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Integrating Lessons from the Qur'an and *Ḥadīth* in Teaching Molecular Biology

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Abstract
The integration of the teachings of Islam in many fields of studies such as physics, chemistry, mathematics, engineering, and molecular biology is perceived by many to be easier said than done. However, it is necessary to caution that taking teachings from Islamic guidelines and integrating them to the context of scientific evidence or vice versa poses inherent threats of inconsistency and inaccuracy. The number of verses in the Qur'an and the number of authentic narrations of *hadith* are restricted; however, the interpretations and the subsequent understanding of those are diverse. Hence, it is not unlikely that understanding of one aspect or issue by one individual may differ from the understanding of the same issue by another. Furthermore, the wisdom of Allah (*s.w.t*), the All Knower who revealed the Qur'an to mankind is absolute compared to the limited human knowledge the basis of most of the scientific theories. At the same time, difference of opinions or controversies among different groups of scientists also exists in explaining a theory of a scientific observation or its application. Therefore, under no circumstances should such integration be aimed at validating or promoting the teachings from Qur'an and *ḥadīth* using scientific theories. This paper highlights few possible ways to integrate lessons from Islam while teaching Molecular Biology. However, it is hoped that the paper would open new ideas to integrate lessons from Islam with course/topic of interests. The focus of the field of molecular biology includes structure function and mechanisms of actions of macromolecules or biomolecules such as proteins, carbohydrates, lipids and nucleic acids (DNA and RNA) found in living things. Relating an understanding of certain verses from the Qur'an and teachings from *hadith* this paper addresses the issues on (i) isomeric preference in structure of biomolecules (ii) application of molecular biology for genetic modification of animals and plants (iii) application of molecular biology as therapeutic interventions and (iv) use of molecular biology in manipulating living processes and/or to create life.

Keywords: Gene technology, biomolecule structure, genetic modified food

Abstrak
Usaha menyatukan pengajaran Islam dalam pelbagai bidang pengajian seperti fizik, kimia, matematik, kejuruteraan dan biologi molekul didapati tidak semudah yang disangka. Namun demikian, harus diingatkan bahawa percubaan mengambil hidayat daripada pengajaran Islam dan menyatukannya dalam konteks bukti saintifik atau sebaliknya menimbulkan masalah tidak konsisten dan tidak tepat. Jumlah ayat-ayat dalam Qur'ān dan pengisahan dalam *ḥadīth* adalah terhad. Sebaliknya, tafsiran dan kemudian pemahaman yang diperoleh adalah pelbagai. Jadi, adalah tidak mustahil berlakunya pemahaman satu aspek atau isu oleh seseorang akan berlainan daripada orang lain. Tambahan lagi, kebijaksanaan Allah (*s.w.t*), yang Maha Mengetahui menyampaikan Al-Qur'ān kepada umat manusia adalah mutlak berbanding dengan pengetahuan manusia yang terhad dalam teori-teori sains. Dalam pada itu, perbezaan pendapat dan kontroversi antara satu kumpulan saintis dengan yang lain juga timbul apabila menghuraikan sesuatu teori saintifik yang berasaskan pemerhatian atau aplikasi. Justeru, adalah tidak wajar untuk menggunakan cara menyatukan kedua-dua domain ilmu yang berbeza itu untuk mengesahkan pengajaran daripada Al-Quran dan hadith dengan menggunakan teori saintifik. Kertas ini menggariskan beberapa cara yang mungkin dapat digunakan untuk menggabungkan pengajaran daripada Islam dalam pengajaran Biologi Molekul. Namun, diharapkan kertas ini dapat menjana idea baharu untuk menggabungkan

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pengajaran daripada Islam dengan kursus atau topik lain yang diminati. Fokus dalam bidang biologi molekul ini termasuk fungsi struktur dan tindakan mekanisme makromolekul atau biomolekul seperti protein, karbohidrat, lipid dan asid nukleik (DNA dan RNA) yang ada dalam hidupan. Berdasarkan pemahaman pada ayat-ayat suci tertentu daripada Al-Quran dan hadith, kertas ini akan menangani isu i) keutamaan isometrik dalam struktur biomolekul ii) aplikasi biologi molekul dalam modifikasi genetik pada haiwan dan tumbuh-tumbuhan (iii) aplikasi biologi molekul sebagai terapi intervensi dan (iv) menggunakan biologi molekul untuk memanipulasi proses kehidupan dan/atau mencipta hidupan.

