Course: Foundations of Science Education (6435)
Semester: Autumn, 2021

ASSIGNMENT No. 1

Q.1 Elaborate some Hadith which support science education with the help of examples.

There is, perhaps, no better illustration of the close links between Islam and science than the Prophet Muhammad's often-quoted statements:

"Seeking knowledge is compulsory on every Muslim."

"Wisdom is the lost property of the believer."

"Whoever follows a path seeking knowledge, Allah will make his path to paradise easy."

These statements and many others are veritable invitations to humanity to enrich their knowledge from all sources. It comes as no surprise, therefore, to learn that in Islam religion and science have always been considered as twin sisters and that today, at a time when science has taken such great strides, they still continue to be associated. Nor is it a surprise to learn that certain scientific data are used for the better understanding of the Quranic text. What is more, in a century where, for many people, scientific truth has dealt a deathblow to religious belief, it is precisely the discoveries of science that, in an objective examination of the Islamic scripture, have highlighted the supernatural nature of revelation and the authenticity of the religion which it taught.

When all is said and done, scientific knowledge seems, in spite of what many people may say or think, to be highly conducive to reflection on the existence of God. Once we begin to ask ourselves, in an unbiased or unprejudiced way, about the metaphysical lessons to be derived from some of today's knowledge, (for example our evolving knowledge of the smallest components of matter or the questions surrounding the origin of life within inanimate matter), we indeed discover many reasons for thinking about God. When we think about the remarkable organization presiding over the birth and maintenance of life, it becomes clear that the likelihood of it being the result of chance lessens quite considerably.

As our knowledge of science in the various fields expands, certain concepts must seem increasingly unacceptable. For example, the idea enthusiastically expressed by the recent French winner of the Nobel Prize for medicine, that living matter was self-created from simple chemical elements due to chance circumstances. Then from this point it is claimed that living organisms evolved, leading to the remarkably complex being called man. To me, it would seem that the scientific advancements made in understand the fantastic complexity of higher beings provides stronger arguments in favor of the opposite theory: that the existence of an extraordinarily methodical organization presiding over the remarkable arrangement of the phenomena of life necessitates the existence of a Creator.

In many parts of the Book, the Quran, encourages this kind of general reflection but also contains infinitely more precise data which are directly related to facts discovered by modern science. It is precisely this data which exercise a magnetic attraction for today's scientists.

For many centuries, humankind was unable to study certain data contained in the verses of the Quran because they did not possess sufficient scientific means. It is only today that numerous verses of the Quran dealing with natural phenomena have become comprehensible. A reading of old commentaries on the Quran, however knowledgeable their authors may have been in their day, bears solemn witness to a total inability to grasp the depth of meaning in such verses. I could even go so far as to say that, in the 20th century, with its compartmentalization of ever-increasing knowledge, it is still not easy for the average scientist to understand everything he reads in the Quran on such subjects, without having recourse to specialized research. This means that to understand all such verses of the Quran, one is nowadays required to have an absolutely encyclopedic knowledge embracing many scientific disciplines.

I should like to stress, that I use the word science to mean knowledge which has been soundly established. It does not include the theories which, for a time, help to explain a phenomenon or a series of phenomena, only to be abandoned later on in favor of other explanations. These newer explanations have become more plausible thanks to scientific progress. I only intend to deal with comparisons between statements in the Quran and scientific knowledge which are not likely to be subject to further discussion. Wherever I introduce scientific facts which are not yet 100% established, I will make it quite clear.

There are also some very rare examples of statements in the Quran which have not, as yet, been confirmed by modern science. I shall refer to these by pointing out that all the evidence available today leads scientists to regard them as being highly probable. An example of this is the statement in the Quran that life has an aquatic origin ("And I created every living thing out of water" Quran, 21:30).

These scientific considerations should not, however, make us forget that the Quran remains a religious book par excellence and that it cannot be expected to have a scientific purpose per se. In the Quran, whenever humans are invited to reflect upon the wonders of creation and the numerous natural phenomena, they can easily see that the obvious intention is to stress Divine Omnipotence. The fact that, in these reflections, we can find allusions to data connected with scientific knowledge is surely another of God's gifts whose value must shine out in an age where scientifically based atheism seeks to gain control of society at the expense of the belief in God. But the Quran does not need unusual characteristics like this to make its supernatural nature felt. Scientific statements such as these are only one specific aspect of the Islamic revelation which the Bible does not share.

