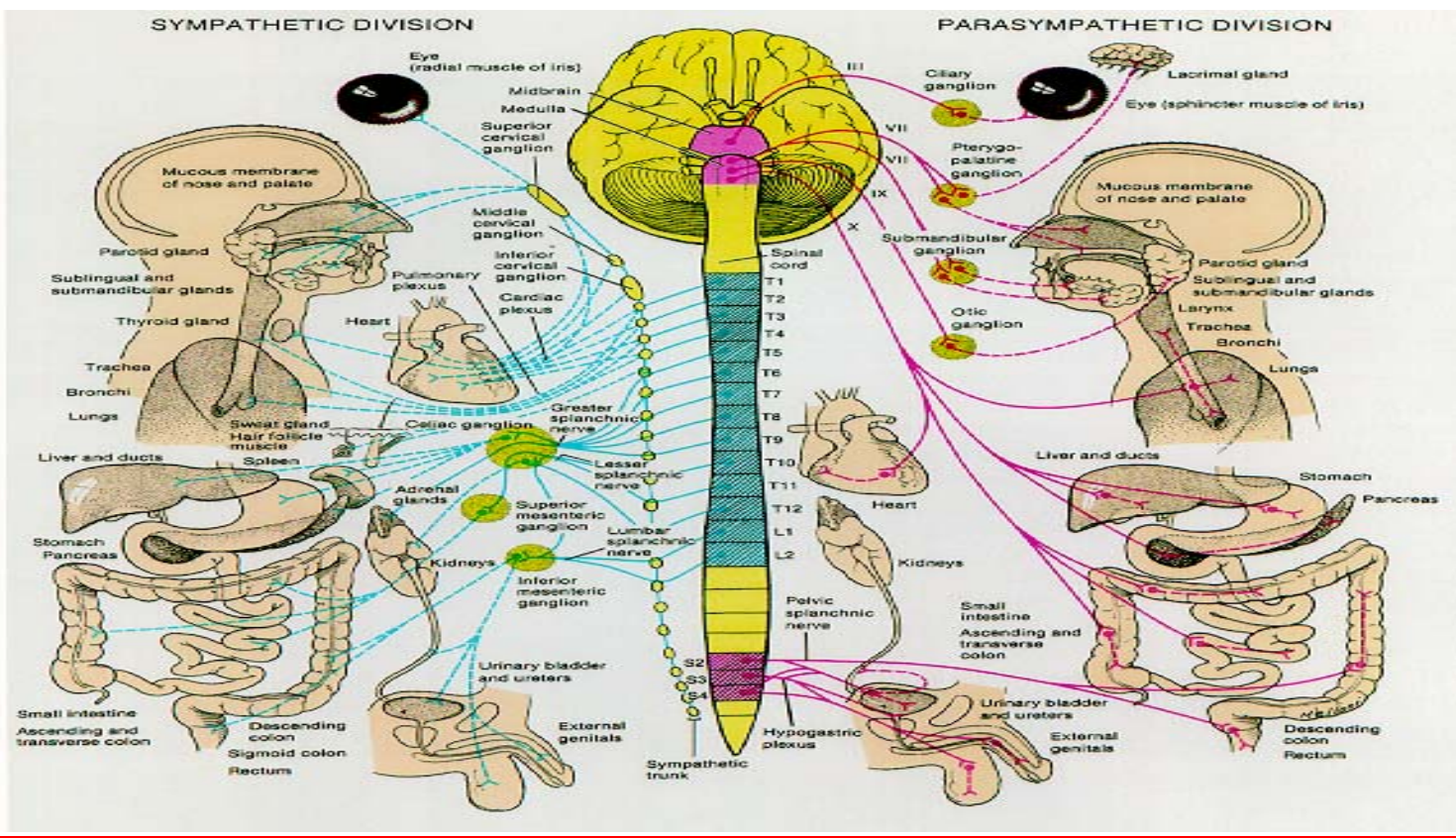
A social organization with basic network of information



