Somatic Stem Cell

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Abstract: The definition of stem cell is "an unspecialized cell that gives rise to a specific specialized cell, such as a blood cell". Somatic stem cell, also called adult stem cell, is a relatively rare undifferentiated cell found in many organs and differentiated tissues with a limited capacity for both self renewal and differentiation. Such cells vary in their differentiation capacity, but it is usually limited to cell types in the organ of origin. Embryonic stem cells are derived from the inner cell mass of blastocyst stage embryos. Somatic stem cells differentiate into only the cells the specific tissue wherein they reside.
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Life is a physical and chemical process. From ontology aspect, the world is timeless and the life exists forever as any other body in the nature. The nature of life is that life is a process of negative entropy, evolution, autopoiesis (auto-organizing), adaptation, emergence and living hierarchy (Hongbao Ma 2005). To the life, the most important are two points: live and die. Conventionally, everybody of us thinks that all the life has a beginning as the birth and the end as the die. All plants and animals, including all the people must die (Ma Hongbao 2009). Stem Cell is the original of life. All cells come from stem cells (Hongbao Ma 2005). It is stem cell offers the hope for the life body eternal.

The definition of stem cell is "an unspecialized cell that gives rise to a specific specialized cell, such as a blood cell". Embryonic stem cells are derived from the inner cell mass of blastocyst stage embryos. Somatic stem cells are generally believed to differentiate only into cells characteristic of the tissue wherein they reside. In the stem cell field, the terms somatic stem cell has the same meaning as adult stem cell. In this article, the terms somatic stem cell and adult stem cell point same concept.

It normally says that somatic stem cells differentiate only into specific tissue cells wherein they reside. However, somatic stem cells can differentiate into cells other than those of their original tissue. Adult bone marrow, fat, liver, skin, brain, skeletal muscle, pancreas, lung, heart and peripheral blood possess stem cells or progenitor cells with the capacity to transdifferentiate. Due to this developmental plasticity, somatic stem cells may have potential in autologous regenerative medicine, circumventing problems like rejection and the ethically challenged use of embryocyte stem cells. Adult stem cells have been identified in many organs and tissues, including brain, bone marrow, peripheral blood, blood vessels, skeletal muscle, skin, teeth, heart, gut, liver, ovarian epithelium, and testis. They are thought to reside in a specific area of each tissue (stem cell niche) (Bavister, 2005; Bernard, 2005).

Adult stem cells are also known as somatic stem cells (from Greek Σωματικός, meaning of the body), they can be found in juvenile as well as adult animals and human bodies. The somatic stem cells are undifferentiated that are existed throughout the body after development, that multiply by cell division to replace dying cells and damaged tissues.

The somatic stem cells has the ability to divide or *self-renew* indefinitely, and differentiated into all the related kinds of cells and the organs. Unlike the embryonic stem cells.

An adult stem cell is thought to be an undifferentiated cell, found among differentiated cells in a tissue or organ that can renew itself and can differentiate to yield some or all of the major specialized cells. The primary roles of adult stem cells in a living organism are to maintain and repair the tissue, in case the cells of the tissue died or damaged. Somatic stem cells are defined by their origin (Cantley, 2005).

Somatic stem cells plays key function in the damaged tissue repair so that important for the living body survive. But, it is possible that stem cells can create cancer. This is an important concern for the stem cell's function and medical application of stem cells.

In the 1950s, researchers discovered that the bone marrow contains at least two kinds of stem cells. One population in these two populations, called hematopoietic stem cells, forms all the types of blood cells in the body. The second population, called bone marrow stromal stem cells, was discovered to make up a small proportion of the stromal cell population in the bone marrow, and can generate bone, cartilage, fat,

cells that support the formation of blood, and fibrous connective tissue, etc. In the 1960s, research scientists who were studying growth of rats discovered two regions of the brain that contained dividing cells that ultimately become nerve cells (Littlefield, Travis et al. 1997).

Typically, there is a very small number of stem cells in each tissue, and once removed from the body, their capacity to divide is limited. To produce generation of large quantities of stem cells is a difficult task. The following methods normally to be used to identify adult stem cells: (1) Label the cells in a living tissue with stem cell molecular markers and then determine the specialized cell types they generate; (2) Remove the cells from a living animal, label them in cell culture, and transplant them back into another animal to determine whether the cells replace their tissue of origin. It is possible to produce large amount stem cells by cell culture technique and this is important in the stem cell application.