Throughout my research I have constantly tried to remain totally objective. I believe I have succeeded in approaching the study of the Quran with the same objectivity that a doctor has when opening a file on a patient. In other words, only by carefully analyzing all the symptoms can one arrive at an accurate diagnosis. I must admit that it was certainly not faith in Islam that first guided my steps, but simply a desire to search for the truth. This is how I see it today. It was mainly the facts which, by the time I had finished my study, led me to see the Quran as the divinely-revealed text it really is.

Before getting to the essence of the subject, there is a very important point which must be considered: the authenticity of the Quranic text.

It is known that the text of the Quran was both recited from memory, during the time it was revealed, by the Prophet and the believers who surrounded him, and written down by designated scribes among his followers. This process lasted for roughly twenty-three years during which many unofficial copies were made. An official copy was made within one year after the Prophet's death at the instruction of Caliph Abu Bakr.

Here we must note a highly important point. The present text of the Quran benefited in its original preparation from the advantage of having its authenticity cross-checked by the text recited from memory as well as the unofficial written texts. The memorized text was of paramount importance at a time when not everyone could read and write, but everybody could memorize. Moreover, the need for a written record was included in the text of the Quran itself. The first five verses of chapter al-'Alaq, which happen to constitute the first revelation made to the Prophet (S), express this quite clearly:

"Read: In the name of your Lord who created. Who created man from a clinging entity? Read! Your Lord is the most Noble, Who taught by the pen. Who taught man what he did not know." Quran, 96:1-5

Then came the Caliphate of 'Uthman (which lasted from the twelfth to the twenty-fourth year following Muhammad's death). Within the first two years of Caliph 'Uthman's rule, seven official copies were reproduced from the official text and distributed throughout a large area of the world which had already come under Islamic rule. All unofficial copies existing at that time were destroyed and all future copies were made from the official seven copies.

In my book, The Bible, the Quran and Science, I have quoted passages from the Quran which came from the period prior to the Hijrah (the Prophet's emigration from Makkah to Madeenah in the year 622) and which allude to the writing of the Quran before the Prophet's departure from Makkah.

There were, moreover, many witnesses to the immediate transcription of the Quranic revelation.

Professor Jacques Berque has told me of the great importance he attaches to it in comparison with the long gap separating the writing down of the Judeo-Christian revelation from the facts and events which it relates. Let us not forget that today we also have a number of manuscripts of the first written versions of the Quran which were from a time period very close to the time of revelation.

I shall also mention another fact of great importance. We shall examine statements in the Quran which today appear to merely record scientific truth, but of which men in former times were only able to grasp the apparent meaning. In some cases, these statements were totally incomprehensible. It is impossible to imagine that, if there were any alterations to the texts, these obscure passages scattered throughout the text of the Quran, were all able to escape human manipulation. The slightest alteration to the text would have automatically destroyed the remarkable coherence which is characteristic to them. Change in any text would have prevented us from establishing their total conformity with modern knowledge. The presence of these statements spread throughout the Quran looks (to the impartial observer) like an obvious hallmark of its authenticity.

The Quran is a revelation made known to humans in the course of twenty-three years. It spanned two periods of almost equal length on either side of the Hijrah. In view of this, it was natural for reflections having a scientific aspect to be scattered throughout the Book. In a study, such as the one we have made, we had to regroup the verses according to subject matter, collecting them chapter by chapter.

How should they be classified? I could not find any indications in the Quran suggesting any particular classification, so I decided present them according to my own personal one.

It would seem to me, that the first subject to deal with is Creation. Here it is possible to compare the verses referring to this topic with the general ideas prevalent today on the formation of the Universe. Next, I divided up verses under the following general headings: Astronomy, the Earth, the Animal and Vegetable Kingdoms, Humans, and Human Reproduction in particular. Furthermore, I thought it useful to make a comparison between Quranic and Biblical narrations on the same topics from the point of view of modern knowledge. This has been done in the cases of Creation, the Flood and the Exodus. The reason that these topics were chosen is that knowledge acquired today can be used in the interpretation of the texts.

Q.2 Discuss the important sources of science knowledge.

