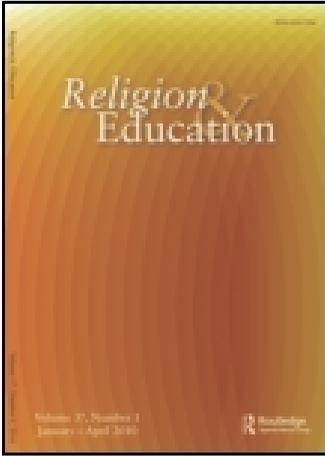


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Evolution in Biology Textbooks: A Comparative Analysis of 5 Muslim Countries

ANILA ASGHAR, SALMAN HAMEED, and
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This study seeks to explore the status and treatment of evolutionary science in secondary education in 5 Muslim countries, including Egypt, Malaysia, Syria, Turkey, and Pakistan. Evolutionary concepts, including natural selection, are presented in the curricula in all these locations. An explicit discussion of human evolution, however, is missing in these curricula. With the exception of Pakistan, though, religious references are not common in evolutionary science curricula. Pakistani biology curriculum presents scientific models and religious perspectives on the origin and evolution of life and presents interpretations of the scripture as compatible with evolutionary science. The current comparative analysis informs our growing understanding of the diversity of scientific and religious perspectives that Muslim students and teachers are exposed to in formal science education.

KEYWORDS *evolution, Islam, modern science, science education, science curricula*

Evolution education occupies a central role in science education because of the fundamental role evolutionary theory plays in unifying biology into a coherent discipline. An effective teaching of evolution, therefore, is essential

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for students to understand and appreciate the explanatory and predictive power of this underlying framework in the biological sciences.¹ Nevertheless, the teaching of evolution continues to be surrounded by social controversies in many Western societies. In the same vein, evolution is becoming a subject of public debate in Muslim societies where some Muslim intellectuals and religious scholars argue against evolution and root their theories in Islamic creationism.²

Islam, in many Muslim societies, is essentially considered a complete code of life and therefore permeates almost every aspect of the culture.³ Thus, it is not uncommon to see modern scientific principles and ideas often interpreted or validated through a religious lens. Scientific knowledge, in many instances, interacts with religious and other local meaning-making systems in a myriad of ways resulting in complex negotiations between them. These negotiations are often governed by the trust one places in different sources of knowledge, which in turn results in a model of conflict, separation, or possibly reconciliation between Islam and science.⁴

Although the impact of creationist ideas on K–12 evolution education has been well documented in Western societies, it remains a relatively uncharted and undertheorized terrain in Muslim cultures and countries. Some recent studies are beginning to shed light on the ways in which social and religious debates influence the treatment of evolution in formal science curricula in predominantly Muslim societies.

In their attempt to elucidate the impact of religion on science education in Muslim majority countries, Dagher and BouJaoude⁵ identified two influential sources: personal or popular religious perceptions and ulema's—religious leaders'—official interpretations of theological texts. Nevertheless, there has been a wide variation in both the popular and the clergy interpretations even within the same society or religious sect. Importantly, Muslim science teachers' and scientists' positions on evolution in relation to their religious beliefs determine how they enact the science curriculum in their classrooms.⁶ Further research with Muslim teachers and physicians from diverse cultures (North America, Europe, South Asia, East Asia, and Middle East) shows that a nation's religious, cultural, and educational contexts significantly shape public perceptions and responses to evolutionary science. At the same time, these studies have found a widespread rejection of evolution among students and teachers in countries with Muslim majorities.⁷

It is perhaps not too surprising that an individual's religious and cultural beliefs may interfere strongly with his/her engagement with the topic of evolution if these are perceived to be at odds with the scientific view of evolution. Contradictory theological notions and frameworks may inhibit a learner in developing a deeper understanding of biological evolution. In some instances, knowledge of evolution has been found to predict one's acceptance or rejection of the scientific model of evolution.⁸ Several scholars have attempted to illuminate the intricate relationship between teachers'

personal religious beliefs and their scientific and pedagogical knowledge.⁹ Elaborating on this sensitive relationship between religion and science, Kim and Nehm¹⁰ pointed out that evolutionary concepts might invoke considerable concerns amongst teachers because of the potential conflict with their faith. Furthermore, it is possible that the conflicting relationship between religion and science may pose difficulties in terms of accommodating evolutionary concepts within one's "cognitive culture."¹¹ Significantly, teachers' religious interpretations oftentimes influence their curricular decisions and pedagogical practices about scientific issues that intersect with religion.¹²

The rejection of evolution, in fact, is often framed in a religious context, embellished with some of the more prevalent misconceptions in the popular culture. It is therefore unsurprising that the narrative of science/biology teachers' and students' objections to evolution show that they lack a comprehensive understanding of evolution and many hold misconceptions about evolutionary theory and mechanisms.¹³ The gaps in understanding of evolution raise questions about how evolution is presented in formal education. In particular, very few studies have focused on an in-depth examination of evolution in science education curricula in Muslim majority countries.

