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Editorial

About life sciences and related technologies

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Abstract

The life sciences include the branches of science that are concerned with scientific studies of living organisms' such as human beings, animals, plants and microorganisms. In fact, all life sciences are biology based sciences and from the beginning of the scientific and technological researches up to date, the obtained scientific data, especially in agriculture, medicine, engineering, as well as molecular biology and biotechnology, led to an escalating specializations in interdisciplinary fields. Some life sciences focus on a specific type of life. For instance, botany is the study of plants and has different branches such as anatomy, genetics, biochemistry, biophysics, taxonomy, physiology, molecular biology and paleobotany etc. of plants. On the other hand, zoology is the study of animals that branches out anatomy, cytology, ecology, embryology, genetics, geology, histology, morphology, neonatology, paleontology, physiology, taxonomy and many others. Also, microbiology is the study of microorganisms that may exist in its single-celled form or in a colony of cells, and branches out to bacteriology, mycology, protozoology, phycology, parasitology, immunology, virology and nematology and related sciences. The branches of these life sciences have their own specific sub-branches related to the studied and mastered subjects. Recently, multidisciplinary new branches like bioengineering have been formed, especially in conjunction with life sciences and engineering sciences, and these branches contribute to the development of science. Life sciences are very useful in improving people's life quality and standards. They have applications in agriculture, health, medicine, food and drug science industries as well as environmental sciences. In this article, information is given about the branches of "life sciences and related technologies" for better understanding of life sciences.

Keywords: *Agriculture; biology; engineering; medicine; inanimate; living*

1. Introduction

Before getting into the topic of what life sciences are, we need to know that what life is, what living and non-living (inanimate), and finally what are the differences between the beings called living and non-living. Although we use these terms many times in our everyday lives, giving the answers of these questions with a few sentences have been very difficult for people from the beginning to human life to today. Instead of making a definition, so many scientists and thinkers have presented some criteria for life, living and non-livings. Nobel laureate Erwin Schrödinger, who is an Austrian physicist tried to answer this (still-unresolved) question as life is differentiated by a"code-script" that regulates cellular organization and genetic endowment, while obviously enabling living beings to defer the second law of thermodynamics.

Life is a feature, which separates physical object that with biological processes, such as life signaling and self-sustaining, as living things (organisms), from those do not have or become unable to perform these functions (died) after a certain time are classified as inanimate.

Simply, we can understand from the above definition, only two properties are required for us to determine whether a physical object is alive or not is metabolism (life functions of an organism, biomass increase and reproduction) and motion (McKay, 2004). Also the simplest requirements of life are

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energy, water, in addition to C, H, O, N, P, S, K, other macro and micro elements such as B, Mg, Ca, Cl, Mo, Cu, Fe, Mn, Zn and a few Al, Co, Na, Ni, Si and V that varies from one organism to another (McKay 1991; Ozyigit et al., 2018).

Seven features of life were listed by Koshland (2002) as **(1)** program (DNA), **(2)** improvisation (response to environment), **(3)** compartmentalization, **(4)** energy, **(5)** regeneration, **(6)** adaptability, and **(7)** seclusion (chemical control and selectivity). After the finding non-coding RNA's, today we can add RNA into the program together with DNA.

2. Living and non-living things

Since there are many different definitions, in order to separate the living from the non-living, the following properties are accepted that a living system must have; **(1)** the ability to encapsulate its components in an enclosed boundary, in order to distinguish itself from the environment, **(2)** the ability to transfer information from one generation to the next generation and finally, **(3)** the ability to accrue variations (mutations) between successive generations (Tauber and Podolsky, 1994; Rodriguez Garcia, 2016).

Here, the encapsulating ability takes us to the cell formation and naturally to "the cell theory". As it is known, Matthias Schleiden, the German botanist and Theodor Schwann, a British zoologist were formally articulated in this historic scientific theory, in 1839 and up to now, it is universally accepted whit minor revisions (Ribatti, 2018). According to this theory, "all living things are made up of cells and cell is the basic structural and functional unit of life". 14 years later, Rudolf Virchow published an important extension of cell theory, based on his observations statement that "all living cells arise from pre-existing cells" (Omnis cellula e cellula) (Epozturk and Gorkey; 2018).