Generally to say, a single adult stem cell can generate a line of genetically identical cells that gives rise to all the appropriate differentiated cell types of the tissue. To confirm experimentally that a putative adult stem cell is indeed a stem cell, research scientists tend to show either that the cell can give rise to these genetically identical cells in culture, and/or that a purified population of these candidate stem cells can repopulate or reform the tissue after transplant into an animal. In a living animal, adult stem cells are available to divide and can give rise to mature cell types that have characteristic shapes and specialized structures and functions of a particular tissue. Adult stem cells are expressed in many tissues and that they enter normal differentiation pathways to form the specialized cell types of the tissue in which they reside for the living requirements. Animal and preliminary human studies of adult cell therapy following acute myocardial infarction have shown an overall improvement of cardiac function (Gnecchi, Zhang et al. 2008).

Mesenchymal stem cells can be differentiated into a variety of cell types: bone cells (osteocytes), cartilage cells (chondrocytes), fat cells (adipocytes), and other kinds of connective tissue cells such as those in tendons. Neural stem cells in the brain give rise to its three major cell types: nerve cells (neurons) and two categories of non-neuronal cells—astrocytes and oligodendrocytes. Epithelial stem cells in the lining of the digestive tract occur in deep crypts and give rise to several cell types: absorptive cells, goblet cells, paneth cells, and enteroendocrine cells. Skin stem cells occur in the basal layer of the epidermis and at the base of hair follicles. The epidermal stem cells give rise to keratinocytes, which migrate to the surface of the skin and form a protective layer. The follicular stem cells can give rise to both the hair follicle and to the epidermis. Hematopoietic stem cells give rise to all the types of blood cells: red blood cells, B lymphocytes, T lymphocytes, natural killer cells, neutrophils, basophils, eosinophils, monocytes, and macrophages (Condorelli, 2005).

Certain adult stem cell types can differentiate into cell types seen in organs or tissues other than those expected from the cells' predicted lineage (i.e., brain stem cells that differentiate into blood cells or blood-forming cells that differentiate into cardiac muscle cells, and so forth). This is called transdifferentiation, not the normal differentiation. Although isolated instances of transdifferentiation have been observed in some vertebrate species, whether this phenomenon actually occurs in humans is under debate by the scientific community. Instead of transdifferentiation, the observed instances may involve fusion of a donor cell with a recipient cell. Another possibility is that transplanted stem cells are secreting factors that encourage the recipient's own stem cells to begin the repair process. Even when transdifferentiation has been detected, only a very small percentage of cells undergo the process. In a variation of transdifferentiation experiments, certain adult cell types can be reprogrammed into other cell types in vivo using a well-controlled process of genetic modification. This strategy may offer a way to reprogram available cells into other cell types that have been lost or damaged due to disease. In addition to reprogramming cells to become a specific cell type, it is now possible to reprogram adult somatic cells to become like embryonic stem cells (induced pluripotent stem cells) through the introduction of embryonic genes. Thus, a source of cells can be generated that are specific to the donor, thereby avoiding issues of histocompatibility (van der Bogt, Sheikh et al. 2008).

Many important questions about adult stem cells remain to be answered. They include:

1 How many kinds of adult stem cells exist, and in which tissues do they exist?
2 How do adult stem cells evolve during development and how are they maintained in the adult? Are they "leftover" embryonic stem cells, or do they arise in some other way?
3 Why do stem cells remain in an undifferentiated state when all the cells around them have differentiated? What are the characteristics of their “niche” that controls their behavior?
4 Do adult stem cells have the capacity to transdifferentiate, and is it possible to

control this process to improve its reliability and efficiency?

5 If the beneficial effect of adult stem cell transplantation is a trophic effect, what are the mechanisms? Is donor cell-recipient cell contact required, secretion of factors by the donor cell, or both?

6 What are the factors that control adult stem cell proliferation and differentiation?

7 What are the factors that stimulate stem cells to relocate to sites of injury or damage, and how can this process be enhanced for better healing?

