General Science

CLASS IX-X

PUNJAB CURRICULUM AND
TEXTBOOK BOARD, LAHORE

Approved by the Federal Ministry of Education, (Curriculum Wing) Islamabad
vide letter No. F.6-5/2003 dated 22 Dec, 2003.

Government of Pakistan, Islamabad.

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Published by: Punjab Curriculum and Textbook Board, Lahore

Printed by: Ali Imran Rajput Printers, Lahore

Date of Printing	PMIU	PEF	Total opies
January 2018	215843	386	216229

1 INTRODUCTION AND ROLE OF SCIENCE

In this chapter you will learn:

- Introduction of Science
- History of Science
- Concept of Science in Islam
- Contribution of Muslim and Pakistani Scientists
- Branches of Science
- Role of Science and Technology
- Limitations of Current Science

The word "Science" is derived from the latin word "Scientia", which means to study and analyse facts in original form. The basic principle of science is observation and hypothesis. To establish scientific law in the light of experiments is called scientific method.

1.1 History of Science

The history of science is as old as the man himself. With the passage of time man learnt from his interaction with the surroundings which later added to his knowledge of science e.g., when he burnt first time the wood for fire, he basically discovered the process of combustion and he also came to know that wood burns but a stone does not.

Greek philosophers took special interest in science as they did in other subjects. They took interest in science even before 500 B.C. Greeks were not interested in proving their ideas through experiments. They had a firm belief that life is based on air, water, earth and fire and these four elements make different things when combined in different proportions.

600 A.D. to 1400 A.D. is the era of Islamic chemistry. In this period many intelligent and research minded scholars observed the properties of matter. They carried on new experiments and discovered elements like "Arsenic". Besides this, a number of compounds were made. Experimental tools like retort were made for distillation. The period of Alchemy was no doubt the period of muslim scientists. They presented chemistry as experimental science for the first time. Many experiments were performed in this period and many new chemical reactions were discovered.

In 13th century muslims brought a complete change in the field of chemistry and they dominated for about seven centuries until Changez Khan and Halaku Khan destroyed the Islamic world. Gradually the western scientists who got knowledge from muslim universities took over the task of developing science from the muslims. They introduced these scientific approaches in Europe, which are still practised. Modern age scientists are Galileo, Isaac Newton, Greger Mendel, Edison, Marconi, Einstein and many others.

1.2 Concept of Science in Islam

Islam is a complete code of life. It gives us a clear and real picture of the facts and invites us to utilize natural resources for the benefit of mankind.

Islam is a practical religion and it is based on logic, observations, experiments and results. Many verses of the Holy Quran point out these factors clearly. The Holy Quran says:

- Don't they see?
- Don't they think over it?
- Don't they ponder upon it?

Teachings of the Holy Quran make us more inquisitive about our surroundings even the first ever words of the Holy Quran are very clear about this:

- Read! In the name of thy Lord and Cherisher, Who created. Created man, out of a clot of congealed blood. Read! And thy Lord is most Bountiful. He Who taught (the use of) the Pen. Taught man that which he knew not (Surah: 96 verse 1-5).

Like Quranic verses there are many hadiths in which emphasis is given on the knowledge, its importance and obligation on muslims. For examples Muhammad (peace be upon him) said:

- "To seek knowledge is the obligation of every man and woman."

Like this, another hadiths is

- "Seek knowledge from lap (cradle) to grave."

Allah says:

- "And of every thing We have created pairs: that ye may receive instruction. (Surah:51,verse: 49)"

We are observing pairs in human beings and other living creatures, however, scientists tell that Allah has made everything in pairs including smallest insects to the biggest creature of the sea. Only males and females reproduce offsprings of animals and plants.

If the human being ponder on these things, they can understand God's power & oneness for further guidance.

Allah Says:

- If the ocean were ink (where with to write out) the words of my Lord, sooner would the ocean be exhausted than would the words of my Lord, even if we added another ocean like it, for its aid. (Surah: 18, Verse: 109)

This tells us that human knowledge & wisdom is unable to the known facts of nature.

