

**Khandesh College Education Society's
Moolji Jaitha College**



Organized a IKS Lecture
on
Topic

IKS-121 Introduction to Indian Knowledge System
Semester II

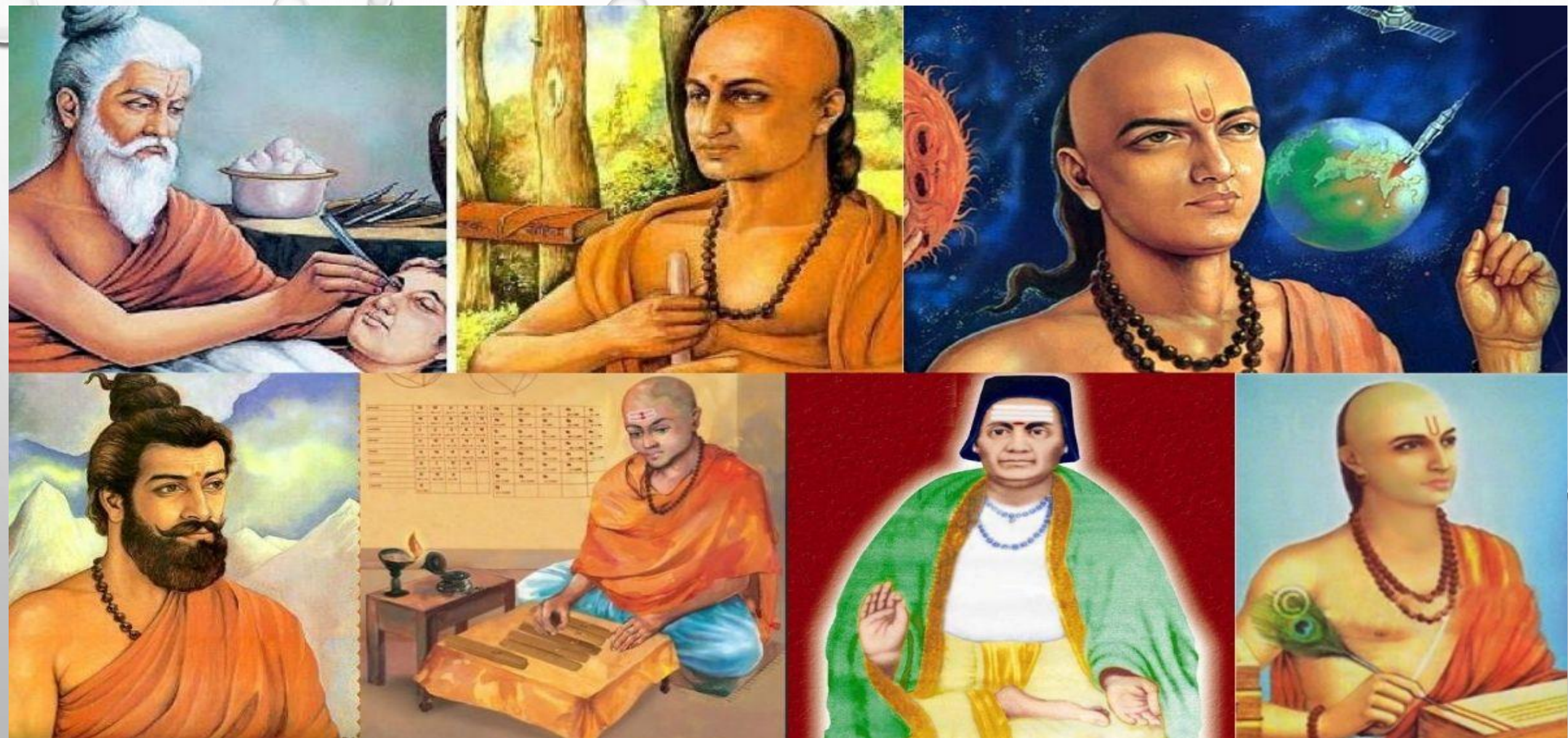
UNIT I. SCIENCE IN ANCIENT INDIA
a. Physics of ancient Indian technologies

Presented by
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Department of Physics,
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A.Y.-2023-24



Ancient Indian Scientist



❖ Contents:

1. **Indian contribution to Science (From Ancient to Modern era)**
2. **Overlook**
3. **Chronological overview**
4. **Name of Scientist & Field**
5. **Ancient Physicist**
6. **Summary**

Even today in the world of
Robotics,

We term as.....

‘Traditional knowledge’

is actually based on scientific
reasoning.