Kata kunci: teknologi gen, mencipta kehidupan, struktur biomolekul, makanan ubah suai genetik

Introduction

Given the philosophy of the International Islamic University Malaysia (IIUM), the integration of lessons from Qur'an and *ḥadīth* as a component of the curriculum for courses offered in different Kulliyyahs (faculties) and/or Institutes is integral. Integrating moral and ethical values rooted in Islam with any program or course offered is neither difficult nor complicated. And looking at the current predicament of the moral and ethical standard *en masse* makes that integration indispensable. Therefore, educating students from any field of studies (for example, physics, chemistry, marketing, law, branches of engineering, biochemistry, molecular biology or business administration) to uphold the integrity, honesty, justice, and impartiality in professional dealings should be endorsed by any means possible.

However, the integration of the teachings of Islam as a core component of the course content in many fields of studies such as physics, chemistry, mathematics, engineering, biochemistry and molecular biology is perceived by many to be easier said than done. One of the important reasons is perhaps due to the extremely limited number (or lack) of academic texts detailing or quoting verses from the Quran and references from *ḥadīth* related to relevant topics in those fields of studies. In medicine and health sciences, it is considered easier as it has become common to see writings that integrate Qur'ānic verses and teachings from *ḥadīth*. For example, human embryonic development (Khandoker, 2006, 2007, 2009) principles of therapeutic interventions (Rahman et al., 2008), health benefits of healthy life style (Rahman and Kareem, 2007), and eating habits are some of the areas that lend themselves easily as part of the core content of related courses in the programs offered by Faculty of Medicine, Dentistry, Nursing, and Allied health sciences.

It is also necessary to caution that taking teachings from Islamic guidelines and integrating or linking them to the context of scientific evidence or vice versa poses inherent threats of inconsistency and inaccuracy. The number of verses in the Qur'an and the number of *ḥadīth* narrated and described in different books, considered authentic, are restricted; however, the interpretations and the subsequent understanding of those guidelines are diverse (manifold). Thus the understanding of the teachings from Qur'an and *ḥadīth* being applied in various aspects of life are ever expanding. Hence, it is not unlikely that the interpretation or understanding of one aspect or issue by one individual may differ from the interpretation or understanding of the same issue by another. Therefore an individual's understanding of a particular issue except the fundamental or the basic principles[i] of an Islamic teaching may not receive acceptability *en masse* be it judged right or wrong by other individual(s). This inconsistency however does not affect the universal validity of the Islamic guidelines based on Qur'an and *ḥadīth*. Furthermore, subjective differences in interpreting or understanding does not reflect any flaws in validity and correctness of an Islamic guideline rather it is the individual's limitation of inaccuracy in interpreting it.

Importantly, under no circumstances should such integration be aimed at validating or promoting the teachings from Qur'an and *ḥadīth* using scientific theories. The rationale behind this caveat is the absolute wisdom of Allah All Knower who revealed the Qur'an to mankind. Scientific theories are often based on human observations that are limited. At the same time, difference of opinions or controversies among different groups of scientists also exists in explaining a theory of a scientific observation or its application. Many scientific theories also rebound or failed to be proven due to the lack of appropriate technology to prove the hypothesis. Moreover, scientific theories and observations are often found to be inconsistent or proven wrong. Therefore, integrating lessons from Islam based on an individual's understanding founded upon wrong interpretation of it with inconsistent scientific observations and theories

would be misleading and damaging to Islam. Yet this paper has been written with the expectation to highlight possible ways to integrate lessons from Islam while teaching a course on Molecular Biology. Should there be any misinterpretation of any text or references taken from the key sources of Islamic teaching, the author seek forgiveness from Allah. However, it is hoped that this paper would open new ideas for others to integrate lessons of Islam with their course/topic of interests.