This study examines the status and treatment of evolution in science curricula from five Muslim majority countries: Egypt, Syria, Malaysia, Pakistan, and Turkey. The Muslim world is too broad and diverse to be placed into just a few categories. A few prior studies have already highlighted the divergent ways in which evolutionary science is treated in the science curricula of Pakistan, Iran, and Saudi Arabia. For example, the Saudi Arabian textbooks are fraught with creationist ideas and objections to evolution, whereas the Iranian curriculum only discusses the scientific model of evolution.¹⁴ Pakistani textbooks, on the other hand, use Qur'anic verses to support the inclusion of evolution in biology textbooks.¹⁵

The countries included in this study provide us with a diverse array of ethnic, political, and cultural variation within the Muslim world. Two of the countries, Egypt and Syria, are currently going through tremendous changes as a result of the Arab Spring. Although Arabic is the common language, there are significant differences in the political and cultural climate of the two countries, and those differences might have an impact on how evolution is approached in biology curricula. Egypt, in particular, is an important case study, as it is not only the most populous Arab country, but it also has an enormous impact on the culture in the Middle East. In the wake of these new political and cultural realities, as well as significant developments in the scientific knowledge in the 21st century, Muslim youths are exploring the questions of "What does it mean to be a Muslim in the modern age?" In the particular case of modern science, the question can be reduced to "What does Islam have to say about the discoveries of modern cosmology and evolutionary biology?"¹⁶

The non-Arab countries in our study, Malaysia, Pakistan, and Turkey, provide us with examples of three different political set-ups and countries where science and technology has played a prominent role in the past few decades. Malaysia, for example, has a booming high-tech industry that accounts for more than half of all its exports. But unlike Pakistan and Turkey, it represents a multireligious culture, with Muslims representing approximately 60% of the population. Buddhism and Hinduism make up the other main religions. Recently, however, there has been a resurgence of Islam, with a significant debate currently taking place over the role of Islam in Malaysian identity.

Pakistan and Turkey represent two opposite ends of the political spectrum. Turkey's constitution is strongly secular, whereas Islam is enshrined in the constitution of Pakistan as well as in its name, The Islamic Republic of Pakistan. And yet, at present, there are intense debates in both countries on the role of Islam in government and in society at large. Perhaps not too surprisingly, some of these debates extend to education policies as well.

The choice of these countries, although still not comprehensive, may provide a snapshot of science education approaches in different Muslim societies. The goals for this study are guided by the following questions:

1. What are the goals of the science education curricula in relation to evolutionary biology?
2. What particular evolutionary concepts are discussed in the curriculum and textbooks?
3. What, if any, religious or cultural views are embedded in the curricula in connection with the evolutionary science concepts?

EDUCATION STRUCTURE

Education systems in Malaysia, Egypt, Syria, Turkey, and Pakistan are centrally organized and managed by their respective Ministries of Education. The respective Ministries of Education formulate the national curriculum goals, policies, and content. The primary language of instruction in Egypt and Syria is Arabic. Secondary education in Egypt and Syria includes Grades 10–12. The language of instruction in Malaysian government schools is currently Malay Bahasa, although it was decided by the government that science and mathematics would be taught in English from 2003 to 2012. The secondary education there spans 5 years (Grades 7–11), and postsecondary/pre-university preparation for local and foreign universities consists of 2 years (Form 6; Grades 12–13). The primary language of instruction in public schools in Pakistan is Urdu. Science textbooks, however, are available both in Urdu and English, depending on the medium of instruction as explained below. Secondary education in Pakistan consists of 2 years (Grades 9–10); higher secondary (pre-university) education comprises Grades 11 and 12.

The language of instruction in Turkey is Turkish, and the complete period of schooling there spans 12 years, with 4 years of secondary education.