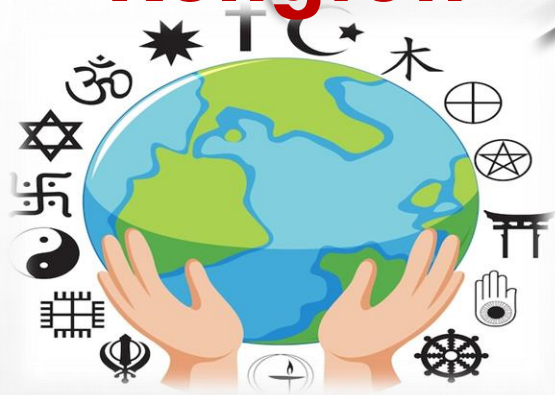


आजही **रोबोटिक्स**च्या जगात,
आम्ही म्हणतो

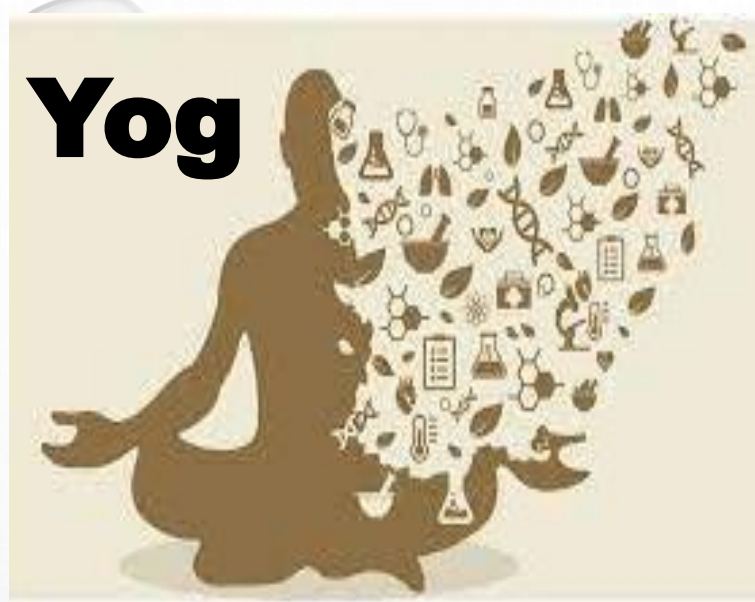
‘पारंपारिक ज्ञान’

प्रत्यक्षात वैज्ञानिक तर्कावर आधारित
आहे.

Religion



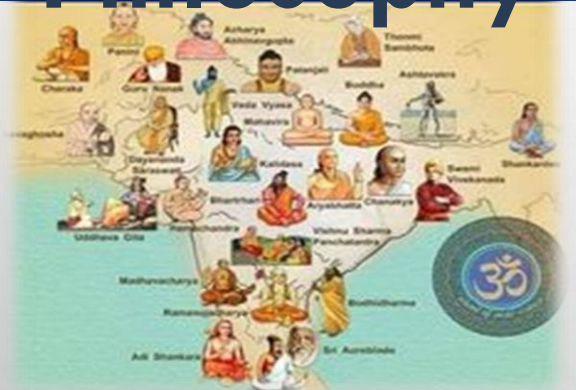
Yog



Aayurved

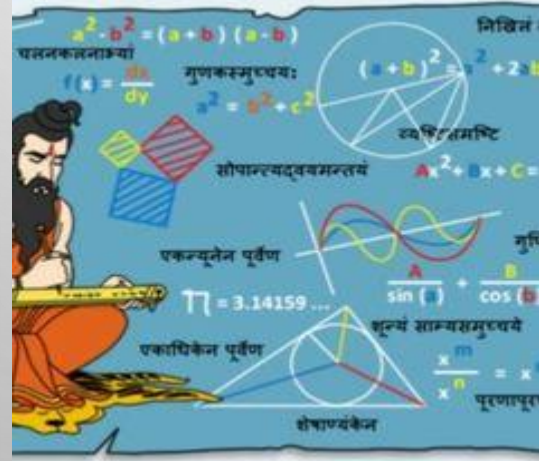


Philosophy



Scientific Achievements

Mathematics



Astronomy

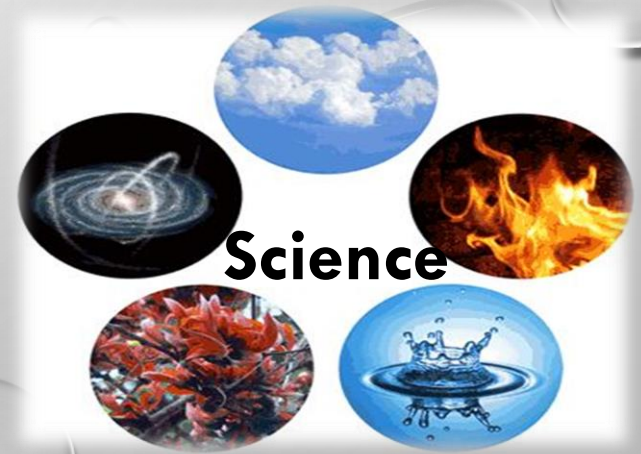
Father of Indian medicine Acharya charak