Molecular biology as an independent discipline- a combination of physical and structural chemical approaches to biology

The focus of the field of molecular biology includes structure function and mechanisms of actions of macromolecules or biomolecules such as proteins, carbohydrates, lipids and nucleic acids (DNA and RNA) found in living things. Synthesis, structure and function of biomolecules; mechanism of nuclear material (DNA) replication, mutation and expression of genes etc are the subject matter of that focus. Scientists in the earlier decades of 20th century used the term molecular biology for different reasons. Yet, what they had common is in recognizing the field of molecular biology as a combination of physical and structural chemical approaches to biology.

The importance of multidisciplinary and integrated contribution to establish the discipline of molecular biology was addressed by one of the pioneers in the field, HJ Muller who concluded: "The geneticist himself is helpless to analyse these properties further. Here the physicist, as well as the chemist, must step in. Who will volunteer to do so?" (Muller, 1936). Warren Weaver, the then director of the Natural Sciences section of the Rockefeller Foundation, introduced the term "molecular biology" in a 1938 report to the Foundation where he wrote, "And gradually there is coming into being a new branch of science-molecular biology – which is beginning to uncover many secrets concerning the ultimate units of the living cell….in which delicate modern techniques are being used to investigate ever more minute details of certain life processes (quoted in Olby 1994, p:442). Francis Crick's called himself a molecular biologist because in his words: "I myself was forced to call myself a molecular biologist because when an inquiring clergymen asked me what I did, I got tired of explaining that I was a mixture of crystallographer, biophysicist, biochemist, and geneticist, an explanation which in any case they found too hard to grasp" (quoted in Stent 1969, p. 36). Likewise, molecular biology is considered to be developed as a result of the encounter between genetics and biochemistry, two branches of biology both of which were developed at the beginning of the 20th century [Morange, 1998]."

A number of breakthrough contributions by geneticists, physicists, and structural chemists to understand the structure and function of the gene are considered to be the foundation of the field of molecular biology. Gregor Johan Mendel's law of inheritance in the early 20th century AD); discovery of the relationship between gene and chromosomes in the hereditary process using the fruit fly, Drosophila (Morgan 1926; Kohler 1994; Wimsatt 1992); recognition of the gene as a 'basis of life' (Muller, 1936); discovery of the structure of DNA (Watson and Crick, 1953); discovery of the size and nature of the gene (Carlson 1971, 1981; Crow 1992); Discovery of genetic code (Khorana, 1968) are just a few of those which were eventually converged in founding the discipline of molecular biology. In addition, Max Delbrueck and another physicist-turned-biologist Salvador Luria marked a critical point in the rise of molecular biology by using bacteriophage (virus) that attacks bacteria for survival and reproduction (Brock 1990; Cairns et al. 1966; Fischer and Lipson 1988; Fleming 1968; Luria 1984). Later Alfred Hershey and Martha Chase uncovered the chemical components of phage (virus) that enters bacteria and subsequently used for viral reproduction. Their observations confirmed that genes are not proteins but deoxyribonucleic acid (DNA) as reported earlier by Oswald Avery (Avery et al., 1944). Linus Pauling, provided theoretical understanding on the nature of the chemical bond and size of large stable biomolecules (Pauling, 1939) such as proteins and nucleic acids. Pauling provided the chemistry of weak forms of bonding, such as hydrogen bonding that plays important roles in the structures and functions of proteins and nucleic acids (Crick, 1996; Sarkar, 1998). Using X-rays bombarding of a molecule that left unique images on photographic plates due to the diffraction of the x-rays by the molecule, Pauling discovered the alpha-helical structure of proteins (Pauling and Corey, 1950; Pauling et al., 1951). Thus contributions from various fields of studies including physics, chemistry and biology have converged and eventually emerged as an independent discipline as molecular biology.