METHODS

Our primary analysis focused on the national secondary science curricula and biology textbooks being used in government/public schools in all five countries included in the study. The curriculum materials were in Arabic (Egypt and Syria), Malay Bahasa (Malaysia), and Turkish (Turkey). These materials were translated into English by native speakers (Ph.D. candidates) with the help of science/biology and science education experts (university academics). Pakistani national science curricula and textbooks were available in English. The textbooks are produced in Urdu but are also available in English for use in English medium schools.

The content analysis methodology used by Asghar and colleagues¹⁷ and Bogdan and Biklen¹⁸ was adapted to conduct a detailed analysis of the curriculum documents and textbooks. Our purpose was to examine the ways in which evolutionary science models are conceptualized and presented in the textbooks across diverse historical, cultural, and political contexts. Content analysis was conducted to develop a coding scheme containing salient evolutionary concepts from the curricula.¹⁹ Codes were compared, revised, and refined through iterative analyses.²⁰ Inductive codes were batched into broader themes (e.g., natural selection, evolutionary mechanisms, human evolution, etc.). Similarly, any religious ideas related to evolution were identified and coded. First we compared the official policies and goals for national education developed by the Ministries of Education from all countries.

Next we attended to the evolutionary concepts covered in the curricula. A template was developed containing the main themes and examples related to evolutionary concepts for each country. Then we compared the templates from all curricula to compare and contrast patterns across countries by creating display matrices and thematic summaries. Identifying any religious or cultural ideas embedded in these texts and the ways in which they were connected to the scientific concepts was also an important consideration during the analysis process. Concept maps were used to examine connections between the religious ideas and evolutionary concepts as presented in these curricula and textbooks.²¹ Discussions among the research team members helped in looking at the data from multiple perspectives and developing alternative interpretations of the trends emerging from country specific and comparative analyses.

FINDINGS AND DISCUSSION

The countries included in the study have unique histories, cultures, and sociopolitical systems. Although a discussion of these differences is beyond

the scope of this article, we hope to examine and illustrate how various cultural and political influences may have shaped the treatment of evolutionary concepts in these curricula. Indeed, our data uncovered several important trends in the way evolutionary concepts are presented. Before we highlight the findings, we want to emphasize that, in this study, we do not intend to evaluate or judge the overall quality of science curricula from these countries. Our intent in this work is to examine the coverage and treatment of biological evolution in these curricula.

Goals of Science Curricula

The generic goals of science curricula usually emphasize understanding of scientific knowledge, curiosity, and creative thinking. Furthermore, the importance of developing students' observation, analytical, and technology skills is also underscored. Indeed, the curricula goals of Syria and Turkey match these values. However, religion plays a foundational role in the goals of Malaysian and Pakistani curricula. Even in Egypt, where the science curriculum includes scientific objectives only, the preface to the Biology curriculum for Grades 9, 10, and 12 ends with this prayer, "Verily, God is the grantor of success." Table 1 presents selected objectives from these curricula.

BouJaoude and colleagues²² also present examples of science curricula from other Islamic countries, such as Oman and Saudi Arabia, where religious goals are intimately tied to science learning objectives. The presence of religious goals and prayers in the science curricula being used in several predominantly Muslim societies (Egypt, Malaysia, Oman, Pakistan, and Saudi Arabia) suggests that the study of the natural world is explicitly viewed as a study of God's creation.

TABLE 1 Selected Goals and Objectives of Science Curricula.

Country	Goals/objectives
Egypt	<ul style="list-style-type: none"> • Develop students' ability to understand science and think scientifically • Develop students' observation, analytic, and reasoning skills
Malaysia	To produce individuals who are: <ul style="list-style-type: none"> • intellectually, spiritually, emotionally and physically balanced and harmonious based on a firm belief in and devotion to God • competitive, dynamic, robust and resilient and able to master scientific knowledge
Pakistan	To enable students to: <ul style="list-style-type: none"> • Appreciate that Allah (S.W.T.³⁸) is the Creator and Sustainer of the universe • Develop an understanding of scientific/biological facts, concepts and principles
Syria	<ul style="list-style-type: none"> • Developing students' knowledge of basic science concept • Developing students' creative thinking and problem-solving skills
Turkey	<ul style="list-style-type: none"> • Teach students essentials of science and technology • Help student improve their skills in critical thinking, problem-solving, and analysis