Medicine



Literature



Science



India

Propaganda

Baudhyan: Mathematical concepts

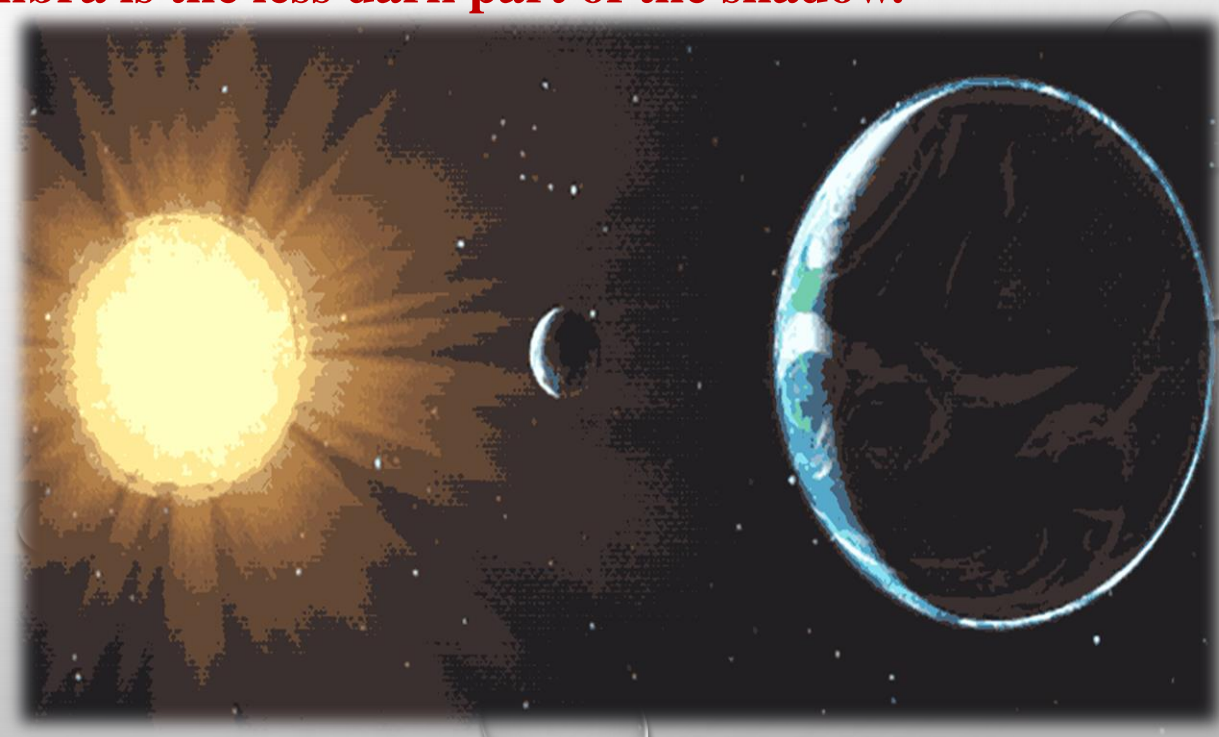
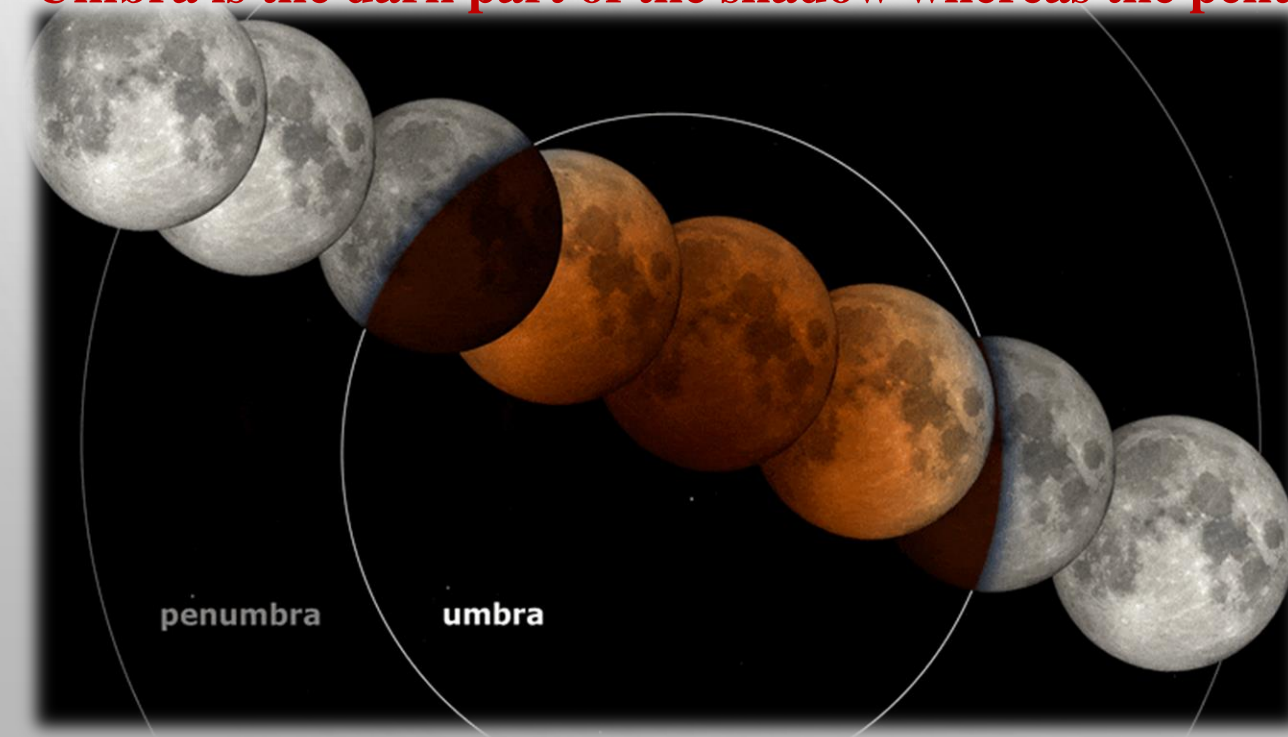
- **First mathematician who talked about and calculated value of π (pi)- to calculate circle and area of circumference.**
- **Sulva sutra (before Pythagoras)**