Recently, the theory has modernized. Today, the "modern cell theory" includes the followings editions **(1)** energy flow occurs within cells, **(2)** cells contain hereditary information (DNA) which is passed from cell to cell **(3)** all cells have basically the same chemical composition (Kumar and Mina, 2015).

Nevertheless, this theory includes cellular organisms. Noncellular organisms like viruses do not obey the cell theory (Marcus, 2012). Possibly, non-cellular or acellular life forms could be hiding out in anywhere like beneath the deep oceans or inside the glaciers in Antarctica and waiting for the moment when it will come out and meet us as a result of global warming and/or with the soil samples brought to Europe by a South Pole explorer.

Cells function differently in unicellular and multicellular organisms. Related to above mentioned information, an organism refers to a living thing that has an organized structure, can react to stimuli, reproduce, grow, adapt, and maintain homeostasis (Folse and Roughgarden, 2010; Díaz-Muñoz et al., 2016; Demarest and Wolfe, 2017). A unicellular organism depends upon just one cell, however that cell can be tremendously complex and realizes all of its functions. A multicellular organism has cells different from each other that specialized to perform different functions that collectively support the organism (Huang et al., 2005; Schulze-Makuch and Bains, 2017; Tetz and Tetz, 2020). Although many cells have differentiated to perform various functions, there are two types of cells as prokaryotic and eukaryotic. Simply, a prokaryotic cell is a type of cell or a unicellular organism that lacks a membrane-bound nucleus, mitochondria, or any other membrane-bound organelle. However, a eukaryotic cell and/or organism have a nucleus that enclosed by membrane and membrane-bound organelles specialized to perform different functions (Martin, 2017; Urry et al., 2020).

Some organisms, like bacteria (*Agrobacterium tumefaciens*, *Eschericia coli*, *Thermus aquaticus*), cyanobacteria (*Chroococcus turgidus*), alga (*Chlamydomonas reinhardtii*, *Chlorella vulgaris*), protozoa (*Paramecium caudatum*, *Plasmodium vivax*, *Trypanosoma brucei*), yeast (*Candida albicans*, *Saccharomyces cerevisiae*), diatoms (*Achnanthes fimbriata*, *Hippodonta arctica*) etc. are unicellular-consisting of a single cell. Other organisms, such as human (*Homo sapiens*), animals (*Danio rerio*, *Drosophila melanogaster*, *Xenopus laevis*), plants (*Arabidopsis thaliana*, *Gossypium hirsutum*, *Helianthus annuus*) and fungi (*Amanita phalloides*, *Armillaria solidipes*) are some samples of multicellular organisms (Kusber and Jahn, 2002; Moore et al., 2019; Urry et al., 2020).

The above unicellular and multicellular organisms are first classified by Linnaeus, 1735 as a 2-kingdom (vegetabilia and animalia) system. As a result of the technological developments related to biological sciences, there have been many changes in following 280 years, and today a 7-kingdom system has been accepted including bacteria, archaea, protozoa, chromista, plantae, fungi and animalia by Ruggiero et al., 2015.

Life sciences cover all scientific studies that are related to the above mentioned groups in direct or indirect ways. Also, all life sciences are related to biology. Biology has a rich history of interactions with many other sciences such as agriculture, chemistry, engineering, food sciences, mathematics, medicine, pharmaceutical sciences and physics etc. Below, some definitive information are given about some selected branches of life sciences.

3. Life science branches

3.1. Basic life science branches and related concepts

Anatomy: Study of structure and relationship of body parts of organisms such as humans, animals, plants and others, especially as revealed by dissection and the separation of parts (Barnes-Svarney and Svarney, 2016; McConnell and Hull, 2020).

Astrobiology: Study of the origins, formation, early evolution, distribution, presence and future of life in the universe. It is formerly known as exobiology (Cottin et al., 2017; Cockell, 2020).