Evolutionary Science

In Egypt, the 10th-grade biology curriculum covers evolution in detail. Because Grade 10 is compulsory for all science students in Egyptian public schools, all science students study biology and are exposed to evolution at this level. In Syria, biology is taught in Grades 10, 11, and 12 and the concept of evolution is covered in detail in the 10th-grade biology textbook. Similar to Egypt, biology is a required subject for Syrian science students in Grade 10. Other advanced evolutionary concepts are further elaborated on in Grade 12.²³

In Malaysia evolution is covered only in Form 6 Biology Curriculum (upper secondary: Grades 12–13), which prepares students to enter medical education.²⁴ The Malaysian science curriculum for compulsory middle and secondary grades does not include evolution. In Pakistan, evolution is presented in Grades 10 and 12 biology textbooks.²⁵ Although 10th-grade biology is mandatory for all science students, biology in the 12th grade is only taken by students preparing to enter medical education. In Turkey the topic of evolution is mainly discussed in detail in the general science and technology curriculum for 8th grade and some evolutionary concepts are included in the biology curriculum for Grades 9 and 12. Evolution was moved from Grade 9 to Grade 8 in 2005. Grade 8 is compulsory for all students²⁶ (see Table 2).

History of Evolutionary Science

The history of evolutionary theory is presented succinctly in the biology/science curricula of all these countries. Lamarck's theory of inheritance of acquired characteristics is explained with examples. Scientific criticism and evidence discrediting the theory are also discussed in Syrian, Malaysian, Pakistani, and Egyptian textbooks (e.g., Weismann's famous experiments with mice over several successive generations showing that acquired characteristics cannot be not inherited). Furthermore, the Egyptian biology textbook also discusses various evolutionary ideas developed by ancient Greek philosophers (Thales, Anaximander, Aristotle) and Arab Muslim thinkers, such as Ibn Rushd (1126–1198).

Darwin's Theory of Evolution

Darwin's theory and the concept of natural selection are taught in all countries. Interestingly, Alfred Russell Wallace's contribution to evolution theory is recognized prominently in the Malaysian curriculum and the theory of evolution is presented as Darwin–Wallace's Theory. This is perhaps not too surprising, as Wallace worked extensively in the Malay Archipelago, then known as the Dutch East Indies, and today covers the countries of Malaysia, Indonesia, and Singapore. Wallace's name is also mentioned in the Turkish

TABLE 2 Evolutionary Concepts Covered in Biology Curricula.

Evolutionary concepts	Country
Evolution or theory of evolution (explicitly indicated in the textbooks)	Egypt, Malaysia, Pakistan, Syria, Turkey
Historical development of evolution (Lamarckism, Darwinism, modern synthesis)s	Egypt, Malaysia, Pakistan, Syria, Turkey
Evolutionary ideas of early Greek scholars (Thales, Anaximander, Aristotle) and medieval Arab Muslim philosophers (Avicenna, Ibn Rushd, Al-Farabi) are presented	Egypt and Turkey
Inheritance of acquired characteristics (Lamarck's theory)	Egypt, Malaysia, Pakistan, Syria, Turkey
Criticism of Lamarckism is discussed	
Darwin's theory of natural selection is discussed with examples	Egypt, Malaysia, Pakistan, Syria, Turkey
Common ancestry/descent with modification	Egypt, Malaysia, Pakistan, Syria, Turkey
Micro- and macro-evolution	Turkey (these terms are mentioned and discussed explicitly) Egypt, Malaysia, Pakistan, Syria, Turkey (examples of micro and macroevolution presented in the textbooks, but the terms are not used)
Natural selection and adaptations	Egypt, Malaysia, Pakistan, Syria, Turkey
Evidence supporting evolution (paleontology, biogeography, comparative anatomy and embryology)	Egypt, Malaysia, Pakistan, Syria, Turkey
Mutations (discussed as a source of genetic variation)	Egypt, Malaysia, Pakistan, Syria, Turkey
Genetic drift	Egypt, Malaysia, Pakistan, Syria, Turkey
Human evolution	None (human evolution is implied in some examples, but the term is not mentioned explicitly) – All countries

curriculum when the theory of evolution is introduced. The concept of common descent with modification is presented in the curriculum in all countries and discussed in detail in Egyptian, Pakistani, and Syrian textbooks and elaborated on with examples. However, it is discussed only briefly in the 8th-grade Turkish textbook and comes up in relation to animal adaptations only.

