5 India's Heritage of Science and Technology

The discoveries and inventions in the field of Science and Technology have brought countries of the world closer. Co-operation among all the nations has increased hence new attitude has developed. Countries have become oriented towards peaceful co-existence and world peace.

Science means systematic 'Knowledge' and Technology means 'the practical utility of systematic knowledge'. Science and technology inspite of being two different words, they are linked to each other.

Heritage of Ancient India in the field of Science

The great sages of our ancient India have gifted invaluable heritage of science to the world. They have made outstanding contribution in the field of Metallurgy, Chemistry, Science of medicine, Surgery, Mathematics, Astronomy, Astrology, Vastushastra and Physics. It is a matter of great pride for us. India has contributed not only in the field of literature, art, religion, education and philosophy but also it has made immense contribution in the field of science and technology. Modern age researches have proved that India has scientific attitude along with religious outlook.

Metallurgy :

Since ancient age, the people of India use metallurgy in their practical life. Ancient India made extraordinary progress in the field of metallurgy. A metallic idol of a female dancer discovered from Indus valley civilization is an examplary achievement of ancient India. Later, statues of Buddha belonging to the Kushan period have been found at Takshshila. In South India, during the Chola period numerous metal idols were made. The statue of Natraja, a masterpiece in sculpture is famous all over the world. It is preserved in a museum at Chennai. Another well-known metal idol 'Ram - The archer' can be seen in the musuem, artistic statues of Gods-Goddessess, birds and animals and betel-nut cutters are considered to be the best example of metallic art. All of them have important place in the history of India.

Chemistry (Alchamical Lore) :

Chemistry is an experimental science. This science is very useful for various minerals, plants, seeds for agriculture, making of various metals or to bring changes in them. It is also useful for making medicine.

Acharya Nagarjun, a learned Buddhist of Nalanda University is known as Acharya in the field of Chemistry. He had written books like 'Rasaratnakar' and 'Arogyamanjari'. Acharya Nagarjuna, advocated the use of Alopathy along with herbal medicines. It is believed that the use of mercury ash as a medicine was initiated by him. Nalanda University had its own school of chemistry and furnace for study and research. The description of main rasa, uprasa, ten types of poisions as well as various types of salts and ash of minerals is seen in the chemistry.

5.1 Acharya Nagarjun

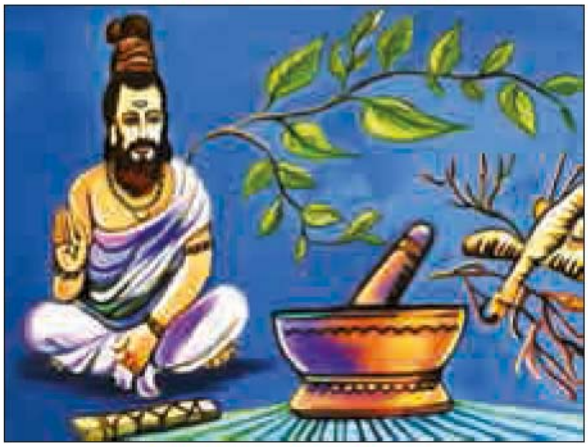
The copper statues of Buddha reflect an expert knowledge and skill in the field of chemistry. The copper statue of Buddha discovered from Sultangunj in Bhagalpur district of Bihar is $7\frac{1}{2}$ feet high and weighs one tonne. The statue of Buddha at

Nalanda is 18 feet high. An exquisite example is of Vijay stambha the 24 feet high iron pillar, which weighs 7 tonnes, built by Chandragupta II. Inspite of nature's fury over centuries, the pillar has not yet corroded. This is the best example of alchemical lore of India.

5.2 Iron Pillar, Delhi

Science of Medicine and Surgery :

India attained an unprecedented achievement in the field of medicine and surgery. Since ancient period Maharshi Charak, Maharshi Sushrut and Vagbhatta pioneered the Indian medicine science and surgery through their intense researches and reached to the greatest height.



5.3 Maharshi Charak

Maharshi Charak has written a book 'Charak Samhita' in which he has mentioned over 2000 medicinal herbs. Maharshi Shushrut has mentioned instruments used in surgery. The instruments were so sharp that they would split a single vertical hair in two divisions. Vagbhatta has written a book "Vagbhatta Samhita", is also a very important work. Study of Charak Samhita, Shushrut Samhita and Vagbhatta Samhita is very useful for every doctor. Hindu herbal science of ancient time is enrichned with huge collection of minerals and medicines from plants and animals. This has presented a detailed and complicated process of making medicines, their classification and their usage. They could even stop blood circulation with bowl-shaped bandage. They could skillfully operate on abdomen, kidney, cataract, hernia, stone, piles and bladder etc. They could classify, also join the broken or displaced bones and extract the things pierced into the body easily and skillfully. recognize symptoms and dignose the disease. They also gave dietary directions after post recovery of diseases.