Allah Says:

- It is only a little knowledge that is communicated to you. (Surah: 17, Verse: 85)

Great scientists cannot claim to understand reality and their views keep on changing day by day. Quran invites us to think, which is the basis of science.

Activity

Read carefully the verse-164 of Surah Al-Baqarah alongwith its translation and make a list of natural phenomena. Do these phenomena introduce us the laws of nature?

1.3 Contribution of Muslim and Pakistani Scientists.

(a) Jabir Bin Hayyan (722-817 A.D.)

Jabir Bin Hayyan is said to be the founder of chemistry. He discovered methods to extract metals from ores, making steel, leather, dyeing cloths and protecting iron from rust. He prepared chemicals like nitric acid, sulphuric acid and hydrochloric acid. Jabir Bin Hayyan was the discoverer of many other chemical compounds. He also knew the methods for the preparation of varnish. Jabir Bin Hayyan was the first chemist who had his own laboratory.

He knew about the process of fractional distillation. Jabir Bin Hayyan wrote books about chemistry and related topics in arabic. Among these books Al-Kitab and Al-Khalis are very famous books. The translation of his book Al-Chemia in Latin was done by an English man Robert of Chester in 1144. In 1892 Mu Aw Homus translated nine books of Jabir Bin Hayyan in French.

(b) Muhammad Bin Zikrya Al-Razi (865-925 A.D.)

His full name was Abu Bakar Muhammad Bin Zikrya Al-Razi. He was born in "Ray" now Tehran in 865 A.D. He was not only a chemist but a great physician as well. He was an experienced surgeon and administrator of a hospital in Baghdad. He was the first person to use opium to make his patients unconscious. He was the first person to explain in detail the causes, symptoms and treatment of chicken pox and small pox. His theories and ideas about these diseases are still practised. He was the first person to prepare alcohol from fermentation.

He classified chemicals substances into four groups.

1. Minerals 2. Botanicals 3. Animals 4. Derived

This classification of chemical compounds done by Al-Razi is still accepted.

(c) Ibn-ul-Haitham (965-1039 A.D.)

His full name was Abu Ali Al-Hasan Ibn-ul-Hassan Al-Basri. He is known as Al- Hazen in the west. He identified inertia of matter, a theory which was later developed by Newton and called laws of motion. He discovered the pinhole camera.

The name of his book, which is reputed all over the world, is "Kitab-ul-Manazir." It is a complete mathematical and practical book about the specialties of light. Ibn-ul-Haitham is considered to be the first expert on the laws of refraction, reflection besides lens and mirrors. The detail that Ibn-ul-Haitham had presented about eye is considered to be the right even now after going through many experiments. Roger Bacon has mentioned the name of Ibn-ul-Haitham in his literary work again and again.

(d) Al-Bairuni (973-1048 A.D.)

Al-Bairuni's full name was Burhan-ul-Haq Abu Rehan Muhammad Bin Ahmad. He was called as Al-Bairuni from the very beginning. He was born in Khawarizam on September 4, 973. He got his early education from Abu-Naser Mansoor, a great philosopher and mathematician of his time.

Al-Bairuni was a physician, astronomer, mathematician, physicist, geographer and a historian all at the same time. He was appointed as historian and scholar in the court of Sultan Mahmood Ghaznavi. He discovered that light travels faster than sound.

He discovered that radius of the earth was 6338 km. He discovered it near Pind Dadan Khan, District Jehlum about 100 km south east of Islamabad, the capital of Pakistan. The latest measure of the earth's radius is 6353 km with a difference of only 15 km. He made great contribution in the fields of astronomy, astrology, mathematics and geography.

During his visit to the sub-continent he discovered that the Sindh-valley was under the sea, with the passage of time the seawater receded and the valley came into being. Modern geologists agree with his idea. He wrote about 150 books on Mathematics. The name of famous book of Al-Bairuni is "Tahreer-ul-Amakin".