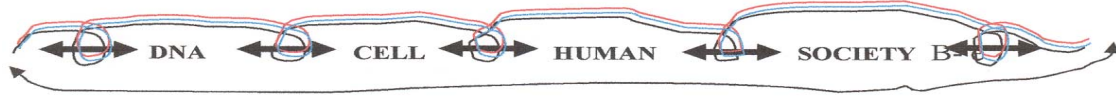
Strings of webs of lives, forming a multi-cellular organisms:
(A network of relationship , exchange of information & energy among
human infrastructures creates an internal communication network)



An example of information & energy exchange in one system. The exchange is via nervous wiring between nervous system & other systems. Most systems are known to have chemical & physical communications also
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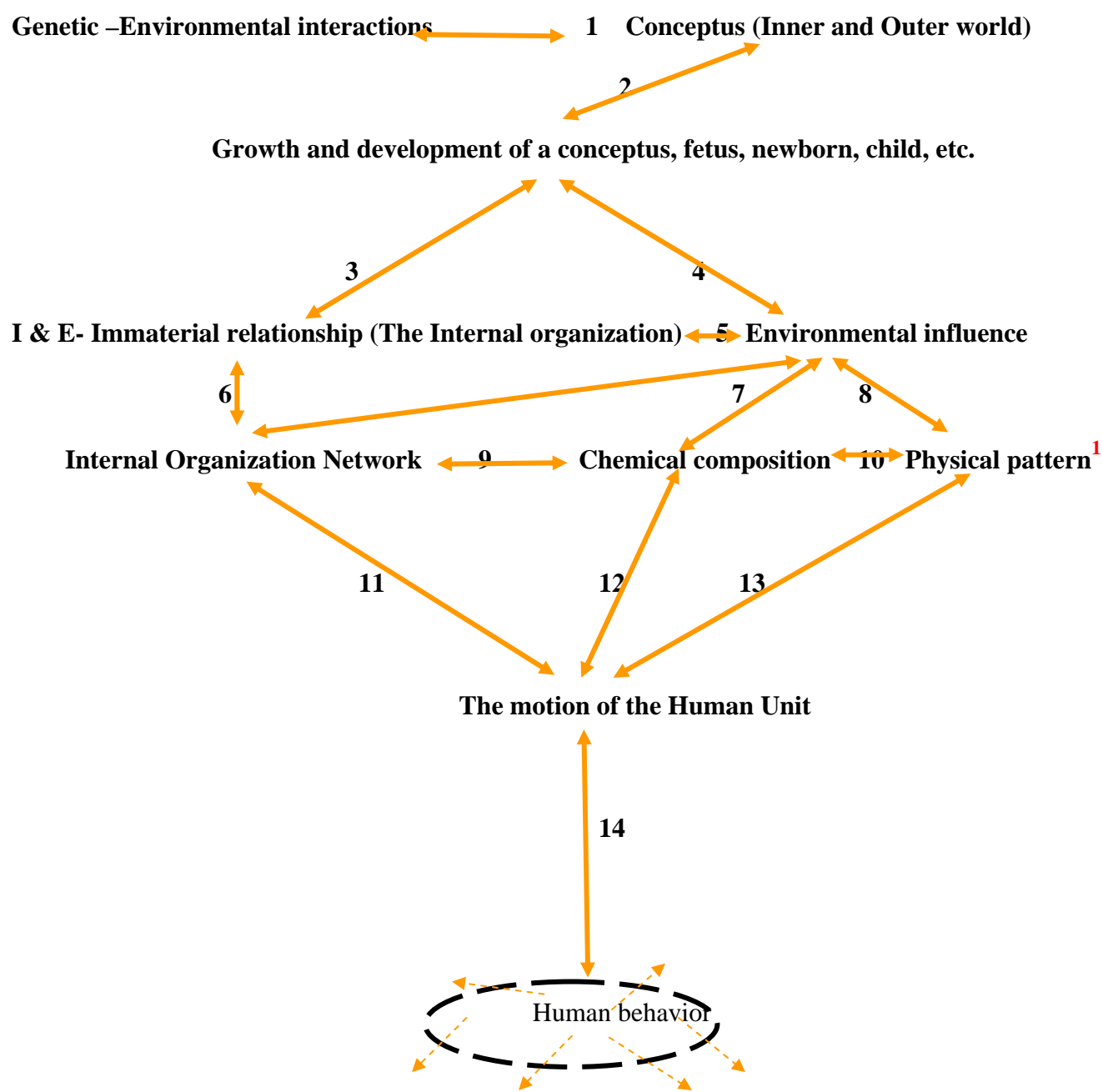