Biotechnology: Study of combination of both the living organism or their parts and a group of technologies to develop or make different products to improve the quality of human life (Ribeiro et al., 2016; Glick and Patten, 2017; Bettencourt, 2020).

Biochemistry: Study of the physico-chemical processes and substances required for life to exist and function, and of the changes they undergo during development and life at the cellular and molecular level (McKee and McKee, 2019; Rodwell et al., 2019).

Bioinformatics: Study of developing and/or using of methods or software tools for obtaining, storing, retrieving, interpreting, organizing and analyzing large amounts of biological information to generate useful biological knowledge (Hogeweg, 2011; Filiz et al., 2017).

Biolinguistics: Study of the biology and development of language related to or derived from the biological characteristics of an organism, especially human (Demirezen, 1988; Martins and Boeckx, 2016; Pleyer and Hartmann, 2019).

Biological anthropology: Study of mostly humans, non-human primates and hominids, their origin, development, biological variation and adaptation to environmental stresses. It is also known as physical anthropology (Jurmain et al., 2013; Ellison, 2018).

Biological oceanography: Study of the distribution, population dynamics and abundance of different types of marine life and their interaction with the physics, chemistry, and geology of the oceanographic system (Lalli and Parsons, 1997; Miller and Wheeler, 2012).

Biology: Study of life and living organisms, including their origin, distribution, classification, chemical processes, physical structure, function, physiological mechanisms, molecular interactions, development, behavior and evolution (Raven et al., 2019; Urry et al., 2020).

Biomechanics: Study of the structure, function and motion of the mechanical aspects of living beings at any level from whole organisms to organs, cells and cell organelles (Alexander, 2005; Arus, 2012; Fung, 2013).

Biophysics: Study of biological processes by using physics-based methods or based on physical principles from molecules, to cells, tissues, organisms and populations (Zhou, 2011; Andersen, 2016; Tabacchi and Termini, 2017).

Botany: Study of plants including their structure, properties, physiological and biochemical processes genetics, ecology, distribution, classification, and economic importance. It is also known as plant science(s), plant biology or phytology (Berg, 2008; Mauseth, 2014; Lüttge et al., 2016)

Cell biology: Study of the cell (Both prokaryotic and eukaryotic) as a fundamental unit of life, structure and functions, molecular and chemical interactions such as cell metabolism, cell communication, cell cycle, and cell composition that occur within and/or between living cells. It is also called as cellular biology, or cytology (Gupta, 2005; Alberts et al., 2013a; Cibas and Ducatman, 2013).

Developmental biology: Study of the processes by which animals and plants grow and develop forms, from zygote to full structure and is synonymous with ontogeny (Pua, 2010; Slack, 2012; Carlson, 2018).

Ecology: Study of the interactions among living organisms and their non-living biophysical environment (Townsend et al., 2003; Sharma and Sharma, 2012; Rana, 2013).

Ethology: Study of both animal and human behavior, with emphasis on the behavioral patterns that occur in natural environments, and viewing behavior as an evolutionarily adaptive trait (Holland and Ball, 2003; Warnock and Allen, 2003; Gomez-Marin, et al., 2014).

Evolutionary biology: Study of the origin and descent of species that produced the diversity of life on earth (Dukas, 2004; Johnson and Stinchcombe, 2007; Futuyma and Agrawal, 2009).

Genetics: Study of genes which is a sequence of nucleotides in DNA or RNA that encodes the synthesis of a gene product, either RNA or protein, genetic variation and heredity in organisms (Griffiths et al., 2005; Elston et al., 2012; Tseng and Yang, 2013; Snustad and Simmons, 2015, Carlberg and Molnár, 2016).

Histology: Study of plant and animal cells and tissues using microscopes to look at specimens of tissues that have been carefully prepared in relation to their specialized functions. It is also called as microscopic anatomy or microanatomy (Kierszenbaum and Tres, 2015; Gartner, 2018; Mescher, 2018).

Immunology: Study of the immune system in all organisms (Bellanti, 2013; Villani et al., 2018).