(e) Bu Ali Sina (980-1037 A.D.)

His full name was Abu Ali Al-Hussain Ibn-Abdullah. He is very well known as Avecena in Europe. He is considered Aristotle of the muslim world. He wrote a research article on 760 herbs. It shows that he was not only a chemist but also an expert in medicine. He was the first person to reject the idea of converting common metal into gold. He wrote about 100 books on philosophy, science, fiqah, literature and biology. His famous book on philosophy is Kitab-al-Shifa. In this famous book along with the subjects of physics, chemistry, mathematics too much

has been discussed about subjects like music and biology. His great work on medicine is his famous book Al-Qanoon-fil-Tib. It consists of 14 volumes. It explains the making and working of different parts of human body. This book was taught as a textbook in western universities until the late 17th century.

Pakistani Scientists

(a) Dr. Abdus Salam

The only nobel prize winner scientist of Pakistan Dr. Abdus Salam was born at Santok Das District Sahiwal on January 29, 1926. After studying in Govt. College Jhang and Lahore he proceeded to England where he did his M.Sc. in mathematics and physics from Cambridge university in 1948-49 and won the Smith prize. He joined Government College Lahore in 1951 and became head of the mathematics department.

He went back to England in 1954 and started teaching mathematics at Imperial College, and stayed there until 1956. He served as member of Pakistan Atomic Energy Commission from 1958 to 1974. He worked as scientific advisor to the president of Pakistan from 1961 to 1974. SPARCO was established in 1961 and he was appointed as its chairman. He proposed the establishment of Islamic Science Foundation during the OIC meeting in Lahore in 1974. He founded Academy of Third World of Science in 1983 and became its president. He also founded an International Institute for theoretical physics in Italy and remained its head for the rest of his life. Dr. Abdus Salam put forward theory of the unification of two natural forces i.e., the weak nuclear force and electromagnetic force. In 1979 along with Weinberg and Gloshow won the nobel prize for his work in theoretical physics Dr. Abdus Salam is the only Pakistani scientist who got nobel prize.

(b) Dr. Abdul Qadeer Khan

The world known scientist of Pakistan, Dr. Abdul Qadeer Khan was born on April 1st 1936 in Bhopal (India). He received his early education in Bhopal and in 1952 his family migrated to Karachi, where he did his B.Sc. from D.G. Science college. He joined government service but very soon left it and went to Europe in 1961, where he studied at Shorlton Berg University in Germany for two years. Then he did his M.Sc from Technology University Hague (Holland). Later he did his Ph.D. from Leaven university, Belgium. He was appointed as research assistant in the same university. He came back to Pakistan in 1975 permanently due to his patriotic spirit, and was appointed as director of Kahuta Research Laboratories, which was later re-named as Dr. A.Q. Khan Research laboratory as a tribute to the great scientist. Along with other Pakistani scientists he successfully tested the nuclear devices at Chaghi in Balochistan on May 28, 1998. As a result of that Pakistan became Atomic Power. Pakistani nation cannot forget the services rendered by Dr. Abdul Qadeer Khan and will salute Dr. Abdul Qadeer Khan with the core of its heart.

(c) Dr. Munir Ahmad Khan

Dr. Munir Ahmad Khan was born in Kasur in 1926. He shifted in 1937 from Qasur to Lahore. He got his early education in Central Model school Lahore and then graduated from Govt. college Lahore. He did his B.Sc. in Electric Power from University of Engineering and Technology Lahore in 1949. He also got M.Sc. degree from an American college in 1951. Dr. Munir Ahmad Khan joined service in International Atomic Agency in Vienna in 1957 and stayed there till 1971. He was appointed as chairman of Pakistan Atomic Energy Commission in 1972 and retired from the services of commission in 1990. Under his guidance, lot of progress was made in the fields of agriculture research, atomic energy and medicine.