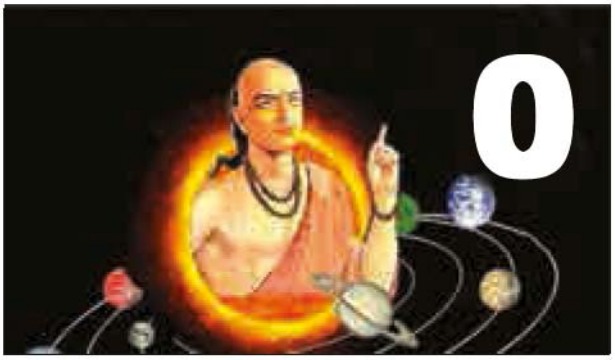
5.4 Maharshi Shushrut

They had knowledge of plactic surgery as well joining nose and ears. They showed a keen interest in teaching students the method of surgery, by doing surgery on the deadbody or on the wax statue. They conducted risky operations during delivery. They were expert gynaecolosists and paediatricians.

Veterinary science also developed in ancient India. They wrote books on diseases related to the horses (Ashwa) and elephants (Hasti). Among them 'Hasti Ayurveda', Shalihotra and 'Ashwashastra', are well known. The scholars/science writer of medicine Vagbhatta made valuable contribution through his work 'Ashtang Hriday' in the field of daignosis.

Mathematics :

Many epoch making mathematical discoveries were considered to be made in India through which contemporary global affairs are carried out. The gifts of India to the world are discovery of zero, decimal systems, algebra, theorem of Boddhayan, Geometry and Arithmetic. Aryabhatta discovered 'zero' (0), the process of writing zero after figures was discovered by the sage named 'Grutsamad'. The ancient Indian mathematicians have decided the names of the numbers made up by placing 53 zeros after 1(one). Decimal system had been seen for measuring and weighing instruments which had been found from the remains of 'Harappa' and 'Mohan-Jo- Daro'.



5.6 Aryabhatta

Bhaskaracharya has written books 'Lilawati Ganit' and 'Bij Ganit' in 1150 A.D. He discovered signs of addition (+) and subtraction (–). Brahmgupta introduced the types of equations; Boddhayan discovered theorem (triangle policy). Aapstambha had decided the masurement of sacrificial pits (yagyavedis) used for vedic Yagyas in 'Shulva Sutras' (1800 B.C.). It also consists analysis of principles. Aryabhatta had mentioned the value of π (Pie) is $\frac{22}{7}$ (3.14) in his book "Aryabhattiyam" he also propounded that π (pie) is constant to show the ratio of circumference and diameter of circle..

Multiplication, addition, subtraction, square-root, cube-root etc, 'Ashtang' method introduced by Aryabhatta in his work hence Aryabhatta is known as the 'father of Mathematics'. Moreover he had written many other books like 'Dash Gitika' and 'Aryabhattiyam'. He has described main principles of Astronomy in short in his book named "Aryasiddhanta". He found the solution of fundamentals of methematics, i.e Arithmetic and Geometry.

A part from this, various aspects of Mathematics had been discussed by many scholars in their books. Among them, the scholars like Boddhayan, Aapastambha, Katyayan, Bhaskaracharya and Bhramhagupta are included.

Other Sciences

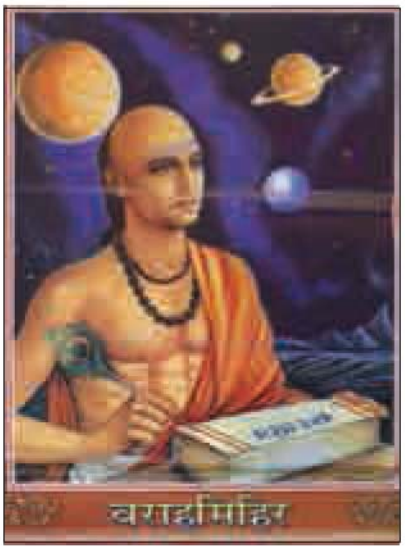
Many books were written on various sciences in the ancient India.

Other Sciences

Sr. no	Name of books Based on Science	Authors
1	Prajananshastra	Bhrambhravya panchal
2	Chikitsasangraha	Chakrapanidatta
3	Kamasutra	Vatsayayan
4	Vruksha Ayurveda	Maharshi Parashar
5	Yogashastra	Maharshi Patanjali
6	Yantra sarvasva	Maharshi Bharadwaj
7	Kaalganana	Shakmuni

Astronomy And Astrology

Astronomy is the most ancient science. Many works (Grantha) related to Astronomy had been written in India. An organized and deep study of Astrology was made by Indian ancient universities. Planets and their movements, constellations and other celestial objects were used for calculations through which astrology and astronomy were developed remarkbly, 'Predictions' were made on the basis of planetary movements.Aryabhatta made a remarkable contribution in the field of Astronomy. So the first Indian satellite was named "Aryabhatta" on his name. He declared that the earth rotates on its own axis and he proved that the basic reason for lunar eclipse is the shadow of the earth, which was addressed as 'Ajarbhar' by the scholars. In the same manner, Brahmagupta popularized the laws of gravitation in his book "Brahmasiddhant".