Topics in the curriculum of molecular biology

It is clear that Molecular biology as an independent discipline is relatively young, originating in the

1930s and becoming institutionalized not until 1950s. However, use of both theoretical and experimental knowledge of molecular biology is prominent in all fields of life sciences. Academicians and researchers from all branches of life science and many other fields are using knowledge of molecular biology and/or advancing (improving) the existing knowledge by adding new information, theory or technique to investigate or explore various aspects of life and living organisms. As mentioned earlier, molecular biology includes structure, function and mechanisms of actions of macromolecules or biomolecules such as proteins, carbohydrates, lipids and nucleic acids (DNA and RNA) found in living things., biosynthesis or origin, structure and function of those biomolecules; mechanism of replication, mutation and expression of genes etc. which govern life and living processes such as metabolism, growth and development, mobility and reproduction. To date research in the field of molecular biology also includes creating, inventing or re-engineering of existing biomoleucles to understand the living processes. Molecular biologists have gone as far as using simple synthetic chemical components to mimic or create natural living processes including drugs and nucleic acids. Thus it is difficult to formulate a universal scheme of classification of topics to identify various branches/aspects of either life or living processes that is covered in molecualr biology.

However, the topics covered in the curriculum of molecular biology at university level depend on: (1) the program under which the course is offered, (2) the level of students i.e., udnergraduate (1^{st}, 2^{nd}, 3^{rd} grade/year or postgraduate) and (3) emphasis and the need of the nation, such as plant (agricultural) molecular biology and clinical molecualr biology. Nonetheless, with the variation in the depth and focus, content of molecular biology course includes: (i) atomic structure (ii) (bio)chemical bonds (iii) structure and biosynthesis of biomolecules e.g. protein, carbohydrte, lipid and nucleic acid (DNA and RNA) (iv) structure, function chromosomes and genes (v) replication, expression, mutation of genes (vi) manipulation of genes i.e., gene therapy and genetic modification of plant and animal genes (vii) use of gene(s) as a tool to identify status of health, nature (genotype) of heredetary disease, pathogenecity and mechanims of pathogenesis of microorganisms causing infections and for forensic medicine (viii) bioinformatics: genomics, proteomics (ix) molecular modelling and drug discovery. This list of topics is however not exhaustive.

In the following sections some of these topics will be discussed in relation to an understanding of certain verses from the Qur'an and teachings from *ḥadīth*. The discussions might appear either convergent or divergent while comparing the understanding, as presented here, of Qur'anic verses and teachings from *ḥadīth* with the knowledge of molecular biology and its application. Nonetheless it is hoped that the discussion will provide a better understanding of integrating the Islamic teachings, the Qur'an and hadith.

Isomeric preference in structure of biomolecules

Structure of biomolecules like protein, carbohydrate, nucleic acids (DNA and RNA) is the foundation of any introductory course on molecular biology. In the following discussion structural basis of proteins is discussed in relation to incorporating Islamic faith based principles of creation. There are only 20 amino acids that act as the natural building blocks of any protein, one of the most important biomolecules, available in any form of life on earth. In nature, each amino acid except Glycine exists in two orientations, left (L) and right (R). Such structural configurations of each amino acid resemblance mirror image of each other in the same way as human hands. This property named stereoisomer is contributed to the "chirality" of the central carbon atom of the amino acid. In living organisms however, mostly L-forms of amino acids exist in most proteins. On the other hand, most of the carbohydrates exist in the biological system are in the R-configuration. Scientists including molecular biologists have been proposing diverse theories to explain such selective preference on isomeric preference.

A group of scientists lead by Ronald Breslow, Ph.D (former ACS President) said in the 235^{th} national meeting of the American Chemical Society has brought the evidence of the cosmozoic origin of preference for L- amino acid in earth's living systems. They have presented the proofs that amino acids delivered to Earth by meteorite bombardments left the left-handed protein units. Besides, a random mixture of L- and R- forms of each amino acid in protein would affect the biochemical properties of the protein enormously. "These meteorites were bringing in what I call the 'seeds of chirality," stated Breslow. Amino acids "seeds" are formed in interstellar space, possibly on asteroids as they careened through space. At the

outset, there might have equal amounts of L- and R- forms of amino acids. However, while flying through the neutron stars, light rays might have triggered the selective destruction of one form of amino acid. Notably, the stars emit circularly polarized light that are either polarized to R or L direction. [American Chemical Society (2008, April 7). Meteorites Delivered The 'Seeds' Of Earth's Left-hand Life, Experts Argue. *Science Daily*]