The Islamic Golden Age refers to a period in the history of Islam, traditionally dated from the 8th century to the 13th century, during which much of the historically Islamic world was ruled by various caliphates and science, economic development, and cultural works flourished. This period is traditionally understood to have begun during the reign of the Abbasid caliph Harun al-Rashid (786–809) with the inauguration of the House of Wisdom in Baghdad, where scholars from various parts of the world with different cultural backgrounds were mandated to gather and translate all of the world's classical knowledge into the Arabic language.

The end of the age is variously given as 1258 with the Mongolian Sack of Baghdad, or 1492 with the completion of the Christian Reconquista of the Emirate of Granada in Al-Andalus, Iberian Peninsula. During the Golden Age, the major Islamic capital cities of Baghdad, Cairo, and Córdoba became the main intellectual centers for science, philosophy, medicine, and education. The government heavily patronized scholars, and the best scholars and notable translators, such as Hunayn ibn Ishaq, had salaries estimated to be the equivalent of those of professional athletes today.

The School of Nisibis and later the School of Edessa became centers of learning and transmission of classical wisdom. The House of Wisdom was a library, translation institute, and academy, and the Library of Alexandria and the Imperial Library of Constantinople housed new works of literature. Nestorian Christians played an important role in the formation of Arab culture, with the Jundishapur hospital and medical academy prominent in the late Sassanid, Umayyad, and early Abbasid periods. Notably, eight generations of the Nestorian Bukhtishu family served as private doctors to caliphs and sultans between the 8th and 11th centuries.

There is no such thing as Islamic science – for science is the most universal of human activities. But the means to facilitating scientific advances have always been dictated by culture, political will and economic wealth. What is only now becoming clear (to many in the west) is that during the dark ages of medieval Europe, incredible scientific advances were made in the Muslim world. Geniuses in Baghdad, Cairo, Damascus and Cordoba took on the scholarly works of ancient Egypt, Mesopotamia, Persia, Greece, India and China, developing what we would call "modern" science. New disciplines emerged – algebra, trigonometry and chemistry as well as major advances in medicine, astronomy, engineering and agriculture. Arabic texts replaced Greek as the fonts of wisdom, helping to shape the scientific revolution of the Renaissance. What the medieval scientists of the Muslim world articulated so brilliantly is that science is universal, the common language of the human race. The 1001 Inventions exhibition at London's Science Museum tells some of the stories of this forgotten age. Here are my top six exhibits . . .

1 The elephant clock

This centrepiece of the exhibition is a three-metre high replica of an early 13th-century water clock and one of the engineering marvels of the medieval world. It was built by al-Jazari, and gives physical form to the concept of multiculturalism. It features an Indian elephant, Chinese dragons, a Greek water mechanism, an Egyptian phoenix, and wooden robots in traditional Arabian attire. The timing mechanism is based on a water-filled bucket hidden inside the elephant.

2 The camera obscura

The greatest scientist of the medieval world was a 10th century Arab by the name of Ibn al-Haytham. Among his many contributions to optics was the first correct explanation of how vision works. He used the Chinese invention of the camera obscura (or pinhole camera) to show how light travels in straight lines from the object to form an inverted image on the retina.

3 Al-Idrisi's world map

This three-metre reproduction of the famous 12th-century map by the Andalusian cartographer, Al-Idrisi (1100-1166), was produced in Sicily and is regarded as the most elaborate and complete description of the world made in medieval times. It was used extensively by travellers for several centuries and contained detailed descriptions of the Christian north as well as the Islamic world, Africa and the Far East.

4 The Banu Musa brothers' "ingenious devices"

These three brothers were celebrated mathematicians and engineers in ninth-century Baghdad. Their Book of Ingenious Devices, published in 850, was a large illustrated work on mechanical devices that included automata, puzzles and magic tricks as well as what we would today refer to as "executive toys".

5 Al-Zahrawi's surgical instruments

This array of weird and wonderful devices shows the sort of instruments being used by the 10th-century surgeon al-Zahrawi, who practised in Cordoba. His work was hugely influential in Europe and many of his instruments are still in use today. Among his best-known inventions were the syringe, the forceps, the surgical hook and needle, the bone saw and the lithotomy scalpel.

6 Ibn Firnas' flying contraption

Abbas Ibn Firnas was a legendary ninth-century inventor and the Da Vinci of the Islamic world. He is honoured on Arabic postage stamps and has a crater on the moon named after him. He made his famous attempt at controlled flight when, aged 65, he built a rudimentary hang glider and launched himself from the side of a mountain. Some accounts claim he remained airborne for several minutes before landing badly and hurting his back. Jim Al-Khalili is an author and broadcaster. He is professor of physics and of the public engagement in science at the University of Surrey.