(d) Dr. Atta-ur-Rehman

Dr. Atta-ur-Rehman was born in Dehli in 1942, migrated to Lahore in 1947. He got his early education from Karachi Grammar School. He did his B.Sc. (honours) from Karachi University in 1963. He got Ph.D. degree from Cambridge University in 1968. In 1977 he was appointed as co-director in Hussain Jamal institute of chemistry and then promoted as director in 1990. His services are highly appreciated in the field of medicine. He has published more than 200 research papers and lot of people have benefitted from him. He has received lot of national and international awards.

(e) Dr. Samar Mubarak Mand

Dr. Samar was born in Rawalpindi on september 17, 1941. He passed his matriculation from Saint Anthony High School Lahore in 1956. He did his M.Sc. in Physics from government college Lahore in 1962. He did his M. Phil in Nuclear Physics from Oxford University England in 1966.

Dr. Samar Mubarak Mand started his career as a scientific officer in Pakistan Atomic Energy in 1962. He was ranked as a director general in 1994, and in 1996 he was made technical member.

His special achievement was the responsibilities given by the Prime Minister of Pakistan to lead the team of Nuclear Scientist at Chaghi to conduct six nuclear tests for Pakistan. These nuclear tests were successfully conducted on 28th and 30th May 1998. As Director General of National Development Complex, he designed and developed “Shaheen” medium range missiles, which were successfully tested on April 15, 1999.

(f) Dr. Ashfaq Ahmad

Dr. Ashfaq Ahmad passed his M.Sc. in physics from government college Lahore in 1951. He taught in government college Lahore from 1952 to 1960. He went to Canada where he did his Ph.D. from Montreal university. He went to Neils Bohr Institute, Coupan Hagen and Sorborn for higher studies. He joined Pakistan Atomic Energy Commission in 1960. He was made Chairman

of Pakistan Atomic Energy Commission in 1991, where he did his best to improve the working of the commission. He is attached with our National Nuclear Programme from the last 25 years. He is one of the pioneers of our nuclear compatibility.

1.4 Branches of Science

Science is a vast subject. For our own convenience we divide it into various branches like other subjects.

(a) Physics

Physics is that branch of science, which deals specially with matter and energy. It is also called the science of measurement because it deals mostly with measurement. Mechanics, heat, light, sound, electricity etc. are its main branches.

(b) Chemistry

Chemistry is that branch of science, which deals with nature, composition, and chemical properties of various things.

A number of chemical reactions are being produced at any time in the world. In our body a large number of chemical reactions are occurring e.g., digestion of food, formation of blood, purification of blood etc. Physical, inorganic and organic chemistry are its main branches.

(c) Biology

It is a study of living things. The word biology is derived from two Greek words i.e., "bios and logos". Bios means life and logos means arguments. Living things include man, animals and plants. In this we study the growth, working and re-production of living things. It has two main branches:

1. **Botany:** It deals with the study of plants. It includes their structure and growth , and interaction with their environment.
2. **Zoology:** It deals with the study of animals. It includes their structure, growth and interaction with their environment. Most of the characteristics in plants and animals are common.

When plants and animals are studied together, the branch is called biology.

(d) Astronomy

It is the study of the universe e.g., Sun, Earth, stars etc. Mathematics and physics play an important role in astronomy.

(e) Mathematics

Mathematics is the knowledge about numbers and measurements, which includes calculations, algebra and geometry, etc. Mathematics is helpful in many other sciences. It helps us to explain long theories and ideas briefly, and results can be deduced easily. Newton and Einstein were great mathematicians.

(f) Agriculture

It deals with land cultivation and livestock. It tells us how to grow crops and how to control their losses. Cultivation devices, machinery, fertilizers and pesticides are also included in this science.

(g) Medicine

It is that branch of science, which deals with knowledge of human anatomy, diagnosis of diseases and their cure. It also includes pharmacy, instruments and machines used in diagnosis and treatment.

(h) Geography

Geo means earth and graphy means graph marking. In geography, the different parts of the earth are marked graphically like the dry regions and wet regions. There is a discussion about human relationship, vegetation, air, water, soil and the structure of the terrestrial globe in the subject of geography.