Evolutionary Mechanisms

Various evolutionary mechanisms, including natural selection, genetic drift, and gene flow, are explained in Egyptian, Syrian, Malaysian, and Pakistani curricula. The Turkish textbooks also discuss natural selection with relevant examples. In addition, various mechanisms of speciation (e.g., isolation, migration) are also presented in the Malaysian, Pakistani, Syrian, and Turkish

biology curriculum. Mutations are recognized as a source of genetic variation in all curricula.

Evidence Supporting Evolution

Notably, various types of evidence supporting evolution are illuminated with examples including evidence from paleontology, geology, comparative anatomy, and comparative embryology in nearly all curricula. The Turkish curriculum mainly focuses on comparative anatomy and embryology. Further evidence across specific curricula includes structural homologies (Malaysia and Pakistan); geographical distribution of species (Syria, Egypt, and Malaysia); taxonomy (Pakistan), mimicry (Turkey), and biochemistry (Malaysia and Pakistan). The importance of an extensive fossil record in supporting evolution is illustrated in all curricula. In addition, evolutionary significance of mimicry or camouflage is also discussed in most curricula.

Human Evolution

Importantly, human evolution is not mentioned explicitly in any of the curricula we examined. Although it appears to be completely missing from the Turkish curriculum, it is implied in the Egyptian and Pakistani textbooks while discussing the various lines of evidence supporting evolution, such as comparative anatomy, embryology, homology, and vestigial structures. Although the Malaysian curriculum mentions humans in the context of artificial selection, the Syrian curriculum refers to human beings in relation to the topic of inheritance without any connection to evolution.

Special Creation

Special creation is presented as a theological idea in Egyptian and Pakistani textbooks and does not seem to be offered as a scientific alternative to evolution. Strikingly, special creation is presented as a theory that existed in the Middle Ages before the modern evolutionary explanations were developed and accepted.

Islam and Evolution

Pakistan is the only country in our study where there is an explicit discussion of the Qur'an and issues of evolution and origin of life in biology textbooks. Interestingly, the religious text is generally presented to be in support of evolutionary theory. For example, the evolutionary implication of a common ancestral origin of "all living things," including humans, is explained in light of certain Qur'anic verses, such as "We made everything from water" (The

Quran, 21:0). As it is explained in the textbooks, “According to Qur’anic verses Allah has created all the diverse living things from water.”²⁷

A close study of the above sermons reveals that all animals had common origin, but they gradually underwent changes afterwards and became different from each other. . . . It seemed that animals of today are advanced forms of the past animals who achieved this form after passing through many changes (*ibid*).

For many, the above interpretations seem to reconcile the scientific and religious perspectives about the common origin and relatedness of all living beings. Furthermore, it appears that these interpretations draw conceptual links between the Qur’anic verses and evolutionary ideas to either explicitly or implicitly support evolution. For example, the religious concept of the creation idea of life from water is compared with the scientific idea of common origin of living beings that “gradually underwent changes afterwards and became different from each other.” Further explanation suggests, “Animals of today are advanced from the past animals.” A more explicit conceptual connection between theological and scientific concepts can be found in the following excerpt from Grade 12.²⁸

It is believed that life may have begun in water especially in hot springs called hydrothermal vents. The Holy Quran also gives evidence for this event in this Holy verse: “Allah hath created every animal of water. Of them is (a kind) that goeth upon its belly and (a kind) that goeth upon two legs and (a kind) that goeth upon four. Allah createth what He will. Lo! Allah is able to do all things.” (Sura Al-Nur, Ayat 45).

The above interpretation further points out an association between the religious concept of the beginning of life in water and the evolutionary conceptions of biochemical origin of life. This particular interpretation of scripture appears to suggest that that all animals are related to each other through common ancestry as the religious view of the beginning of life in water corroborates the scientific evidence suggesting that life originated in oceans. Of note is the comparison between the interpretation of the religious text focusing on the creation of humans and the scientific idea of human evolution. Specifically, the scriptural interpretation²⁹ of the two main stages involved in human creation is linked to the common origin of living beings in water and biological relatedness between humans and other animals as “there are certain similarities between the structure of man and other animals.” The following excerpt explicates the ways in which the religious and scientific perspectives are compared.