Q.3 Elaborate how deterioration of science took place in the Muslim world.

Philosophy of science is a branch of philosophy concerned with the foundations, methods, and implications of science.[1] The central questions of this study concern what qualifies as science, the reliability of scientific theories, and the ultimate purpose of science. This discipline overlaps with metaphysics, ontology, and epistemology, for example, when it explores the relationship between science and truth. Philosophy of science focuses on metaphysical, epistemic and semantic aspects of science. Ethical issues such as bioethics and scientific misconduct are often considered ethics or science studies rather than philosophy of science.

There is no consensus among philosophers about many of the central problems concerned with the philosophy of science, including whether science can reveal the truth about unobservable things and whether scientific reasoning can be justified at all. In addition to these general questions about science as a whole, philosophers of science consider problems that apply to particular sciences (such as biology or physics). Some philosophers of science also use contemporary results in science to reach conclusions about philosophy itself.

While philosophical thought pertaining to science dates back at least to the time of Aristotle, general philosophy of science emerged as a distinct discipline only in the 20th century in the wake of the logical positivist movement, which aimed to formulate criteria for ensuring all philosophical statements' meaningfulness and objectively assessing them. Charles Sanders Peirce and Karl Popper moved on from positivism to establish a modern set of standards for scientific methodology. Thomas Kuhn's 1962 book The Structure of Scientific Revolutions was also formative, challenging the view of scientific progress as steady, cumulative acquisition of knowledge based on a fixed method of systematic experimentation and instead arguing that any progress is relative to a "paradigm," the set of questions, concepts, and practices that define a scientific discipline in a particular historical period.[2]

Subsequently, the coherentist approach to science, in which a theory is validated if it makes sense of observations as part of a coherent whole, became prominent due to W.V. Quine and others. Some thinkers such as Stephen Jay Gould seek to ground science in axiomatic assumptions, such as the uniformity of nature. A vocal minority of philosophers, and Paul Feyerabend in particular, argue that there is no such thing as the "scientific method", so all approaches to science should be allowed, including explicitly supernatural ones. Another approach to thinking about science involves studying how knowledge is created from a sociological perspective, an approach represented by scholars like David Bloor and Barry Barnes. Finally, a tradition in continental philosophy approaches science from the perspective of a rigorous analysis of human experience.

Philosophies of the particular sciences range from questions about the nature of time raised by Einstein's general relativity, to the implications of economics for public policy. A central theme is whether the terms of one scientific theory can be intra- or intertheoretically reduced to the terms of another. That is, can chemistry be reduced to physics, or can sociology be reduced to individual psychology? The general questions of philosophy of science also arise with greater specificity in some particular sciences. For instance, the question of the validity of scientific reasoning is seen in a different guise in the foundations of statistics. The question of what counts as science and what should be excluded arises as a life-or-death matter in the philosophy of medicine. Additionally, the philosophies of biology, of psychology, and of the social sciences explore whether the scientific studies of human nature can achieve objectivity or are inevitably shaped by values and by social relations.

When making observations, scientists look through telescopes, study images on electronic screens, record meter readings, and so on. Generally, on a basic level, they can agree on what they see, e.g., the thermometer shows 37.9 degrees C. But, if these scientists have different ideas about the theories that have been developed to explain these basic observations, they may disagree about what they are observing. For example, before Albert Einstein's general theory of relativity, observers would have likely interpreted an image of the Einstein cross as five different objects in space. In light of that theory, however, astronomers will tell you that there are actually only two objects, one in the center and four different images of a second object around the sides. Alternatively, if other scientists suspect that something is wrong with the telescope and only one object is actually being observed, they are operating under yet another theory. Observations that cannot be separated from theoretical interpretation are said to be theory-laden.

All observation involves both perception and cognition. That is, one does not make an observation passively, but rather is actively engaged in distinguishing the phenomenon being observed from surrounding sensory data. Therefore, observations are affected by one's underlying understanding of the way in which the world functions, and that understanding may influence what is perceived, noticed, or deemed worthy of consideration. In this sense, it can be argued that all observation is theory-laden.