Relationship of Different Branches of Science

Different branches of science have a deep relationship with one another. For instance physics and chemistry are connected with each other. The concept that matter is made up with the mingling of different atoms has always been a subject of physics. Also the structure of atom is included in physics. But the formation of molecules by atoms and its causes have been a subject of chemistry. Physics describes the physical properties of matter and explain the laws according to which atoms combine to make molecules. But the formation of molecules shows the chemical characteristic. There is a great relationship between chemistry and biology. In biology the functioning of different organs and their structures are described. But different living bodies and the chemical reactions taking place in them are related to chemistry, which is called biochemistry.

Mathematical assistance is applied for the mathematical solution of different quantities of physics and chemistry. Many laws of physics and chemistry are derived by mathematics. Some of the branches of science studied collectively are mentioned below:

1. Biophysics:

Biology is studied with the help of the principles of physics.

2. Biochemistry:

Biology is studied with the help of chemistry.

3. Geophysics:

Different aspects and characteristics of land are analysed with the help of physics.

4. Astrophysics:

When the whole universe (astronomical phenomena) is studied in context with the laws of the physics it is called Astrophysics.

1.5 Role of Science and Technology in our Life

Various articles of daily use e.g., the wheel of clay-man, the forge of blacksmith, the spindle of weaver, the rahat and plough of farmer and the oarage boats etc. are the result of ancient knowledge and technology.

Generation and supply of electricity, in mid 19^{th} century resulted in various domestic and industrial inventions. Electricity not only provides light but also runs various industrial and home appliances. As a result, increase in industrial production occurred.

Various discoveries and inventions in the present century have brought a revolution in communication sector. Wireless, telephone, radio, television, computer and satellites have interlinked the whole world. The man has made the travel in space possible.

Today computer rule the world. This invention of modern world, have brought a revolution in every field of life. E-mail has become quick means of communication. Computers have also provided a convenient means of photography. Through internet, one can easily get information from all around the globe. The data can easily be saved and retrieved.

We use science and technology to live a comfortable life. Today, there is hardly any field not affected by science and technology. In agriculture sector, it is the production of high yielding varieties, pesticides, fertilizers and farm machinery. In industrial sector, the use of automatic electrical and mechanical machines, in communication introduction of supersonic planes, electrical trains and in medical, use of life saving drugs and diagnostic instruments are the result of advancement in the field of science and technology.

1.6 Limitations of Current Science

In last half a century, there has been a rapid expansion and advancement in the field of science and technology. New inventions are added everyday. Things which were considered impossible, now have become very common.

But despite of all these achievements, there are several matters where science is still helpless. Human knowledge cannot be perfect. Science also has some of its own limitations beyond which it has not yet been successful.

In the medical section hormones and vaccines against various non-curable diseases have been produced through genetic engineering, but genetic diseases are still incurable. The study of genome is not complete yet. Diseases like aids and hepatitis could not be controlled. Cancer is still incurable disease.

Despite of producing better varieties of crops through nuclear rays and genetic engineering, the food problem for the mankind could not be solved completely. It needs such plant variety which can fulfill the needs of ever growing population.

Space research has no limits. Landing on moon is only the first step. The conquest of Mars and other planets thereafter are challenging.

Ever growing population has increased the demand of energy. The natural resources hidden under the earth for centuries are exhausting. The substitute resource have not been developed with the same pace. No doubt, the use of nuclear energy for peaceful purposes is increasing, but it has also its own problems. A main problem of this is the disposal of nuclear waste.

Despite of all the research and development, natural disasters could not be controlled. For examples destructions by earthquakes are still the same. Scientists could not succeed to be aware of them before time, nor they have succeeded to overcome them. Similarly the man is helpless against other disasters.

Research in the field of science is continuing. New discoveries are added and field of knowledge is broadening day by day. If the current pace of research continues, tomorrow will be surely better than today.