One major difference between embryonic and adult stem cells is their different abilities in the number and type of differentiated cell types they can become. Embryonic stem cells can become all cell types of the body because they are pluripotent. Adult stem cells are limited to differentiating into different cell types of their tissue of origin. Embryonic stem cells can be grown relatively easily in culture. Adult stem cells are rare in mature tissues, so isolating these cells from an adult tissue is comparative difficult. Somatic nuclei can be reprogrammed to pluripotency through fusion with embryonic stem cells (Ma, Chiang et al. 2008).

Reprogramming of differentiated somatic cells into induced pluripotent stem cells has potential for derivation of patient-specific cells for therapy as well as for development of models with which to study disease progression. Derivation of pluripotent stem cells from human somatic cells has been achieved by viral transduction of human fibroblasts with early developmental genes. Because forced expression of these genes by viral transduction results in transgene integration with unknown and unpredictable potential mutagenic effects, identification of cell culture conditions that can induce endogenous expression of these genes is desirable (Page, Ambady et al. 2009).

Adult stem cells and tissues derived from them are less rejection after transplantation. This is because a patient's own cells could be expanded in culture, coaxed into assuming a specific cell type (differentiation), and then reintroduced into the patient. The adult stem cells and tissues derived from the patient's own adult stem cells are less rejected by the immune system. This represents a significant advantage.

Glossary of Stem Cells

1 Adult stem cell—Also called somatic stem cell, a relatively rare undifferentiated cell found in many organs and differentiated tissues with a limited capacity for both self renewal and differentiation. Such cells vary in their differentiation capacity, but it is usually limited to cell types in the organ of origin. This is an active area of investigation.

2 Astrocyte—A type of glial cell existed in the nervous system.

3 Blastocoel—The fluid-filled cavity inside the blastocyst, an early, preimplantation stage of the developing embryo.

4 Blastocyst—A preimplantation embryo of about 150 cells produced by cell division following fertilization. The blastocyst is a sphere made up of an outer layer of cells (trophoblast), a fluid-filled cavity (blastocoel), and a cluster of cells on the interior (inner cell mass).

5 Bone marrow stromal cells—A population of cells found in bone marrow that are different from blood cells.

6 Bone marrow stromal stem cells (skeletal stem cells)—A multipotent subset of bone marrow stromal cells able to form bone, cartilage, stromal cells that support blood formation, fat, and fibrous tissue.

7 Cell-based therapies—Treatment in which stem cells are induced to differentiate into the specific cell type required to repair damaged or destroyed cells or tissues.

8 Cell culture—Growth of cells in vitro in an artificial medium for research or medical treatment.

9 Cell division—Method by which a single cell divides to create two cells. There are two main types of cell division depending on what happens to the chromosomes: mitosis and meiosis.

10 Chromosome—A structure consisting of DNA and regulatory proteins found in the nucleus of the cell. The DNA in the nucleus is usually divided up among several chromosomes. The number of chromosomes in the nucleus varies depending on the species of the organism. Humans have 46 chromosomes, 23 pairs.

11 Clone— (v) To generate identical copies of a region of a DNA molecule or to generate genetically identical copies of a cell, or organism; (n) The identical molecule, cell, or organism that results from the cloning process.

(1) In reference to DNA: To clone a gene, one finds the region where the gene resides on the DNA and copies that section of the DNA using laboratory techniques.

(2) In reference to cells grown in a tissue culture dish: a clone is a line

of cells that is genetically identical to the originating cell. This cloned line is produced by cell division (mitosis) of the original cell.

(3) In reference to organisms: Many natural clones are produced by plants and (mostly invertebrate) animals. The term clone may also be used to refer to an animal produced by somatic cell nuclear transfer or parthenogenesis.

12 Cloning—Clone. (v) To generate identical copies of a region of a DNA molecule or to generate genetically identical copies of a cell, or organism; (n) The identical molecule, cell, or organism that results from the cloning process.

13 Cord blood stem cells—See Umbilical cord blood stem cells.

14 Culture medium—The liquid that covers cells in a culture dish and contains nutrients to nourish and support the cells. Culture medium may also include growth factors added to produce desired changes in the cells.

15 Differentiation—The process whereby an unspecialized embryonic cell acquires the features of a specialized cell such as a heart, liver, or muscle cell. Differentiation is controlled by the interaction of a cell's genes with the physical and chemical conditions outside the cell, usually through signaling pathways involving proteins embedded in the cell surface.

16 Directed differentiation—The manipulation of stem cell culture conditions to induce differentiation into a particular cell type.