While other scientists pointed out that the primordial Earth environmental condition held an equal chance of forming the same amounts of each amino acid in either orientation i.e., L- or R-configuration. However, at the dawn of emergence of primitive form of life on earth more than 3 billion of years ago, all the amino acids in the proteins had the L- configuration and that continued until the evolution of the modern plants and animals available to date. To prove the preference for L configuration to be included in the primitive form of life, mixtures of both L- and R- aspartic acid were tested to demonstrate how temperature and other conditions affect its crystal formation. Under the conditions that could have existed on primitive Earth, L-aspartic acid crystals were formed easily and on a large scale [Lee and Lin, 2010].

Whether these theories and observations are considered opposing or contradictory to each other to conclude on how and why L-configured amino acids predominate in living system, it is obvious that molecular biologists may have different or even opposing observations or theories to describe one biological phenomenon. In those proposition whether or not the purpose in creation of Allah is either opposed or ignored, Muslim apprentice should not be left in dilemma in what to or not to believe in. Highlighting the related Qur'ānic verse [The Qur'ān, 23:115] stating the purpose in creation of Allah would resolve such dilemma.

Application of molecular biology for genetic modification of animals and plants

One of the most important topics in the course of molecular biology is about the current advancement in genetic modification (GM) and its application. Mostly this topic is deemed and taught as a beneficial tool that provides solution to many problems related to food and food products that a large number of developing nations are apparently suffering from. The following discussion will highlight some important facts related to the principle and application of GM technology in relation to an understanding from Qur'anic verses.

Gene technologists or molecular biologists (better known as biotechnologists) have the ability to tailor genes to produce transgenic plants/animals for specific and higher productivity of certain substances that would otherwise considered be in short (or no) supply. Genes are segments of chromosomal DNA and contain the instruction (genetic code) and information expressing biomolecules like proteins resulting in specific traits (phenotypes). Genetic material or DNA sequence when they are expressed as phenotypes use the same universal genetic codes and genetic material common for all organisms and share the same chemical properties as well. Thus the modification or transfer of the genetic material from one organism to another is easy and applies similar technology across the species. Genetically modified traits are either not available naturally or would not be achievable through natural (conventional) breeding in the organism which is genetically modified. Therefore, the concerns over GM products include: if the process is ethical or against nature; if the products possess any potential danger either to the host or to the environment; or a combination of these [Christiansen and Sandøe, 2000; Polkinghorne, 2000; Straughan, 2000]. Application of GM technology includes: increased and higher productivity of crops; improvement of the quality of food and food products; producing medicines and health related products such as vaccines; additional production of proteins, vitamins, minerals in natural sources of food; introducing genes without disorder or mutation to treat hereditary disorders. For higher productivity or better shelf life slow-ripening tomato are developed by Calgene Inc.; super salmon are produced that can grow to be sold in 18 months; better milk producing cows are generated by introducing somatotropin gene and a number of GM rice with many genetically added properties [Datta, 2004].

GM crops with higher productivity are promoted to satisfy the increasing demand for food of the increasing global population. In accordance with that, transgenic crops were planted by 8.5 million farmers in 21 countries namely, USA, Argentina, Brazil, Canada, China, Paraguay, India, Iran, Germany, France etc. The global market value of biotech crops, estimated by Cropnosis, was $5.25 billion in 2005 [James, 2005]. Ironically, waste of food causes enormous losses that otherwise could essentially solve the anticipated or calculated food shortage. For example, recovering 5% of food discards from consumer, retail, and food service in USA would represent the equivalent of a day's food

for each of 4 million people [recovered from the Environmental Protection Agency (EPA), USA; Don't throw away that food - strategies for record-setting waste reduction. Municipal Information and Analysis Branch EPA Office of Solid Waste, Washington, DC, USA, retrieved from (http://www.epa.gov/epaoswer/non-hw/reduce/food/foodmain.pdf)]. An estimated amount of over one fourth of all food produced for human consumption in US goes to waste, that ~130 pounds of food per person ending up in landfills costing an annual value of this excess food at around $31 billion. Roughly 49 million people could have been fed by those lost resources [Economic Research Service, USDA 1997]. Notably, that amount is over five times more than the market of GM crops.