Microbiology: Study of microscopic organisms (microorganisms) those being unicellular (single cell), multicellular (cell colony), or acellular (lacking cells) and their interactions with other living organisms and the environment (Madigan et al., 2010; Carr, 2017).

Molecular biology: Study of molecular basis of biological activities in and between cells, including molecular synthesis, modification, mechanisms with biochemistry, genetics and microbiology (Cox et al., 2012; Michal and Schomburg, 2012; Alberts et al., 2013b).

Neuroscience: Study of the nervous system and human brain to understand the fundamental and emergent properties of neurons and neural circuits (Hudspeth et al., 2013; Ogawa and Oka, 2013).

Paleontology: Study of prehistoric organisms, their evolution, interactions with each other and natural environment in formergeologic periods as based on fossils (Turner, 2011; Louys, 2012).

Physiology: Study of the functioning of living organisms and the organs and parts of living organisms from the basis of cell function at the ionic and molecular level to the integrated behavior of the whole body and the influence of the external environment (Raff et al., 2014; Hall, 2016).

Population biology: Study of groups of conspecific organisms that how they interact with their environment. It is an application of mathematical models to population genetics, community ecology, and population dynamics (Hastings, 2013; Thieme, 2018).

Quantum biology: Study of quantum mechanics and theoretical chemistry in organisms (Brookes, 2017; Waring, 2018).

Structural biology: Study of molecular biology, biochemistry, and biophysics concerned with the molecular structure of biological macro-molecules (especially proteins and nucleic acids at a molecular level) which are essential for all life forms. How they acquire their structures and how alterations in their structures affect their functions Karplus and McCammon, 2002; Liljas et al., 2009).

Synthetic biology: Study of creating new biological parts, devices and systems. Design and construction of new biological entities such as enzymes, genetic circuits and cells, or the redesign of existing biological systems that are already found in nature (Keasling, 2012; Bueso and Tangney, 2017; El Karoui et al., 2019).

Systems biology: Study of the relationships between various components within a biological system, using computational and mathematical analysis with particular focus upon the role of cell-signaling strategies and metabolic pathways in physiology. (Breitling, 2010; Saetzler et al., 2011; Tavassoly and Iyengar, 2018).

Theoretical biology: Study of using abstractions and mathematical models to understand biological phenomena of the living organisms, their structure, development and behavior of the systems, as opposed to experimental biology (Hogeweg, 2011; Krakauer et al., 2011; Longo and Soto, 2016).

Toxicology: Study of the nature, effects, and detection of poisons chemical substances on living organisms (Hodgson, 2010; Smart and Hodgson, 2018).

Virology: Study of viruses, which are submicroscopic, parasitic particles of genetic material contained in a protein coat, their characteristics, classification, and the relationship with their respective hosts, and virus-like agents (Cann, 2001; Carter et al., 2007).

As seen, all these above life science branches are primarily related with biology. The below ones are consisted of some other sciences, especially engineering, medicine, pharmacology, food and agriculture. Here are some samples of applied life science branches and related concepts.

3.2. Applied life science branches and related concepts

Biocomputers: Process of building computers that use the information of biologically developed molecules (DNA, RNA and proteins) to perform computational analysis involving data storage, retrieving, and data processing (Ausländer et al., 2012; Kuo et al., 2017; Lin et al., 2018).

Biocontrol: A method of controlling pests such as insects, mites, weeds and plant diseases using other living organisms. It is also called as biological control (Flint and Dreistadt, 1998; Follett and Duan, 2012; Bhargava et al., 2020).

Bioengineering: Application of principles of biology with an emphasis on applied knowledge and the tools of engineering to generate functional, palpable and economically feasible products. It is also called as biological engineering (Pasotti and Zucca, 2014; Wintle et al., 2017; Goyal, 2018).

Bioelectronics: Study of electrical state of biological matter that significantly affects its structure and function, like membrane potential, signal transduction, isoelectric point etc (Rivnay et al., 2014; Birkholz et al., 2016).