17 DNA—Deoxyribonucleic acid, a chemical found primarily in the nucleus of cells. DNA carries the instructions or blueprint for making all the structures and materials the body needs to function. DNA consists of both genes and non-gene DNA in between the genes.

18 Ectoderm—The outermost germ layer of cells derived from the inner cell mass of the blastocyst; gives rise to the nervous system, sensory organs, skin, and related structures.

19 Embryo—In humans, the developing organism from the time of fertilization until the end of the eighth week of gestation, when it is called a fetus.

20 Embryoid bodies—Rounded collections of cells that arise when embryonic stem cells are cultured in suspension. Embryoid bodies contain cell types derived from all 3 germ layers.

21 Embryonic germ cells—Pluripotent stem cells that are derived from early germ cells (those that would become sperm and eggs). Embryonic germ cells are thought to have properties similar to embryonic stem cells.

22 Embryonic stem cells—Primitive (undifferentiated) cells that are derived from preimplantation-stage embryos, are capable of dividing without differentiating for a prolonged period in culture, and are known to develop into cells and tissues of the three primary germ layers. Embryonic stem cells are isolated from cells in a blastocyst, a very early stage embryo. Once isolated from the blastocyst, these cells form colonies in culture (closely packed groups of cells) and can become cells of the three germ layers, which later make up the adult body.

23 Embryonic stem cell line—Embryonic stem cells, which have been cultured under in vitro conditions that allow proliferation without differentiation for months to years.

24 Endoderm—The innermost layer of the cells derived from the inner cell mass of the blastocyst; it gives rise to lungs, other respiratory structures, and digestive organs, or generally "the gut."

25 Enucleated—Having had its nucleus removed.

26 Epigenetic—Having to do with the process by which regulatory proteins can turn genes on or off in a way that can be passed on during cell division.

27 Feeder layer—Cells used in co-culture to maintain pluripotent stem cells. For human embryonic stem cell culture, typical feeder layers include mouse embryonic fibroblasts or human embryonic fibroblasts that have been treated to prevent them from dividing.

28 Fertilization—The joining of the male gamete (sperm) and the female gamete (egg).

29 Fetus—In humans, the developing human from approximately eight weeks after conception until the time of its birth.

30 Gamete—An egg (in the female) or sperm (in the male) cell. See also Somatic cell.

31 Gastrulation—The process in which cells proliferate and migrate within the embryo to transform the inner cell mass of the blastocyst stage into an embryo containing all three primary germ layers.

32 Gene—A functional unit of heredity that is a segment of DNA found on chromosomes in the nucleus of a cell. Genes direct the formation of an enzyme or other protein.