GM food is also promoted as a solution to health related problems. For instance vitamin A enriched rice (better known as golden rice) was produced to help the problem of nigh blindness among the developing countries. However, since the physiological systems maintain a constant balance within a specified range both quantitatively and qualitatively for enzyme, hormone, vitamin, mineral and electrolyte, deviation from that range can be harmful. Thus vitamin A enriched GM rice may cause *hypervitaminosis* for those who eat rice in their regular meal in large quantities such as in many developing Asian and African countries. Notably several pathological conditions are reported linked to hypervitaminosis such as Hypercalcemia [Bhalla et al., 2005], liver disease [Castano, 2006; Cheruvattath et al., 2006] and osteoporosis [Penniston and Tanumihardjo, 2006].

Therefore, whatever purpose(s) is/are used by the group of biotechnologist to promote GM technology and its application such as for improved quantity and quality, the GM food and food products are not balanced in composition of nutrient elements and if we can stop or at least minimize food waste, there is no need to depend on so called highly productive GM crops. Notably, wasteful behaviour is considered as act of Satan in Islam. Furthermore, acceptability of this induced imbalance can be a major concern from an Islamic perspective. It is obvious that Allah has created everything in measured proportion as mentioned in many verses in the Qur'an. To quote just a few, "And the earth We spread out, and placed therein firm mountains, and caused to grow therein all kinds of things in due proportion" [The Qur'an, 15:19]; "He has created everything, and has measured it exactly according to its due measurements" [The Qur'an, 25:2]; "Verily, all things have We created in proportion and measure [The Qur'an, 54:49]. *All things* or *everything*, as mentioned in the quoted verses, essentially include man who himself is an epitome of measured proportion. Qur'an clearly declares this: "O man! what has made you careless concerning your Lord, the Most Generous? Who created you, fashioned you perfectly, and gave you due proportion"[The Qur'an, 82:6-7]. The Balance that Allah has set up [The Qur'an, 55:7] is connected figuratively with the heavens and sustained by mathematical balance [Ali, 1992]. Allah requires man, His supreme creation, not to act contrary to the balance; as He says: "In order that you may not transgress (due) balance. And observe the weight with equity and do not make the balance deficient" [The Qur'an, 55:8-9]. Thus, man is entrusted with the responsibility of keeping balance in his conduct in every sphere of his life. The above discussion on GM food exemplifies the limitation of the technology and can be considered to be added when such topic is introduced according to the curriculum.

Application of molecular biology as therapeutic interventions

Modern medicine has been proven to be effective in prevention and cure of many diseases. Among the major tools of modern medicine, vaccine development, gene therapy and use of stem cell involves molecular biological technique. These tools of modern therapeutic interventions are also acclaimed to be the basis of the future for healthy human society. It has already been reported that vaccination can reduce mortality due to infectious diseases [de Quadros, 2006; Kimman and Boot, 2006; Vitek 2006]. Further, gene therapists can eliminate specific diseases using this therapeutic technology [Hayafune et al., 2006; Ruifa, 2006]. Thus, confidence in these technologies is very high and unbound. However, from the Islamic point of view, acceptance of the medicines for the purpose of healing would be permitted for those who take the medicines merely as an addition, not as a substitution, while having confidence in the blessings of Allah not on the medicine for the ultimate healing. In other words, the purpose of using medicines should not conflict with the authority of Allah by giving sole credit to the effectiveness of the medicine.

Indeed Allah has not sent down any disease without its cure, except ageing and death as narrated in several *ḥadīth*

"Allah did not send down any disease without sending down its cure."

(Narrated by Abu Hurayrah, Sahih al-Bukhari. *Kitāb al-Ṭibb, ḥadīth* no.395)

"Allah has sent down the disease and the cure and for every disease there is a cure. So take medicine but do not use anything haram (unlawful) as medicine."