Biomaterials: Any matter, surface, substance or construct to interact with biological systems. Biomaterials can be found and/or derived in nature and can be synthesized for different purposes in bioengineering (Williams, 1987; Vert et al., 2012; Habibovic and Barralet, 2011; Ratner and Castner, 2020).

Biomedical science: A set of scientific disciplines applying the rules of natural science and/or formal science, to develop knowledge, inventions, or technology that are being used in healthcare or public health from cells to organs and systems in the human body (Marshall and Williams, 2002; Bernstam et al., 2010; Subbiah et al., 2010).

Biomonitoring: Measurement of the body burden of elements or compounds having toxic effects, or the metabolites, in various biological materials such as hair, nails, saliva, urine, meconium, faeces, semen, blood, breast milk, teeth and bones (in human/animal) and root, shoot, ring, bark, branch, leaf and flower (in plant) (Angerer et al., 2007; Akguc et al., 2008; Yasar and Ozyigit, 2009; Yener and Yarci, 2010).

Biopolymers: They are natural polymers produced by living organisms such as polynucleotides (RNA and DNA), polypeptides (collagen, actin, and fibrin, etc.) and polysaccharides (starch, cellulose and alginate, etc.) it can also be said that they are polymeric biomolecules, which derived from cellular or extracellular matter (Mohanty et al., 2005; Kumar et al., 2007).

Conservation biology: Protecting and restoring the Earth's biodiversity with the aim of protecting species, their habitats, and ecosystems for the intrinsic value of these systems Morris and Doak, 2002; Hunter and Gibbs, 2006; Berger-Tal and Lahoz-Monfort, 2018).

Fermentation technology: Study of use of microorganisms for industrial fabrication of commercial products like antibiotics, amino acids, vitamins, beer, wine, etc by using fermentation, which is a metabolic process that produces chemical changes in organic substrates through the action of enzymes (Hui and Evranuz, 2015; Choudhary et al., 2018; Joshi et al., 2018).

Genomics: Application of recombinant DNA, DNA sequencing methods, and bioinformatics to sequence, assemble, and analyze the function and structure, evolution, mapping, and editing of genomes (Xia, 2013; Pevsner, 2015; Chakravorty et al., 2018).

Kinesiology: The scientific study of human or non-human body movement and its mechanics and how they impact on health and wellbeing. It scrutinizes the dynamic principles of physiology and biomechanics, and mechanisms of their action (Gall et al., 2008; Twietmeyer, 2012).

Metabolomics: The comprehensive analysis of metabolites, which can collectively be referred to as the metabolome in a biological specimen (Clish, 2015; Liu and Locasale, 2017).

Optogenetics: A special neuromodulation technique in neuroscience which uses the principles and techniques of both optics and genetics to control and monitor the activities of individual neurons in living tissue (Eugenin et al., 2006; Deisseroth, 2011).

Pharmacogenomics: It is the study of the drug-genome interactions and the role of the genome in drug response. On the other hand, it is a technology that analyses how genomic variation affects an individual's response to drugs (Johnson, 2003; Wang, 2010).

Population dynamics: It is the study of size and age composition of populations in both short- and long-term, and the biological and environmental factors involved in their maintenance, decline, or expansion such as birth and death rates, immigration and emigration (Saccheri and Hanski, 2006; Leigh and Van Emden, 2017; Wade, 2018).

Proteomics: It is the large-scale study of proteins, which are the vital parts of living organisms, particularly their structures and functions (Anderson and Anderson, 1998; Blackstock and Weir, 1999; McArdle and Menikou, 2020).

Transcriptomics: Study of an organism's transcriptome, the sum of all of its RNA, the set of all RNA transcripts, including coding and non-coding (Schirmer et al., 2010; Chambers et al., 2019).

New discoveries in life sciences help people to improve their quality of life standards. In addition to biology, life sciences have applications in some agriculture, engineering, human and animal health/medicine, pharmaceutical and food science and industries. Some examples about these scientific fields are given below.