33 Germ layers—After the blastocyst stage of embryonic development, the inner cell mass of the blastocyst goes through gastrulation, a period when the inner cell mass becomes organized into three distinct cell layers, called germ layers. The three layers are the ectoderm, the mesoderm, and the endoderm.
34 Hematopoietic stem cell—A stem cell that gives rise to all red and white blood cells and platelets.
35 Human embryonic stem cell (hESC)—A type of pluripotent stem cells derived from early stage human embryos, up to and including the blastocyst stage, that are capable of dividing without differentiating for a prolonged period in culture, and are known to develop into cells and tissues of the three primary germ layers.
36 Induced pluripotent stem cell (iPSC)—A type of pluripotent stem cell, similar to an embryonic stem cell, formed by the introduction of certain embryonic genes into a somatic cell.
37 In vitro—Latin for "in glass"; in a laboratory dish or test tube; an artificial environment.
38 In vitro fertilization—A technique that unites the egg and sperm in a laboratory instead of inside the female body.
39 Inner cell mass (ICM)—The cluster of cells inside the blastocyst. These cells give rise to the embryo and ultimately the fetus. The ICM may be used to generate embryonic stem cells.
40 Long-term self-renewal—The ability of stem cells to replicate themselves by dividing into the same non-specialized cell type over long periods (many months to years) depending on the specific type of stem cell.
41 Mesenchymal stem cells—A term that is currently used to define non-blood adult stem cells from a variety of tissues, although it is not clear that mesenchymal stem cells from different tissues are the same.
42 Meiosis—The type of cell division a diploid germ cell undergoes to produce gametes (sperm or eggs) that will carry half the normal chromosome number. This is to ensure that when fertilization occurs, the fertilized egg will carry the normal number of chromosomes rather than causing aneuploidy (an abnormal number of chromosomes).
43 Mesoderm—Middle layer of a group of cells derived from the inner cell mass of the blastocyst; it gives rise to bone, muscle, connective tissue, kidneys, and related structures.
44 Microenvironment—The molecules and compounds such as nutrients and growth factors in the fluid surrounding a cell in an organism or in the laboratory, which play an important role in determining the characteristics of the cell.
45 Mitosis—The type of cell division that allows a population of cells to increase its numbers or to maintain its numbers. The number of chromosomes remains the same in this type of cell division.
46 Multipotent—Having the ability to develop into more than one cell type of the body. See also pluripotent and totipotent.
47 Neural stem cell—A stem cell found in adult neural tissue that can give rise to neurons and glial (supporting) cells. Examples of glial cells include astrocytes and oligodendrocytes.
48 Neurons—Nerve cells, the principal functional units of the nervous system. A neuron consists of a cell body and its processes—an axon and one or more dendrites. Neurons transmit information to other neurons or cells by releasing neurotransmitters at synapses.
49 Oligodendrocyte—A supporting cell that provides insulation to nerve cells by forming a myelin sheath (a fatty layer) around axons.
50 Parthenogenesis—The artificial activation of an egg in the absence of a sperm; the egg begins to divide as if it has been fertilized.
51 Passage—In cell culture, the process in which cells are disassociated, washed, and seeded into new culture vessels after a round of cell growth and proliferation. The number of passages a line of cultured cells has gone through is an indication of its age and expected stability.
52 Pluripotent—Having the ability to give rise to all of the various cell types of the body. Pluripotent cells cannot make extra-embryonic tissues such as the amnion, chorion, and other components of the placenta. Scientists demonstrate pluripotency by providing evidence of stable developmental potential, even after prolonged culture, to form derivatives of all three embryonic germ layers from the progeny of a single cell and to generate a teratoma after injection into an immunosuppressed mouse.
53 Polar Body—A polar body is a structure produced when an early egg cell, or oogonium, undergoes meiosis. In the first meiosis, the oogonium divides its chromosomes evenly between the two cells

but divides its cytoplasm unequally. One cell retains most of the cytoplasm, while the other gets almost none, leaving it very small. This smaller cell is called the first polar body. The first polar body usually degenerates. The ovum, or larger cell, then divides again, producing a second polar body with half the amount of chromosomes but almost no cytoplasm. The second polar body splits off and remains adjacent to the large cell, or oocyte, until it (the second polar body) degenerates. Only one large functional oocyte, or egg, is produced at the end of meiosis.

54 Preimplantation—With regard to an embryo, preimplantation means that the embryo has not yet implanted in the wall of the uterus. Human embryonic stem cells are derived from preimplantation-stage embryos fertilized outside a woman's body (in vitro).

55 Proliferation—Expansion of the number of cells by the continuous division of single cells into two identical daughter cells.

56 Regenerative medicine—A field of medicine devoted to treatments in which stem cells are induced to differentiate into the specific cell type required to repair damaged or destroyed cell populations or tissues. (See also cell-based therapies).

57 Reproductive cloning—The process of using somatic cell nuclear transfer (SCNT) to produce a normal, full grown organism (e.g., animal) genetically identical to the organism (animal) that donated the somatic cell nucleus. In mammals, this would require implanting the resulting embryo in a uterus where it would undergo normal development to become a live independent being. The first mammal to be created by reproductive cloning was Dolly the sheep, born at the Roslin Institute in Scotland in 1996. See also Somatic cell nuclear transfer (SCNT).

58 Signals—Internal and external factors that control changes in cell structure and function. They can be chemical or physical in nature.

59 Somatic cell—Any body cell other than gametes (egg or sperm); sometimes referred to as "adult" cells. See also Gamete.

60 Somatic cell nuclear transfer (SCNT)—A technique that combines an enucleated egg and the nucleus of a somatic cell to make an embryo. SCNT can be used for therapeutic or reproductive purposes, but the initial stage that combines an enucleated egg and a somatic cell nucleus is the same. See also therapeutic cloning and reproductive cloning.

61 Somatic (adult) stem cells—A relatively rare undifferentiated cell found in many organs and differentiated tissues with a limited capacity for both self renewal and differentiation. Such cells vary in their differentiation capacity, but it is usually limited to cell types in the organ of origin. This is an active area of investigation.