IMPORTANT POINTS

- Word science is derived from latin word “scientia” means regularly observing the facts.
- Ancient Greek philosophers were of the view that all things in the world are composed of four elements air, water, soil and fire.
- Jabir Bin Hayyan was the founder of chemistry. First time he prepared sulphuric acid, nitric acid and hydrochloric acid.
- Muhammad Bin Zikrya Al-Razi was a chemist, but he was also a medical practitioner.
- Ibn-ul-Haitham was a physicist. He invented pinhole camera.

- Al-Bairuni wrote 150 books on different topics of mathematics.
- Bu Ali Sina is considered "Aristotle of the muslim world".
- Al-Qanoon-fil-Tib is an encyclopedia on "Tib" which consists of fourteen volumes.
- Dr. Abdus Salam is the only Noble prize winner scientist of Pakistan.
- Dr. Abdul Qadeer Khan alongwith other Pakistani scientists successfully tested the nuclear device at Chaghi in Balochistan on May 28, 1998.
- Dr. Munir Ahmad Khan remained the chairman of Atomic Energy Commission from January 20, 1972 to 1990.
- Dr. Atta-ur-Rehman worked as director in Hussain Jamal institute of chemistry. His services are highly appreciable in the field of medicine.
- Dr. Samar Mubarak Mand performed successfully nuclear experiments at Chaghai on May 28 and 30, 1998.
- Dr. Ashfaq Ahmad joined Pakistan Atomic Energy Commission in 1960 and was appointed as its Chairman in 1991.

Glossary

Technology: Science of industrial art. Methods used by experts.

Medicine: Knowledge about diseases, their cure and pharmacy.

Plants: Living, growing thing other than animal, especially one with leaves, flowers, and roots, smaller than a tree.

Astronomy: Science of the sun, moon, planets and stars.

Botany: Study of plants.

Zoology: Study of animals.

Geography: Graph marking of different parts of the earth.

Questions

Q:1 Fill in the blanks:

i. Jabir Bin Hayyan was an expert in _____.

ii. The study of animals is called _____.

iii. Bu Ali Sina is called _____of the muslim world.

iv. _____ divided chemical compounds into four categories namely, minerals, botanicals, animals and derived compounds.

v. Muslim scientist _____ is considered as the pioneer in the field of chemistry.

vi. "Kitab-ul-Manazir" is the first book on _____.

Q:2 Put the sign (✔) against the correct statement and the sign (✘) against the wrong statement.

i. Bu Ali Sina was considered to be one of the founders of medicine.

ii. Jabir Bin Hayyan was the first who discussed in detail the causes, symptoms, cure and prevention of smallpox and measles.

iii. Jabir Bin Hayyan was an expert in physics.

iv. "Kitab-ul-Manazir" is a publication of Al-Bairuni.

v. The knowledge about animals is called botany.

vi. In the life of animals and plants, many factors are common.

Q:3 Identify the correct answer and encircle it from the following statements.

(i) Ibn-ul-Haitham is related to branch of science.

a. Sound b. Heat

c. Light d. Chemistry

(ii) The name of famous book written by Al-Bairuni is:

a. Kitab-ul-Manazir b. Al-Havi

c. Al-Shafa d. Tahreer-ul-Amakin

(iii) The branch of science related to mechanics, heat, light and sound is?

a. Geology b. Astronomy

c. Chemistry d. Physics

Q: 4 What is meant by science?

Q: 5 Write down the important branches of science. What do you know about each branch of science?

Q: 6 Write down the names of two muslim scientists and give their important contribution to the service of science.

Q: 7 Write down the names of a few Pakistani scientists and discuss their contributions.

Q: 8 What are the limitations of science?

Q: 9 What is meant by technology? Give some example of ancient technology.

Q: 10. Define biology. Discuss that it is a branch of science.

Q: 11 The importance of science and knowledge have been discussed in the Holy Quran. Write two verses of the Holy Quran to explain.

Q: 12 What is physics? Write down the names of its important branches.