(Narrated by Abu l-Darda, Sunan Abi Dawud. *Kitāb al-ṭibb* (The book of medicine), *ḥadīth* no. 3376.).

Both these *ḥadīth* are available in Mawsūʿat al-*ḥadīth al-sharīf*, CD-Rom, Sakhr Software 2nd edition. 1993.]. Therefore, we can surely hope to find the treatment or the means of therapy of any disease we may encounter. Furthermore, the Prophet has prescribed different forms of medicine (material form, e.g. honey and psychological or spiritual, e.g. prayer) or followed suggestions of physicians for treatment. This approach not only ensures the availability of the cure for any form of disease but also justifies the search for the necessary cure.

Nonetheless, the sole responsibility of a medicine for the cure of a disease is denied in Islamic guidelines. This is clearly stated in a verse from the Qur'an:

"And when I am ill, it is He who cures me"

[The Qur'ān, 26: 80]

Therefore, no disease can be cured without the kindness and approval of Allah the Most Merciful. Even with the proper application of the proven practices of treatment, the ultimate cure comes only after His approval. The curing effect of a medicine, if it is there, is given by Allah. Thus, medical treatment, even if recommended or compulsory in certain cases, cannot be considered as the cause of healing. Rather, it is a means that may lead to the appropriate result with the permission of Allah. This approach is in line with the basic Islamic creed that Allah is the Creator of everything existing, the Master over cause and effect. In the Qur`an, Allah says:

"*We send down (stage by stage) of the Qur`an that which is a healing and mercy to those who believe*"

[The Qur'ān, 17: 82]

From this understanding, relating cause of a disease at genetic level and finding its cure solely using gene technology without denying (or ignoring) the spiritual confidence on the will and power of Alalh should be reviewed and incorporated as a part of the curriculum whenever the related topics are introduced.

Use of molecular biology in manipulating living processes and/or to create life

Origin of life and molecular basis of living processes are integral contents of a course on molecular biology. Related to origin of life and evolution of diversity in living organisms and living processes, theory of Darwin has provoked debates from all quarters of the intellectual society. However, among the most debatable and unresolved issues in the field of science, the question of how life was created has been at the top of the list. Scientists across disciplines proposed various hypotheses and/or theories to answer this age old questions. In the field of molecular biology an affirmative answer to that question is based on: (i) the birth of Dolly-the cloned sheep (ii) *in vitro* development of tissues and organs such as liver, skin and bones from stem cells (iii) test tube babies, and (iv) most recently, the bacteria that has been created in the laboratory. Indeed these discoveries were made possible because of the knowledge of molecular biology. Whether these achievements prove human ability to create life or at the least, human being is on the way to create life will remain inconclusive because of the individual differences in understanding of what is life. However, molecular biologist address the issue of life by comparing living and non-living organisms based on the molecular basis of living processes.

At the macroscopic level, living organism differs from a non-living entity because of their ability to grow, respire, move, and reproduce. However, not all living organisms share these abilities in the same manner. For example, animals and trees move in different ways. Bacterial mode of reproduction (binary fission, one cell divides into two) is different in plants and in animals. In animals it generally requires sexual conjugation. At the cellular level, living organisms differ from each other in structure and content of the cellular material. For example, bacterial chromosome (DNA) is not surrounded by any membrane while

human chromosomes are; again plant cell wall structures are more complicated than that of human cells. At the genetic (molecular) level, differences in DNA sequence are not only observed at species or genus but also at the individual level within the same species. Beyond the cellular or molecular structures, all living and non-living entities are composed of elements like carbon, oxygen, hydrogen, nitrogen, iron, and silicon. But the composition differs only in type of elements and their ratio. For example, rocks have more silicon while the human cells have more carbon and hydrogen. At the atomic level these elements are composition of the same electron, proton, neutron etc. What it means is that all living and non-living entities have nothing but the same electron, proton and neutron. Therefore, the distinguishing features among living and/or between living and non-living entities are relative to what is observed or perceived and it is dependent on the tools used for the observation. For instance when the microscope was used, differences were identified at the cellular level but with the discovery of molecular biological techniques such as DNA sequencing, differences are identified at the molecular or DNA level.