Kuhn denied that it is ever possible to isolate the hypothesis being tested from the influence of the theory in which the observations are grounded, and he argued that it is not possible to evaluate competing paradigms independently. More than one logically consistent construct can paint a usable likeness of the world, but there is no common ground from which to pit two against each other, theory against theory. Each paradigm has its own distinct questions, aims, and interpretations. Neither provides a standard by which the other can be judged, so there is no clear way to measure scientific progress across paradigms.

For Kuhn, the choice of paradigm was sustained by rational processes, but not ultimately determined by them. The choice between paradigms involves setting two or more "portraits" against the world and deciding which likeness is most promising. For Kuhn, acceptance or rejection of a paradigm is a social process as much as a logical process. Kuhn's position, however, is not one of relativism. According to Kuhn, a paradigm shift occurs when a significant number of observational anomalies arise in the old paradigm and a new paradigm makes sense of them. That is, the choice of a new paradigm is based on observations, even though those observations are made against the background of the old paradigm.

Q.4 Explain inductive reasoning and deductive reasoning with the help of examples from science education.

Inductive reasoning

Inductive reasoning is a logical thinking process in which specific observations that are believed to be true are combined to draw a conclusion to create broader generalizations and theories.

Deductive reasoning

Deductive reasoning, on the other hand, works in the opposite direction of inductive reasoning. It is a logical thinking process that uses the top-down approach to go from the more general to the more specific. It involves the usage of general assumptions and logical premises to arrive at a logical conclusion.

Deductive reasoning, also known as deduction, is a basic form of reasoning. It starts out with a general statement, or hypothesis, and examines the possibilities to reach a specific, logical conclusion, according to Norman Herr, a professor of secondary education at California State University in Northridge The scientific method uses deduction to test hypotheses and theories, which predict certain outcomes if they are correct, said Dr. Sylvia Wassertheil-Smoller, a researcher and professor emerita at Albert Einstein College of Medicine.

"We go from the general — the theory — to the specific — the observations," Wassertheil-Smoller to

In deductive reasoning there is a first premise, then a second premise and finally an inference (a conclusion based on reasoning and evidence). A common form of deductive reasoning is the syllogism, in which two statements — a major premise and a minor premise — together reach a logical conclusion. For example, the major premise "Every A is B" could be followed by the minor premise, "This C is A." Those statements would lead to the conclusion "This C is B." Syllogisms are considered a good way to test deductive reasoning to make sure the argument is valid.

For example, "All spiders have eight legs. A tarantula is a spider. Therefore, tarantulas have eight legs." For deductive reasoning to be sound, the hypothesis must be correct. It is assumed that the statements, "All spiders have eight legs" and "a tarantula is a spider" are true. Therefore, the conclusion is logical and true. In deductive reasoning, if something is true of a class of things in general, it is also true for all members of that class.

Deductive conclusions are reliable provided the premises are true, according to Herr. The argument, "All bald men are grandfathers. Harold is bald. Therefore, Harold is a grandfather," is valid logically, but it is untrue because the original premise is false.

While deductive reasoning begins with a premise that is proven through observations, inductive reasoning extracts a likely (but not certain) premise from specific and limited observations. There is data, and then conclusions are drawn from the data; this is called inductive logic, according to the University of Illinois in Springfield.

"In inductive inference, we go from the specific to the general. We make many observations, discern a pattern, make a generalization, and infer an explanation or a theory," Wassertheil-Smoller told Live Science. "In science, there is a constant interplay between inductive inference (based on observations) and deductive inference (based on theory), until we get closer and closer to the 'truth,' which we can only approach but not ascertain with complete certainty."

In other words, the reliability of a conclusion made with inductive logic depends on the completeness of the observations. For instance, let's say that you have a bag of coins; you pull three coins from the bag, and each coin is a penny. Using inductive logic, you might then propose that all of the coins in the bag are pennies."Even though all of the initial observations — that each coin taken from the bag was a penny — are correct, inductive reasoning does not guarantee that the conclusion will be true.

Here's another example: "Penguins are birds. Penguins can't fly. Therefore, all birds can't fly." The conclusion does not follow logically from the statements.

Another form of scientific reasoning that diverges from inductive and deductive reasoning is abductive. Abductive reasoning usually starts with an obviously incomplete set of observations and proceeds to the likeliest possible explanation for the data, according to Butte College in Oroville, California. It is based on making and testing hypotheses using the best information available. It often entails making an educated guess after observing a phenomenon for which there is no clear explanation.