3.3. Agricultural sciences-related life sciences and related concepts

They are mainly, agricultural engineering, agricultural education, agricultural chemistry, agricultural economics, agricultural communication, agricultural policy, agricultural philosophy, agronomy, horticulture, agricultural soil science and agroecology. Some selected ones are given below.

Agricultural engineering: This study area covers from agricultural machinery to food engineering, from farming equipment to bioprocess engineering and the management of natural resources (Field and Long, 2018; Heldman et al., 2018)

Agricultural policy: This study area covers agricultural economics and agricultural engineering, agrophysics, animal science including animal breeding/animal nutrition/fisheries science/poultry science, aquaculture, biological engineering (genetic engineering/microbiology), environmental science (conservation/resources management/wildlife management) and food science (human nutrition/food technology) (Allen and Singh, 2016; Kovács, 2018; Browman et al., 2019; Baldi et al., 2020).

Agricultural production: Cash crop and agricultural products (food, natural fibers, lumber, paper, medicine and biofuels) (Poltronieri and D'Urso, 2016; Elevitch et al., 2018; Kamani et al., 2019; Kuma et al., 2019; Shogren et al., 2019).

Agricultural soil science: This study area covers agrogeology, agrology, land degradation and improvement, soil chemistry (soil amendment/soil erosion/soil life/soil type/soils retrogression) (Pimentel et al., 1987; Bai et al., 2008; Calzolari, 2013).

Agroecology: This study area covers problems of agroecosystem and analysis of agrophysics, biodiversity, climate change and agricultural adaptation, composting, valuation of ecosystems and environmental economics, green manure, recycling, soil science, valuation of natural resources and wildculture (Thomas and Kevan, 1993; Oteros-Rozas et al., 2014; Snapp and Pound, 2017; Mirsayapov et al., 2019).

Agronomy: This study area covers plant science (crop science/forestry/plant pathology/wood science), horticulture, plant breeding, theoretical production ecology and the correct use of fertilizers (Narwal et al., 2000; Hansen et al., 2007; Bhargava and Srivastava, 2019).

Farming: Aquaculture, mariculture, organic farming, alligator farming, dairy farming, pig farming, poultry farming, sheep husbandry, sericulture and viticulture (Hermansen et al., 2004; Nickum et al., 2018; Oyinlola, 2019; Raju et al., 2020; Squire, 2020).

Farming methods and practices: Aeroponics, aquaponics, artificial selection, field day, grazing, hydroponics, intercropping, irrigation, permaculture, pollination management, and sustainable agriculture (Daimon, 2002; Krebs and Bach, 2018; Martin-Guay et al., 2018; Randall and Smith, 2019).

Forestry: Agroforestry, analog forestry, forest gardening and forest farming (Michon and de Foresta, 1998; Senanayake, 2000; Elevitch et al., 2018).

3.4. Engineering sciences-related life sciences and related concepts

Agricultural engineering: Although most of the disciplines are covered by the agricultural science, engineering technology makes different agricultural engineering. Its subdisciplines and related concepts are; aquaculture engineering, biomechanical engineering, bioprocess engineering, biotechnical engineering, ecological engineering (ecosystem engineering), food engineering, forest engineering, health and safety engineering, information and electrical systems engineering, natural resources engineering and machinery systems engineering (Michon and de Foresta, 1998; Fescemyer and Smith, 2006; Ferreira and Van Loggerenberg, 2011; Gholamrezai and Bahadori, 2013; Browman, et al., 2019; Mirsayapov et al., 2019).

Biological engineering: Subdisciplines and related concepts cover bioacoustics, biochemical engineering, biomedical engineering, biomolecular engineering, bioresource engineering, bioprocess engineering, biosystems engineering, biotechnical engineering, cellular engineering, genetic engineering, food and biological process engineering, health and safety engineering, microbiological engineering, molecular engineering, protein engineering, systems biology, synthetic biology (Dooley, 2003; Johnson and Schreuders, 2003; Ferentinos, 2005; Heldman and Moraru, 2010; Goyal, 2018).