Non-Symbolic Model: The natural laws of biology are evolutionary designs for survival of species & improving the chances of survival for individual member of that species. This cooperation and competition relates to I and E exchange which is the foundation for communication and interactions. The survival of a biosystem in the competitive, interactive & interdependent web of life depends on the natural set of laws:

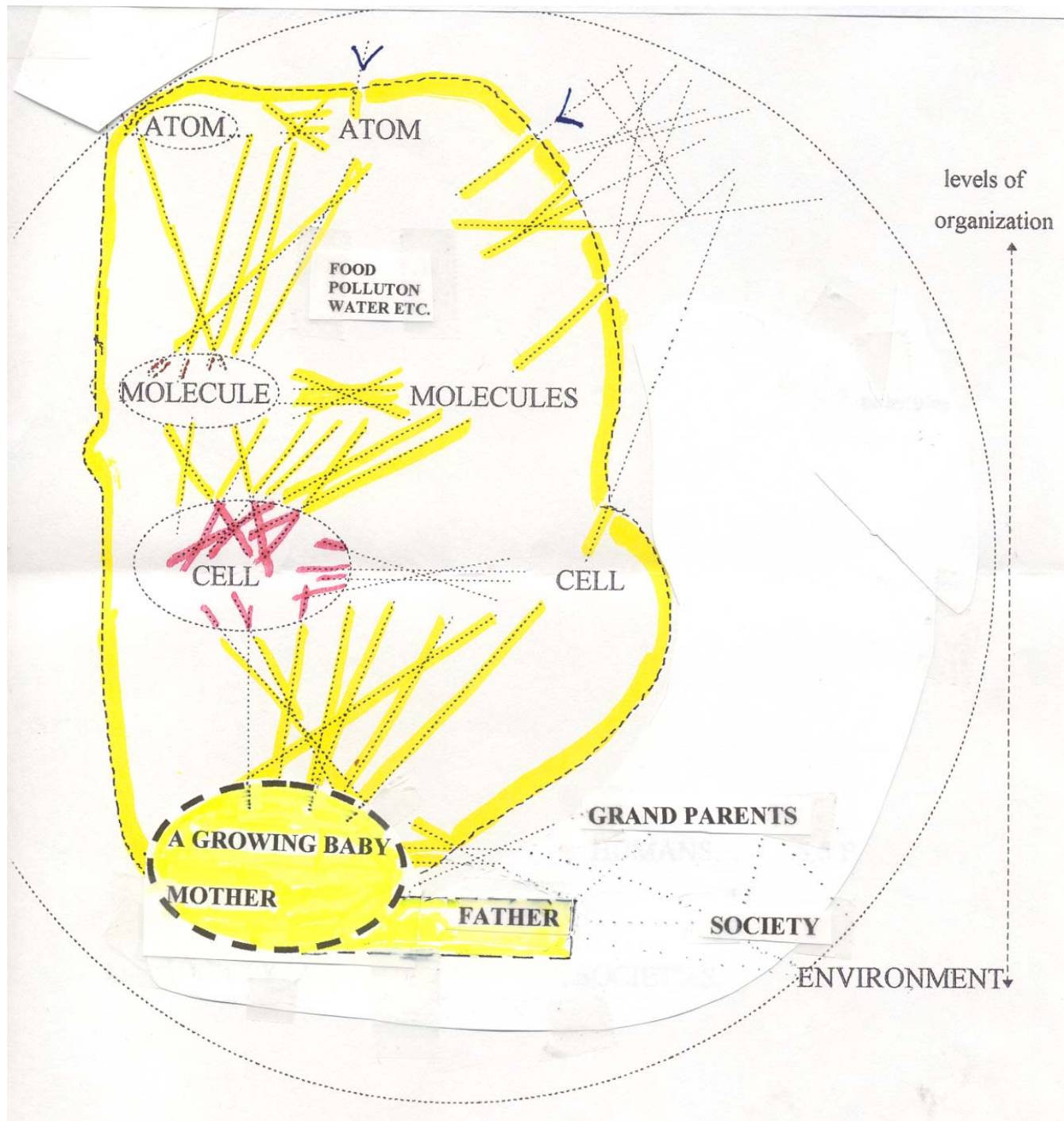
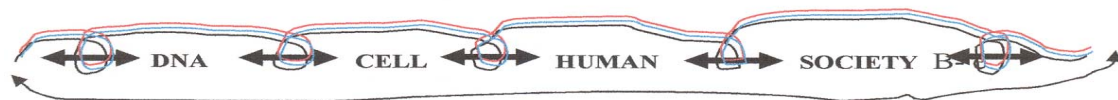