Aryabhata:

Also, calculated value of $\pi = 3.1416$

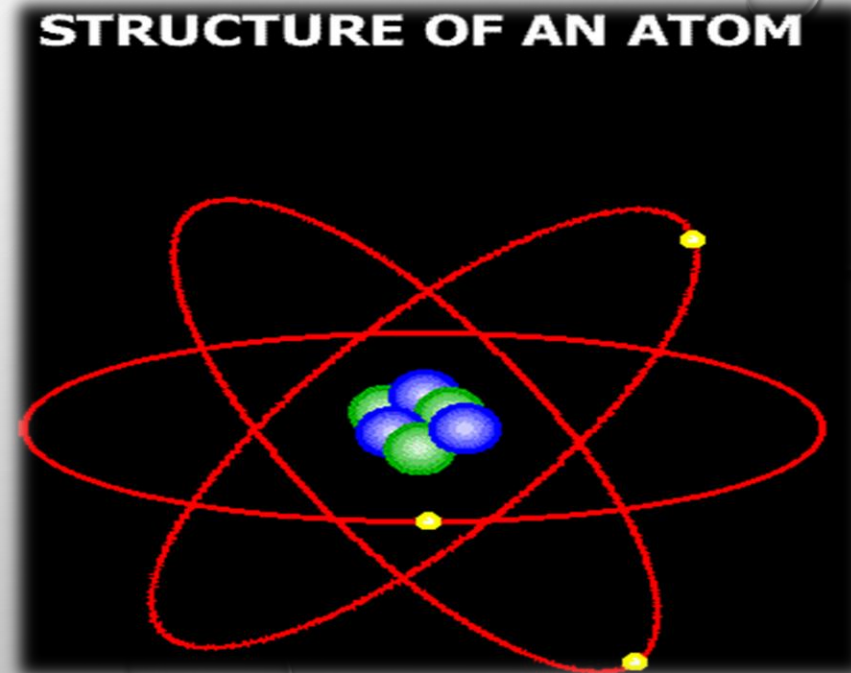
- **Decimal system, number theory, etc.**
- **Solar system hypothesis**

Umbra is the dark part of the shadow whereas the penumbra is the less dark part of the shadow.



Rishi Kanada (6th century BC):

- **Vaisesika school concept**
- **Atomic theory**



Varahmihira (6th century AD):

- **Hydrology**
- **Geology**
- **Ecology**
- **Astrology**
- **Identified Six animals and thirty plants who can help to locate Groundwater**
- **Brihatsamhita (about Earthquake)**
- **Panchsidhantika (5 astronomical system)**

Nagarjuna (2nd century BC)-Chemist

The existence of the **Iron Pillar in Delhi**, the pillar was installed as a trophy in building the Quwwat-ul-islām mosque by Sultan Iltutmish in **13th century**. It is evident that India's indigenous technologies had been very sophisticated. India's Contribution to Science and Technology (from Ancient to Modern). Indian Contributions to Science natural air conditioning, complex stone work and construction engineering.