Biomedical engineering: Bioinstrumentation, bioinformatics, biomechanics, biomaterial, biomedical optics, biosignal processing, biotechnology, clinical engineering, medical imaging, neural engineering, and pharmaceutical engineering and tissue engineering (Bronzino, 2000; Saltzman, 2009; Enderle and Bronzino, 2012; Bronzino and Peterson, 2014).

Biomolecular engineering: Genetic engineering (of whole genes and genomes), biomolecular/biochemical engineering, DNA, RNA and protein engineering (related to genetic engineering) (Ryu and Nam, 2000; He et al., 2006; Rees et al., 2017).

Environmental engineering: Ecological engineering, sanitary engineering, wastewater engineering (blackwater, greywater and irrigation water) and municipal/urban engineering (Aitken et al., 2004; Abiko, 2010; Allen et al., 2010).

3.5. Medical sciences-related life sciences and related concepts

Basic medical sciences: Anatomy, biochemistry, biomechanics, biophysics, biostatistics, cytology, embryology, endocrinology, epidemiology, genetics, histology, immunology, medical physics, microbiology, molecular biology, neuroscience, nutrition science, pathology, pharmacology, photobiology, physiology, radiobiology and toxicology (Stetten, 1964; Easterbrook, 2005; Laake and Benestad, 2015; Ozturk and Gencturk 2018).

Diagnostic medical sciences: Clinical laboratory sciences (transfusion medicine, cellular pathology, clinical chemistry, hematology, clinical microbiology and clinical immunology), pathology, diagnostic radiology, nuclear medicine and clinical neurophysiology (Culling et al., 2014; Murphy et al., 2017; Ozturk and Gencturk, 2018; Marshall et al., 2020).

Interdisciplinary medical fields: Aerospace medicine, addiction medicine, biomedical engineering, pharmacology, conservation medicine, diving or hyperbaric medicine, disaster medicine, evolutionary medicine, forensic medicine, gender-based medicine, hospice and palliative medicine, hospital medicine, laser medicine, medical ethics and medical humanities, health informatics, nosology, nosokinetics, occupational medicine, pain management (pain medicine/algiatry), pharmacogenomics, podiatric medicine, sexual medicine, sports medicine, therapeutics, travel medicine, tropical medicine, urgent care, veterinary medicine and wilderness medicine (Payne-James et al., 2003; Daszak et al., 2004; Eddleston et al., 2005; Hüttmann et al., 2005; Davis et al., 2008; Porst and Buvat, 2008; Quest et al., 2009; Ries et al., 2009; Doukas et al., 2012; Kumar and Gandhimathi, 2012; Kumar and Sivakumar, 2012; Oriani et al., 2012; Kling et al., 2016; Auerbach et al., 2018).

Internal medical sciences: Angiology/vascular medicine, cardiology, critical care medicine, endocrinology, gastroenterology, geriatrics, hematology, hepatology, infectious disease, nephrology, neurology, oncology, pediatrics, pulmonology/pneumology/respirology/chest medicine, rheumatology and sports medicine (Kumar and Gandhimathi, 2012; Ficalora and Mueller, 2013; Ozturk and Gencturk, 2018; Abdi and Bektas, 2019).

Surgical medical sciences: General surgery, breast surgery, eye surgery, cardiovascular surgery, colorectal surgery, cosmetic surgery, dermatologic surgery, gynecologic surgery, hand surgery, neurosurgery, oral and maxillofacial surgery, oncologic surgery, ophthalmic surgery, oral and maxillofacial surgery, orthopedic surgery, otolaryngology, plastic surgery, podiatric surgery, skull-base surgery, transplant surgery, trauma surgery, urologic surgery, vascular surgery and pediatric surgery (Stegman and Tromovitch, 1982; Trokel et al., 1983; Lundborg, 2000; Sullivan, 2001; Grillo, 2004; Lanfranco et al., 2004; O'Malley and Weinstein, 2007; Vitug and Newman, 2007; Shaw et al., 2010; Kumar and Gandhimathi, 2012; Mulholland et al., 2012; Lawrence et al., 2013; Ozturk and Gencturk, 2018). Methodologically, endoscopic surgery, laparoscopic surgery, laser surgery and robotic surgery etc. (Hüttmann et al., 2005; Nezhat et al., 2006; Schleef, 2008).