- 1- Natural laws of biology demands synergy. Synergy demands that all level's of the human infrastructure of the human being must belong to a larger whole for best chance of survival (Both worlds). Synergy assures a better chances of survival for participating members
- 2- Natural biological laws of relationship, communication & interactions Takes into account that all possible influencing variables on the behavior any biosystem form a network of relationship (in microorganism, plants & human being etc.). 3- The network of relationship is called bioforce that guide, regulate & synchronize behavior of every biosystem.
- 4- The network, like a city map contains pathways & intersections for cars, pathways & circuits in human being or links and hubs of the airlines.
- 5- Natural laws of survival depend on exchange of information & energy. It is based on pattern of cooperation and competition between individuals and species.
- 6- The cooperation is primarily in the biosystems in the inner world for formation of a larger whole; & the competition is primarily with the biosystems in the outer world. This quality protects the individual's right within a system. The isolated individuals are expected to be eliminated first
Measuring, quantifying I and E in two worlds of the human being and biology can be measured objectively, (physical, chemical and radiative methods (useful tool)
- 7- The Network is the Internal Organization Network is the non-material aspect of biosystem. The flow of information & energy within it, is chemically translated and physically expressed. The physical expression of the chemical changes leads to a single individual behavior. (The single individual behavior of DNA, cell, tissue, organ, 14 systems, society. (Colony of bacteria, swarm of ants and flies, The complex non-material pattern of network leads to pattern of behavior that we call lifestyle, personality, habits, attitude, stress & even conscious & subconscious.
- 8- The emergent properties of the larger whole (biosystem): The traffic pattern of I and E in a single dynamic network find direction, velocity, magnitude & order in the network of a single biosystem; it can be typically exemplified by ant colony is one way. In the larger networks with more complex responsibility and behavior it becomes network (many, many traffic patterns like a city). The information flow among member of an organization can be best exemplified by ant society & their methods of collecting food. Their society & hunting skill, their traffic is so organized that across the forest floor they may catch up to 3000 invertebrates each hour. The swarm of insect flow is so organized there are no pile ups. They use all three methods of communications & exchange of information: Non –material infrasound, chemical pheromones & physical contacts are their bases of organization. When an obstacle like presence of groups of other ants pileup may happen.

The human being like all other biosystems is 3-D, dynamic & integrative beings. The non-material relationships of a human being begin with Genetic-environmental interactions of the conceptus.



¹ In terms of human being, the world could be only in these three forms – Interactive mixture of all. I & E can unify them all



ⁱ These are identified as the following systems: Nervous,, Cardiac, Vascular, Blood, Gastrointestinal, Muscular, Skeletal, Tegumentary, Endocrine, Exocrine, Reproductive, Lymphatic, Urinary, and Connective Tissue.

ⁱⁱ See the book by John Guare from which the following quote is taken by Duncan Watts in his book, *Six Degrees: The Science of a Connected Age*, “I read somewhere that everybody on this planet is separated by only six other people. Six degrees of separation. Between us and everybody else on this planet.”