The Indus Valley Civilization was the world's first to build planned towns with underground drainage, civil sanitation, hydraulic engineering and air-cooling architecture. While other ancient civilizations of the world were small towns with one central complex, the Indus Valley Civilization had the distinction of being spread across a region about half the size of Europe. Weights and linguistic symbols were standardized across this vast geography, for a period of over 1000 years, from around 3000 BCE to 1500 BCE

Charak & Atrey Rishi (1st century BC):

- **Early pro-pounders of Ayurved and Medical science**
- **Royal Doctor (राज वैद्य) of Emperor Kanishka-Charaka**
- **Charak Samhita- provided root causes & treatments for various diseases**

Sushruta (1000 to 800 BC):

- **Plastic surgery- Rhino surgery**
- **Cataract-Ophthalmic surgery**
- **Sushrut Samhita~ apart from 1100 diseases & 700 medicinal plants**

Patanjali (2nd century BCE to 4th century CE):

- **Yoga—comes Sanskrit word ‘Yuj’, means ‘to unite’-individual and universal consciousness**
- **Healing without medicine**
- **Provided physical, mental, emotional & spiritual balance**
- **Meditation and controlled breathing (प्राणायाम)**
- **..... From 21st June 2015 – Global recognition to rich and glorious Indian past**

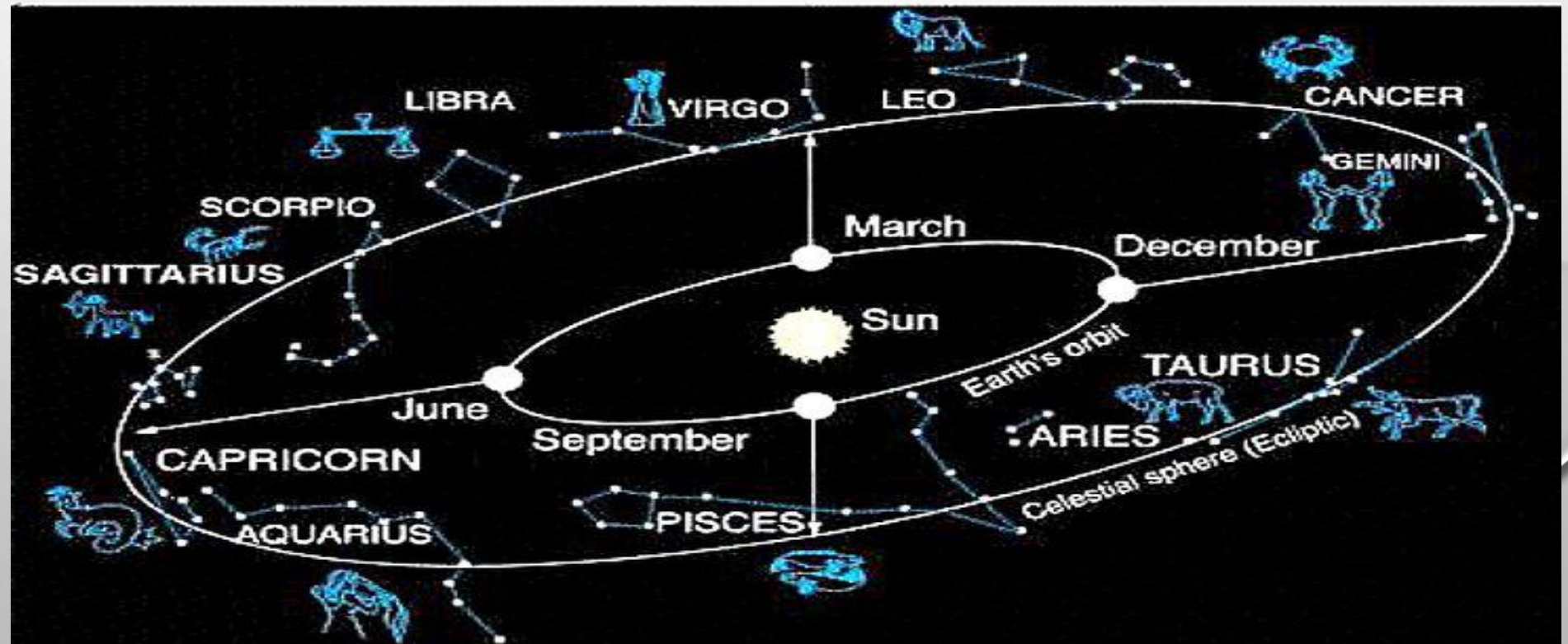
The background features a light gray gradient with several realistic water droplets of various sizes scattered across the surface. A faint, circular, textured pattern is visible in the upper center of the image.

Indian Ancient Physicist

○ Lagadha (1st millennium BCE):

Vedanga Jyotica, which provides details on several astronomical attributes, generally applied for timing social and religious events.

1. Vedanga Jyotica has connections with Indian astrology and mentions important aspects of the time and seasons, including lunar months, solar months, and their adjustment by a lunar leap month of Adhimasa. Ritus and Yugas are also described.
2. It also mentions of 27 constellations (नक्षत्र), eclipses, seven planets and 12 signs of the zodiac known at that time.



○ **Aryabhata (476–550 CE):**

Aryabhata was the author of the **Aryabhatiya** and the **Aryabhatasiddhanta**.

1. Aryabhata explicitly mentioned that the earth rotates about its axis, thereby causing what appears to be an apparent westward motion of the stars.
2. Aryabhata also mentioned that reflected sunlight is the cause behind the shining of the moon.
3. Principles of the diurnal (दैनंदिन) rotation of the earth-Earth's rotation from west to East.