Differences between living and nonliving organisms exist not only in the living process but also in the process of death and decay. Not all living organisms die in the same manner. The dying process of a bacterium and that of a human being is not the same. The life cycle of a bacterium does not end with death as at the end of the generation time[ii] one bacterium becomes two. After each division or cycle of multiplication or reproduction, the daughter (new) bacterial cells may appear the same as the parent cell. However, the life cycle of human being ends with death and after each cycle of reproduction both parents and off springs continue their unique existence. If optimum environmental conditions (i.e., fresh air, nutrient etc. are provided) a dying bacterial culture may start growing and multiplying while this will not happen with a dying human being. Furthermore, a bacterium or an isolated cell from a dead or living body does not have any life expectancy, while the whole organism i.e., human being or even plants have a certain life span. However, unlike the bacterial cells which may not face death as long as the optimum condition is provided, an isolated cell from the human body may die after a few or more cycles of multiplication because of telomere shortening or other related phenomenon. Ironically, when a living being is declared dead, still the organs and cells of the dead body can be placed into a new living host where they may function as usual. Besides, a single cell or genetic material of the cells can be manipulated to create new tissues, organs or even new organisms. Thus, with the use of molecular biological techniques such as cloning, and artificial synthesis of DNA, living organisms (or life?) could be recreated from what is declared dead.

When such topic is introduced in a course of molecular biology it is essential to discuss the related text and evidence on creation of life or living in Qur'an and *ḥadīth*. To exemplify, it suffices to mention here the verses from the holy Qur'ān that describe human embryonic development. As described, at certain stage of development in the womb, Allah gives the command to give life (*Ruh*)[iii] in the lump developed from the leech like clot [the Qur'ān, 80:17-19, 76:2, 96:2]. If the command is considered as '*ruh*' or soul, then it might be the basis of life of his living creation. Allah has created *Jinns* and Angels who have the ability to perform duties (*ibadah*) like human beings; however, whether they possess other living processes like metabolism, growth and reproduction it is not revealed. Other evidence available in Qur'an and *hadith* related to the creation of life are as follows: (i) Prophet Moses converted a wooden stick to a snake to challenge the apparently similar act of the magicians [the Qur'ān, 20:17, 68-70] (ii) Prophet Īsā (Jesus) brought a dead to life [the Qur'ān, 3:49] (iii) Prophet Mohammad (*s.a.w*) warned that *Dajjal*, the anti-Christ, will give back life to those he would kill to demonstrate his power as God. Do these acts of returning or giving life to the dead or non-living be considered as creation of life would depend on the individual's level of faith. However, incorporating related discussion on these events and evidence along with the topic on creation of life and molecular basis of life would be of vital importance to relate the issue from faith perspective in Islam.

Conclusion

Integrating lessons from Qur'an and *ḥadīth* can help the Muslim apprentice not only to resolve any dilemma raised because of diverse or opposing theories to explain natural or biological phenomena but also to set the ethical and moral standards in deciding the extent to which scientific theories be applied to understand those phenomena. At the same time, the application of scientific principles and theories in the requirement of modern living can be framed with that lesson. This paper is

written with the expectation to highlight possible ways to integrate lessons from Islam while teaching Molecular Biology. Should there be any misinterpretation of any text or references taken from the key sources of Islamic teaching, the author seek forgiveness from Allah.

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i. Fundamental or the basic principles include: the Oneness of Allah, Prophethood and life hereafter as well as other fundamental aspects of faith such as the existence of angels, the Judgment day, the revealed books to other messengers such as Prophet Isa (AH), Prophet Moses (AH) and Prophet David (AH).

ii. Generally, generation time refers to the time required for a bacterial population to become double in number. After each cycle of multiplication (cell division) each cell give rise to two daughter cells.

iii. They ask thee concerning the Spirit. Say: "The Spirit (cometh) by command of my Lord: Of knowledge it is only a little that is communicated to you." If it were Our Will, We could take away that which We have sent thee by inspiration: Then wouldst thou find none to plead thy affair in that matter against Us. (Al Qura'n, 17: 85-86)