Other major medical sciences: Anesthesiology (anesthetics), dermatology, emergency medicine, family medicine, obstetrics and gynecology (Obs and Gynae), medical genetics, neurology, ophthalmology, pediatrics, pharmaceutical medicine, physical medicine and rehabilitation (physiatry), podiatric medicine and psychiatry (Stegman and Tromovitch, 1982; Nezhat et al., 2006; Kumar and Gandhimathi, 2012; Turnpenny and Ellard, 2016; Cuccurullo, 2019; Rogers and Stavosky, 2019).

3.6. Other sciences-related life sciences and related concepts

Food sciences: Food chemistry and food engineering, food microbiology, food technology, molecular gastronomy, quality control and sensory analysis (Carpenter et al., 2012; Burke et al., 2016; Carr, 2017; Gillibert et al., 2018; Heldman et al., 2018; Laganà and Avventuroso, 2018).

Forestry sciences: Aesthetically appealing landscapes, biodiversity management, employment, erosion control and forest replanting, fuel wood, landscape and community protection, natural water quality management, recreation, timber provision, watershed management and wildlife habitat (Pimentel et al., 1987; Sim and Nykvist, 1991; Thorne and Huang, 1991; Umans, 1993; Cude, 2001; Hillring, 2006; Khatun, 2011; Browman et al., 2019; Randall and Smith, 2019).

Pharmacy: Pharmaceutics (pharmaceutical formulation, pharmaceutical manufacturing, dispensing pharmacy, physical pharmacy), medicinal chemistry, pharmacognosy, pharmacy practice (clinical interventions, pharmaceutical care, communication skills and patient care) and pharmacology (Lachman et al., 1986; Remington, 2006; Bond and Raehl, 2007; Holdford and Brown, 2010; Shiksha, 2020).

Veterinary sciences: Anesthesia, animal welfare, behavior, dentistry, dermatology, emergency and critical care, internal medicine (cardiology, neurology, oncology), laboratory animal medicine, microbiology, nutrition, ophthalmology, pathology, pharmacology, poultry veterinarians, preventive medicine, radiology, sports medicine and rehabilitation, surgery (orthopedics, soft tissue surgery), theriogenology, toxicology, veterinary practitioners (avian practice, equine practice, beef cattle practice, feline practice, canine/feline practice, exotic companion mammal practice, food animal practice, dairy practice, reptile and amphibian practice and swine health management) and zoological medicine (Singh et al., 2006; Lawhead and Baker, 2016; Ettinger et al., 2017; Studdert et al., 2020; Veterinary, 2020).

4. Future Perspective

All authorities consider biology as the center of life sciences and being as the science of the future. Today, new inventions in biological sciences are mostly being implemented through biotechnology and genetic engineering applications. Biological sciences exploit the developments in technological applications in terms of trying to solve problems related with many fields including health, environment, animal husbandry, food and agriculture. As known, life sciences are mostly related with biological sciences and study "life" in all its forms, past and present. The study of every living entity in the universe is a complicated task. Of course, the branches of life sciences were being limited as the result of low level and slow scientific developments in the past. As advancements in science increasingly becomes more complex in the past 20 years, the interdisciplinary research involving researchers from multiple academic disciplines is quickly adopted as the rule rather than the exception. Interdisciplinary researches provide opportunities for synthesis of ideas and the synthesis of peculiarities from many disciplines. As well, it addresses researchers' individual differences and helps to develop important, transferable skills. For instance, geneticists use the techniques from the fields of molecular biology and chemistry, chemists use information from molecular biology and genetics, plant pathologists have to be equipped with knowledge on molecular biology to study disease resistance. For these reasons, hundreds of new disciplines will be created in the next ten years in life sciences; thus, new scientific studies and inventions will be multiplied.

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