.....*continued*

- **Great Physicist, Astronomer & Mathematician**
- **Value of Π (pi)**
- **Notable invention of Zero (0)**
- **Earth is spherical body & it rotates around its own axis**
- **Heliocentrism (सूर्यकेंद्री)**
- **Lunar eclipses (In 1975 first launched satellite named Aryabhata)**



Bhaskara I (629 CE):

His works on astronomy are Mahabhaskariya, Laghubhaskariya and Aryabhatiyabhashya (629 CE), a commentary on the Aryabhatiya.

- devised methods for determining the parallax in longitude directly, the motion of the equinoxes and the solstices, and the quadrant of the sun at any given time.

I. Physics in Vedas:

- **Atomic Theory from Bhagavad-Gita**

Which Indian invented atomic theory?

Acharya Kanad

However, the atomic theory was formulated 2500 years before Dalton which was given by an Indian sage and philosopher. - The Indian sage who gave the atomic theory was Acharya Kanad.



Who is the real father of atomic theory?

John Dalton, (born September 5 or 6, 1766, Eaglesfield, Cumberland, England—died July 27, 1844, Manchester), English meteorologist and chemist, a pioneer in the development of modern atomic theory

From the 19th century to the 21st century everyone knows John Dalton who is credited with the development of atomic theory.

But today in this era a very few people know that the atomic theory was originated about 2,600 years ago by an Indian sage and philosopher. It is believed that the sage lived between the 6th century to 2nd century BCE.

It was **Rishi Kanada**, an Indian philosopher who drafted the ideas about the atom in a systematic manner. His real name was to be known as "**Kashyap**". Since his childhood, even small things tempted his attention. He is being called as *the father of the atomism*, who propounded the *parmanu* (atoms), an approach to physics and philosophy in the approach to physics and philosophy in the Sanskrit text "**Vaisesika Sutra**".

Vaiseshikas further claimed that atoms of the same substance combined with each other create **dvyanuka**(diatomic molecules) and **tryanuka**(triatomic molecules).

Electricity has become an important part of our life. It is quite impossible to imagine life without electricity now a days. Electricity from thunder and lightning has also fascinated us since primitive ages. We are still working on how to safely store and use the enormous electric energy discharged from thunder and lightning. We have ample evidence which proves the use of electricity and battery way back around 10000 – 8000 BCE.

People in ancient times were well aware about electricity. Electricity has been cited in the **5th Mandal of Rigveda**. Example: Oh people! The day and night can be spent in comfort, if electricity and fire, just like the Sun God are used tactically.

सुपेशसं माव सृजन्त्यस्तं गवां सहस्रै रुशमासो अग्ने ।

तीव्रा इन्द्रमममन्दुः सुतासोऽक्तौर्व्युष्टौ परितक्म्यायाः ॥

ऋग्वेद – ष्.३०.१३

Different kinds of electricity:

- ***TADITA*** (– (तडति) Generated by rubbing silk cloths
- ***SAUDĀMINĪ*** (– (निमदिदौस) Generated by rubbing two gems
- ***VIDYUT*** (– (तद्युव) Generated from thunder
- ***ŚATAKUMBHĪ*** (– (भिकुंतश) Generated by hundred cells of pillars (Kumbha's)
- ***HRDANI*** (– (निदह) Stored electricity with portable properties
- ***AŚANI*** ((निशअ – Generated from magnetic rods (P. P. Hole –Machines in Samskrit Literature)

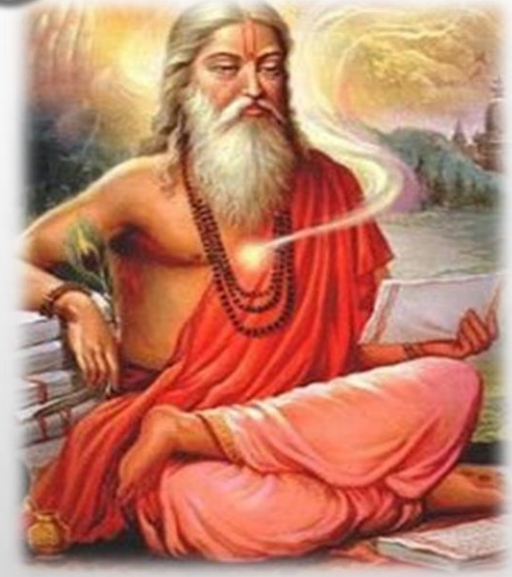
The three main sources of Light and Energy mentioned in the R̥igveda are:

1. The Sun
2. Electricity
3. Fire inside the Earth

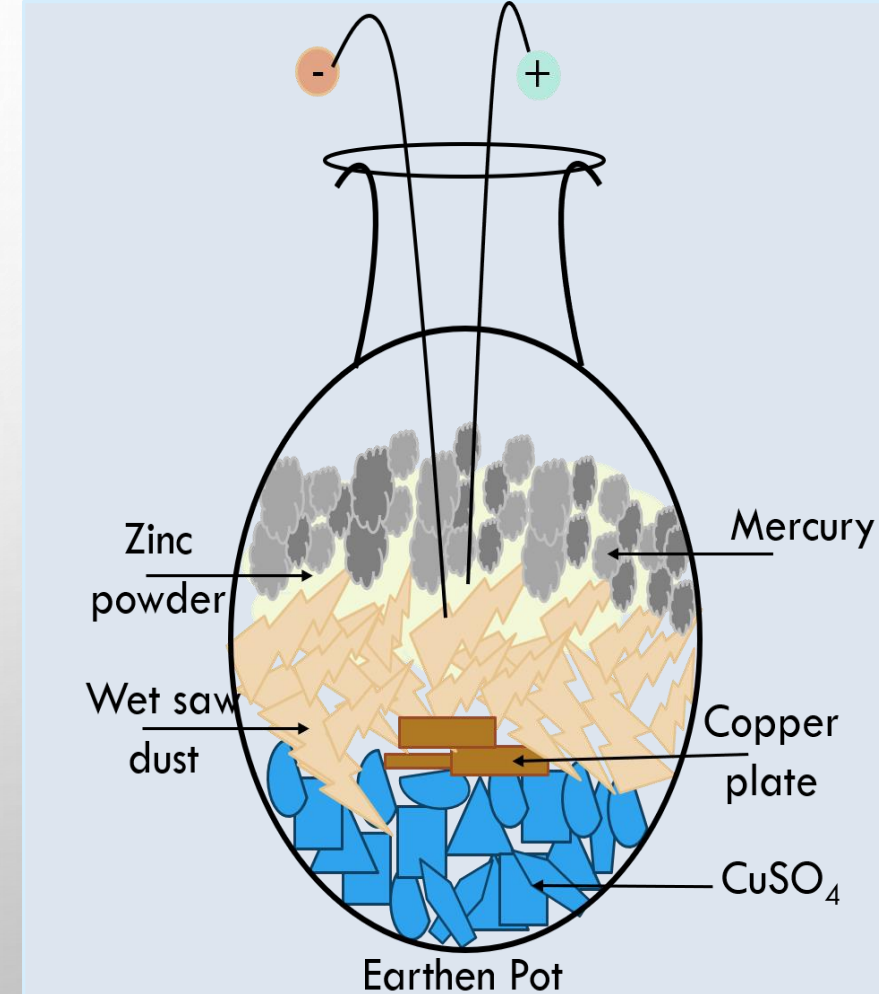
त्री रोचना वरुण त्रीरुत द्युन्त्रीणि मित्र धारयथो रजांसि ।
वावृधानावयति क्षत्रियस्थानु व्रतम् रक्षमाणावजुर्यम् ॥
ऋग्वेद ५.६९.१

Henceforth, it can be assumed from the above verse, that use of Sunlight during day time and Electricity at night was used during the Vedic age. The great Sage Agastya mentioned the process of making Battery in his composition Agastya Saṁhitā (around 8000 BCE).

History of Electricity: From Ancient Times to the Modern Times



संस्थाप्य मृण्मये पात्रे ताम्रपत्रं सुसंस्कृतम् ।
छादयेच्छिखिग्रीवेन चार्दाभिः काष्ठपांसुभिः ॥
दस्तालोष्टो निधातव्यः पारदाच्छादितस्ततः ।
संयोगाज्जायते तेजो मित्रावरुणसंज्ञितम् ॥
(दूसरा सन्दर्भ, परा. हि. शि. शा. सा , आगस्त्य षंहिता पृष्ठ १३६)



अनेन जलभङ्गोस्ती प्राणो दानेशु वायुषु एवम् शतनं
कुम्भनसंयोगकार्यकृतस्मृतः।

Translation:

“He says that if we use the power of 100 earthen pots on water, then water will change its form into life-giving oxygen and floating hydrogen.”

वायुबन्धकवस्त्रेन् सन्ति यनमस्तके उदानः स्वालाघुत्वे बिभारत्यकाशायनकं ।

Translation:

If hydrogen is contained in an air tight cloth, it can be used in aerodynamics, i.e. it will fly in air.

• **Laws of Motion:**

Invention of laws of motion There are two great scientists behind the invention of law of motion: **(1) Rishi Kanada and (2) Sir Isaac Newton (1643-1727)**. We, all are familiar with Newton's Laws of Motion that Sir Isaac Newton, the physicist who formulated the laws of motion first. He published these laws in his book, "Philosophica Naturalis Principia Mathematica" on July 5, 1687.

But before Newton, the laws were discovered by Indian scientist and philosopher Rishi Kanada who had given **Vaisheshika Sutra in 600 BCE** which describes the relation between force and motion. We first discuss the Newton's three laws of motion.