Therefore, it seems that there were two big steps as far as the creation of man was concerned. The first step was the creation from water. The

second step was where by the first created thing on admixing with clay was transformed into more advanced being. The same can also be applied to other animals, because there are certain similarities between the structure of man and other animals. Digestive system, nervous system, circulatory system, and reproductive system are similar although dissimilar in other details.³⁰

Although there is an attempt to draw connections between the religious and biological ideas, these texts are usually kept in separate sections. Importantly, the discussion of the religious ideas is not meant to oppose evolutionary science on theological grounds.³¹

This study contributes significant insights to our growing understanding of the goals of science education curricula from various predominantly Muslim countries and cultures, particularly with respect to evolutionary science. A country's science education curriculum reflects the scientific knowledge and skills that are deemed important for that nation's citizens. Moreover, they also provide a framework for assessment and for teachers.³²

The review and analysis of the curricula in these five predominantly Muslim countries suggest that students are indeed exposed to the foundational concepts concerning evolutionary theory. The goals of science education also stress the importance of engaging students in observation and scientific thinking to understand scientific concepts. Moreover, the scientific arguments and physical evidence supporting evolution are discussed to explain why biological evolution is the accepted scientific explanation for the evolution and diversity of life. Notably, the scientists of the National Academies of Egypt, Pakistan, and Turkey are also signatories of an Inter-Academy statement confirming the validity of evolutionary theory.³³ It is important to note, however, that although evolution is featured in detail in the Malaysian optional upper secondary biology curriculum for university preparation, it is entirely missing from the mandatory secondary science education curriculum.

An interesting diversity on the use and inclusion of religion in biology curricula was observed. For example, there is no explicit mention of Islam or any Qur'anic verses in Syrian or Malaysian biology, even though religion is mentioned prominently in goals of Malaysian science curriculum.³⁴ On the other hand, Egyptian science goals do not mention religion, and yet, a Qur'anic verse is included at the end of the preface to the biology curriculum. The science curriculum being used in Turkey does not contain any religious perspectives although it explains the historical development of the model of evolution in light of the contributions made by Muslim philosophers (Avicenna and Al-Farabi) as well as Lamarck, Darwin, and Wallace.

Fascinatingly, Islam and the Qur'an are not only mentioned explicitly in the goals of Pakistani science curriculum, but religion is also used as a justification for the acceptance of the scientific theory of evolution. In fact, it appears that the textbook authors have tried to explicitly harmonize religion

and science in the arena of biological evolution. Contrary to North American science curricula, which tend to maintain clear, distinct boundaries between scientific and theological domains, such separation between modern science and religion is nonexistent in Pakistan, and seems fluid in other Muslim countries as well.

IMPLICATIONS AND FUTURE DIRECTIONS

This comparative analysis promotes a greater understanding of the diversity of curricular approaches to evolutionary science in Muslim societies. Further studies are needed to look at the impact of these curricula on students' understanding of evolution and the pedagogical approaches used by Muslim teachers to enact these curricula in their classrooms. The presence of the religious text in Pakistani science textbooks also opens up interesting avenues for future research. It would be important to examine the ways in which this religious text and its interpretations interact with Pakistani students' and teachers' emerging understandings of evolution. Specifically, does exposure to different religious perspectives on evolution in formal science instruction help or hinder students' acceptance of evolution? Relatedly, are there any significant differences in the religious and scientific understandings of students from Pakistan and other Muslim countries?

Another important finding emerging from the analysis of these curricula is that the concepts and processes related to the nature of science are not discussed explicitly, particularly in relation to the construction of knowledge in the area of evolutionary science. Although we noticed that some of these concepts are embedded in the discussion of the mechanism and evidence for evolution, students may not develop a deeper understanding of them without learning about the explicit connections between scientific epistemology and biological evolution. Importantly, recent studies have shown that developing a comprehensive and meaningful understanding of the nature of science is essential for teachers and students to understand and accept evolution.³⁵ Relevant research with Muslim science teachers and students from some Arab and other Muslim cultures indicate that they lack a comprehensive understanding of the nature of science.³⁶ Conversely, other studies with Muslim scientists and biology professors reveal that a deeper understanding of the physical evidence supporting evolution and an active engagement in constructing biological knowledge through research enabled most of them to accept evolution, including human evolution.³⁷ Thus, inclusion of the nature of science related concepts specifically in the context of evolution (e.g., the role of physical evidence in constructing scientific knowledge, various methods used by the scientists to test the validity of their claims, and the role of inference in connecting data to theory) in the science/biology curricula as well as teacher education programs would potentially enhance teachers' and students' understanding of evolutionary science.

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38. “SWT: (S) Subhaanahu (Glory be to Allah), (W) and (T) Wa Taàalaa (The Exalted).