5.7 Astrologer Varahmihir

Varahmihir was the great astrologer and astronomer who divided astrology into 3 sections - Tantra, Hora and Samhita. His Grantha named 'Brihadsamhita' gives informationa regarding effects of planets on man's future, his charactristics, various classes of animals, the time of marriage, ponds, wells, gardens and good omen for sowing. We should feel pride that our ancestors were experts in the various sciences.

Vastushastra :

There is an immense contribution of ancient India in the field of Vastushastra. It is an inseparable part of astrology. Vastushastra of India is being recognized, dignified and praised by many countries of the world. Brahma, Narad, Bruhspati, Bhrugu, Vashishtha and Vishwakarma have made unique contribution in the field of Vastushastra.

They have propogated the principles of construction for dwellings, temple, palace, ashwashala, forts, store-house of ammunition and the town planning The description of Vastushastra is mentioned in 'Brihat Samhita', Rana Kumbha of Mewar revived this science


5.8 First architect of God : Vishwakarma

in the 15th century.

According to the traditional belief, Vishwakarma was the first architect of Gods. He divided Vastushastra into eight sections .Various information of Vastushastra like selection of place, shapes, structure, proper planning of things, temples, Bhramsthan, dining - room, bedroom etc. are mentioned. As the time passes by changes are taking place regarding the principles and understanding of Vastushastra. Now it is being adopted by the foreigners.

Ancient Indian knowledge of science has been accepted by the world. Indian culture is very vast and heterogeneous It is a blending of science and religion, traditional ideals and practical knowledge, which is rarely seen in the other countries of the world. Tolerance and equality towards all religions is seen in our culture. Inspite of having diversity in religion, life style and values we see unity in our country. We should not forget that, Indian culture reflects unique feature of 'unity in diversity'.

Exercise

1. Answer the following questions in detail :

(1) Write about the contribution made by ancient India in metallurgy.

(2) Write about the development in chemistry achieved by ancient India.

(3) Discuss ancient India's progress in medical science and surgery.

(4) Write about the scientific heritage of ancient India.

2. Answer the following questions pointwise :

(1) Write about the progress made by ancient India in mathematics.

(2) Write a short-note on : Astronomy of ancient India.

(3) Write contribution of India in the field of astrology.

(4) Which information are included in Vastushastra ?

3. Answer the following questions in short :

(1) What is meant by science and technology ?

(2) Write about the contribution of Nagarjuna in the field of chemistry.

(3) Write a note on discoveries made by Aryabhatta in mathematics.

(4) Into how many sections is astrology divided ?

(5) Name the pioneers of Vastushastra ?

4. Choose the correct option from the following to answer the following question :

(1) Which sculpture has international significance from the art point of view ?

(A) Buddha (B) Nataraja (C) Bodhigaya (D) Ram-the archer

(2) Which is not correct statement from the following ?

(A) Nagarjuna is considered as a Acharya of chemistry.

(B) The use of mercury ash as a medicine has been initiated by Nagarjuna.

(C) Chemistry is not a science of experiment.

(D) Description of metallic ashes is seen in the works (books) of chemistry.

(3) Maharshi Charak : Charak Samhita ; Maharshi Shushrut : .....

(A) Shushrut Samhita (C) Vagbhatta Samhita

(B) Charak Shastra (D) Shushrut Shastra

(4) In the class of a school various students discuss about mathematics. Which one is true among them ?

Shreya : Bhaskaracharya had written book named "Lilawati Ganit" and "Bij Ganit".

Yash : Boddhayan discovered decimal system.

Mansi : Aryabhatta is acknowledged as a father of mathematics.

Harda : India discovered zero (0).

(A) Yash (B) Harda (C) Shreya (D) Shreya, Mansi, Hard

(5) Book written by Brahmbhava Panchal is .....

(A) Chikitsasangraha (B) Prajananshastra (C) Kamasutra (D) Yantra Sarvaswa

(6) In ancient India, who wrote 'Brahmsidhant' which declares the law of gravitation ?

(A) Brahmgupta (B) Vastsyayan (C) Grutsamad (D) Maharshi Patanjali

(7) Which science from the following suggests about the principle of direction while constructing temples, palaces, ashwashala, fort etc. ?

(A) Mathematics (C) Science of medicine

(B) Chemistry (D)Vastushastra

Activity

- Arrange a seminar on the subject of "Science of Ancient India."
- Prepare an exhibition of photographs of - Nagarjuna, Charak, Shushrut, Aryabhatta, Brahmagupta, Bhaskaracharya, Varahmihir, Vishwakarma etc.
- Prepare handwritten article on "Science in India."
- Collect the information to make a project work "Scientist of India".
- Find out details of 'Ancient inventions of Science' with the help of Internet and exhibit them on the notice board.
- Prepare chart on the subject "Science of Ancient India" by using library
- Arrange an elocution competition on 'Contribution of Women in science'.

Fact

22nd December is declared as 'National Maths Day' and 2012 as 'National Maths Year' in the memory of Shriniwas Ramanujan.