62 Stem cells—Cells with the ability to divide for indefinite periods in culture and to give rise to specialized cells.

63 Stromal cells—Connective tissue cells found in virtually every organ. In bone marrow, stromal cells support blood formation.

64 Subculturing—Transferring cultured cells, with or without dilution, from one culture vessel to another.

65 Surface markers—Proteins on the outside surface of a cell that are unique to certain cell types and that can be visualized using antibodies or other detection methods.

66 Telomere—The end of a chromosome, associated with a characteristic DNA sequence that is replicated in a special way. A telomere counteracts the tendency of the chromosome to shorten with each round of replication.

67 Teratoma—A multi-layered benign tumor that grows from pluripotent cells injected into mice with a dysfunctional immune system. Scientists test whether they have established a human embryonic stem cell (hESC) line by injecting putative stem cells into such mice and verifying that the resulting teratomas contain cells derived from all three embryonic germ layers.

68 Tetraploid complementation assay—An assay that can be used to test a stem cell's potency. Scientists studying mouse chimeras (mixing cells of two different animals) noted that fusing two 8-cell embryos produces cells with 4 sets of chromosomes (tetraploid cells) that are biased toward developing into extra-embryonic tissues such as the placenta. The tetraploid cells do not generate the embryo itself; the embryo proper develops from injected diploid stem cells. This tendency has been exploited to test the potency of a stem cell. Scientists begin with a tetraploid embryo. Next, they inject the stem cells to be tested. If the injected cells are pluripotent, then an embryo develops. If no embryo develops, or if the resultant embryo cannot survive until birth, the scientists conclude that the cells were not truly pluripotent.

69 Therapeutic cloning—The process of using somatic cell nuclear transfer (SCNT) to produce cells that exactly match a patient. By combining a patient's somatic cell nucleus and an enucleated egg, a scientist may harvest embryonic stem cells from the resulting embryo that can be used to generate tissues that match a patient's body. This means the tissues created are unlikely to be rejected by the patient's immune system. See also Somatic cell nuclear transfer (SCNT).

70 Totipotent—Having the ability to give rise to all the cell types of the body plus all of the cell types that make up the extraembryonic tissues such as the placenta. (See also Pluripotent and Multipotent).

71 Transdifferentiation—The process by which stem cells from one tissue differentiate into cells of another tissue.

72 Trophectoderm—The outer layer of the preimplantation embryo in mice. It contains trophoblast cells.

73 Trophoblast—The outer cell layer of the blastocyst. It is responsible for implantation and develops into the extraembryonic tissues, including the placenta, and controls the exchange of oxygen and metabolites between mother and embryo.

74 Umbilical cord blood stem cells—Stem cells collected from the umbilical cord at birth that can produce all of the blood cells in the body (hematopoietic). Cord blood is currently used to treat patients who have undergone chemotherapy to destroy their bone marrow due to cancer or other blood-related disorders.

75 Undifferentiated—A cell that has not yet developed into a specialized cell type.

The therapeutic application of adult stem cells is developing very quickly but critically. The adult stem cells have the ability to differentiate into any cell type. The ability of a differentiated stem cell of one lineage to produce cells of a different lineage is called transdifferentiation, which is important for the living body development. Somatic stem cell therapies require the stem cell source of the specific lineage is needed. The harvesting and/or culturing the stem cell in important technique in the stem cell research and application.

Even the there are a lot of rebates and critical in stem cell's clinical application in science, technology, religions, politics and economics, etc., the further researches and applications cannot be stopped in anyway.

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7. Hongbao Ma, S. C. (2005). "Nature of Life." Life Science Journal **2**(1): 7 - 15. Life is a physical and chemical process. From ontology aspect, the world is timeless and the life exists forever as any other body in the nature. The nature of life is that life is a process of negative entropy, evolution, autopoiesis (auto-organizing), adaptation, emergence and living hierarchy. Up to now, there is no scientific evidence to show that life body and non-life body obey the same natural laws. But, all the researches are made by the methods of biology, biochemistry and molecular biology, etc. I t is very possible that the life and non-life are essential different in the biophysics, i.e. the quantum level. In the future, it is possible to make ar tificial life by either biological method or elect ronic technique.

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