For example, a person walks into their living room and finds torn-up papers all over the floor. The person's dog has been alone in the apartment all day. The person concludes that the dog tore up the papers because it is the most likely scenario. It's possible that a family member with a key to the apartment destroyed the papers, or it may have been done by the landlord, but the dog theory is the most likely conclusion.

Abductive reasoning is useful for forming hypotheses to be tested. Abductive reasoning is often used by doctors who make a diagnosis based on test results, and by jurors who make decisions based on the evidence presented to them.

Q.5 Write importance of falsification. Describe all possible ways about this theory which are important for new horizons of science.

- Karl Popper believed that scientific knowledge is provisional – the best we can do at the moment.
- Popper is known for his attempt to refute the classical positivist account of the scientific method, by replacing induction with the falsification principle.
- The Falsification Principle, proposed by Karl Popper, is a way of demarcating science from non-science. It suggests that for a theory to be considered scientific it must be able to be tested and conceivably proven false.
- For example, the hypothesis that "all swans are white," can be falsified by observing a black swan.

- For Popper, science should attempt to disprove a theory, rather than attempt to continually support theoretical hypotheses.

Karl Popper is prescriptive, and describes what science should do (not how it actually behaves). Popper is a rationalist and contended that the central question in the philosophy of science was distinguishing science from non-science.

Karl Popper in The Logic of Scientific Discovery emerged as a major critic of inductivism, which he saw as an essentially old-fashioned strategy.

Popper replaced the classical observationalist-inductivist account of the scientific method with falsification (i.e. deductive logic) as the criterion for distinguishing scientific theory from non-science.

All inductive evidence is limited: we do not observe the universe at all times and in all places. We are not justified therefore in making a general rule from this observation of particulars.

According to Popper, scientific theory should make predictions which can be tested, and the theory rejected if these predictions are shown not to be correct. He argued that science would best progress using deductive reasoning as its primary emphasis, known as critical rationalism.

Popper gives the following example. Europeans for thousands of years had observed millions of white swans. Using inductive evidence, we could come up with the theory that all swans are white.

However, exploration of Australasia introduced Europeans to black swans. Poppers' point is this: no matter how many observations are made which confirm a theory there is always the possibility that a future observation could refute it. Induction cannot yield certainty.

Karl Popper was also critical of the naive empiricist view that we objectively observe the world. Popper argued that all observation is from a point of view, and indeed that all observation is colored by our understanding. The world appears to us in the context of theories we already hold: it is 'theory-laden'.

Popper proposed an alternative scientific method based on falsification. However many confirming instances there are for a theory, it only takes one counter observation to falsify it. Science progresses when a theory is shown to be wrong and a new theory is introduced which better explains the phenomena.

For Popper the scientist should attempt to disprove his/her theory rather than attempt to continually prove it. Popper does think that science can help us progressively approach the truth but we can never be certain that we have the final explanation.

Popper's first major contribution to philosophy was his novel solution to the problem of the demarcation of science. According to the time-honored view, science, properly so called, is distinguished by its inductive method – by its characteristic use of observation and experiment, as opposed to purely logical analysis, to establish its results.

The great difficulty was that no run of favorable observational data, however long and unbroken, is logically sufficient to establish the truth of an unrestricted generalization.

Popper's astute formulations of logical procedure helped to reign in the excessive use of inductive speculation upon inductive speculation, and also helped to strengthen the conceptual foundation for today's peer review procedures.

However, the history of science gives little indication of having followed anything like a methodological falsificationist approach. Indeed, and as many studies have shown, scientists of the past (and still today) tended to be reluctant to give up theories that we would have to call falsified in the methodological sense; and very often it turned out that they were correct to do so (seen from our later perspective).

The history of science shows that sometimes it is best to 'stick to one's guns'. For example, "In the early years of its life, Newton's gravitational theory was falsified by observations of the moon's orbit"

Also, one observation does not falsify a theory. The experiment may have been badly designed, data could be incorrect.

Quine states that a theory is not a single statement; it is a complex network (a collection of statements). You might falsify one statement (e.g. all swans are white) in the network, but this should not mean you should reject the whole complex theory.

Critics of Karl Popper, chiefly Thomas Kuhn, Paul Feyerabend, and Imre Lakatos, rejected the idea that there exists a single method that applies to all science and could account for its progress.