The Rishi Kanada's Vaisheshika Sutra [5, 6, 11]

Mahrshi Kanada mentioned karma is related to motion, and there five types of motion:

- 1) Upward Motion
 - 2) Downward Motion
 - 3) Motion due to release of tensile stress
 - 4) Shearing stress
- General motion

➤ **First Sutra**

वेगः निमित्तवशेषात् किमणो जायते | [Vegah Nimitta Visheshat Karmano Jayate].

Translation: Change of motion is due to impressed force. (The law states that an object at rest tends to stay at rest and an object in motion tends to stay in motion with the same speed and in the same direction unless acted upon by an unbalanced force.)

➤ **Second Sutra** वेगः निमित्तापेत किमणो जायते नियतदिक क्रियाप्रबन्धहेतु | [Vegah Nimitta Pekshat Karmano Jayate Niyatdik Kriya Prabandha Hetu].

Translation: Change of motion is proportional to the impressed force and is in the direction of the force.

➤ **Third Sutra** वेगः संयोगवशेषवरोधी | [Vegah Sanyog Vishesh Virodhi.]

Translation: Action and reaction are equal and opposite.

Matter States:

Paramaanu corresponds to the organic molecular size as estimated by the modern western scientists. As mentioned in the *Upanishads*, the five elements of the nature are -

- **Earth**
- **Water**
- **Air**
- **Fire** and
- **Akasa**

However, the concept of Akasa was missing amongst the ancient Greek or Roman philosophers. It was quite easy to deduce the role of the remaining four elements as –

- **The Earth represents the solid state**
- **The Water constitutes the liquid state**
- **The Air forms the gaseous state and**
- **The Fire constitutes of the plasma as the fourth state of matter.**

Bhaskaracharya: Theory of Gravitation:

Bhaskaracharya stated the laws of gravity in the book Surya Siddhanta in 11th century.

Here there are some of the shlokas from Surya Siddhanta that mentions how gravitation works:

“मध्ये समन्तन्दस्य भुगोलो व्योमनि तिस्थति बिभ्रानः परमस्सक्तिं ब्राह्मणो धरणात्मिकम्”.

[सूर्यसिद्धान्त १२ अध्याय ३२ श्लोक]

Translation: The spherical earth stands at its centre in space due to the dharanatmikam sakti which prevents earth from falling away and helps it to stand firm.

“अक्रस्त सक्तिश्च महि ताय यत् स्वस्थं गुरु स्वाभिमुखं स्वसक्त्य अक्रस्यते तत्पततीव
भाति समान समन्तत् क्व पातवियम् खे”
[सिद्धान्त शिरोमणि, भुवनकोस, ६ श्लोक] ।

Translation: Every object falls on the ground due to earth’s force of attraction. This force allows the sun, earth, moon and constellations to stay in the orbit. **Bhaskaracharya wrote a treatise ‘Lilavati’,** he explained that earth has gravitational force (**gurutvakarshan shakti**). There is a mutual attraction between the planets and this allows them to hold themselves firmly in space. He also mentioned the shape of the earth that “what we see is not the reality, Earth may appear flat but it is spherical in reality”. He further explained this theory by stating: “if you draw a very big circle and look at one fourth of its circumference, you see it as a straight line. But in true sense it is a circle. Similarly, earth is spherical in shape.” These historical mentions were the proofs that law of gravity was first discovered in India by Bhaskaracharya. His law predated the law of Newton. Everybody knows about Newton’s law of Gravity but we do not have any idea about “Bhaskaracharya’s Law of Gravity”.



Light:

In Rig Veda, light is explained as a source of energy or source of our life. Nature of light as a wave or as a particle was not come into picture till late into the modern age, but in Rig Veda it is clearly mentioned that **“Seven horses draw the chariot of the sun, tied by snakes”**. (Rig-Veda 5. 45. 9)

Above poetic verse speaks about the nature of light as being composed of 7 rays and the snake symbolizes it's curved path. Now, these colors are actually described as red, orange, yellow, green, blue, Indigo and violet in the yoga sutras and the Vedic Upanishads.

In Rigveda, following sloka's state about the speed of light which is nearly about of modern value of 186,282.397 miles / seconds:

तारान् विश्वदर्शतो ज्योतिष्रदसि सूर्य विश्वमा भासिरोचनं ॥

Meaning: Oh Sun! (You) overwhelm all in speed, visible to all, source of light (You) shine pervading the Universe.

“योजनानं द्वे द्वे शाते द्वे च योजना एकं निमिषर्धेन क्रम्मना नमोस्तुते”

(Rig-Veda I,50-4)

In the verse Sun light speed is measured with the help of units called Yojan & Nimesha. This verse explain that sunlight moves 2202 Yojans in Half Nimish.

Importance of Acoustics:

In modern times the importance of acoustics is very well known. The field of acoustics deals with generation, propagation and reception of sound.

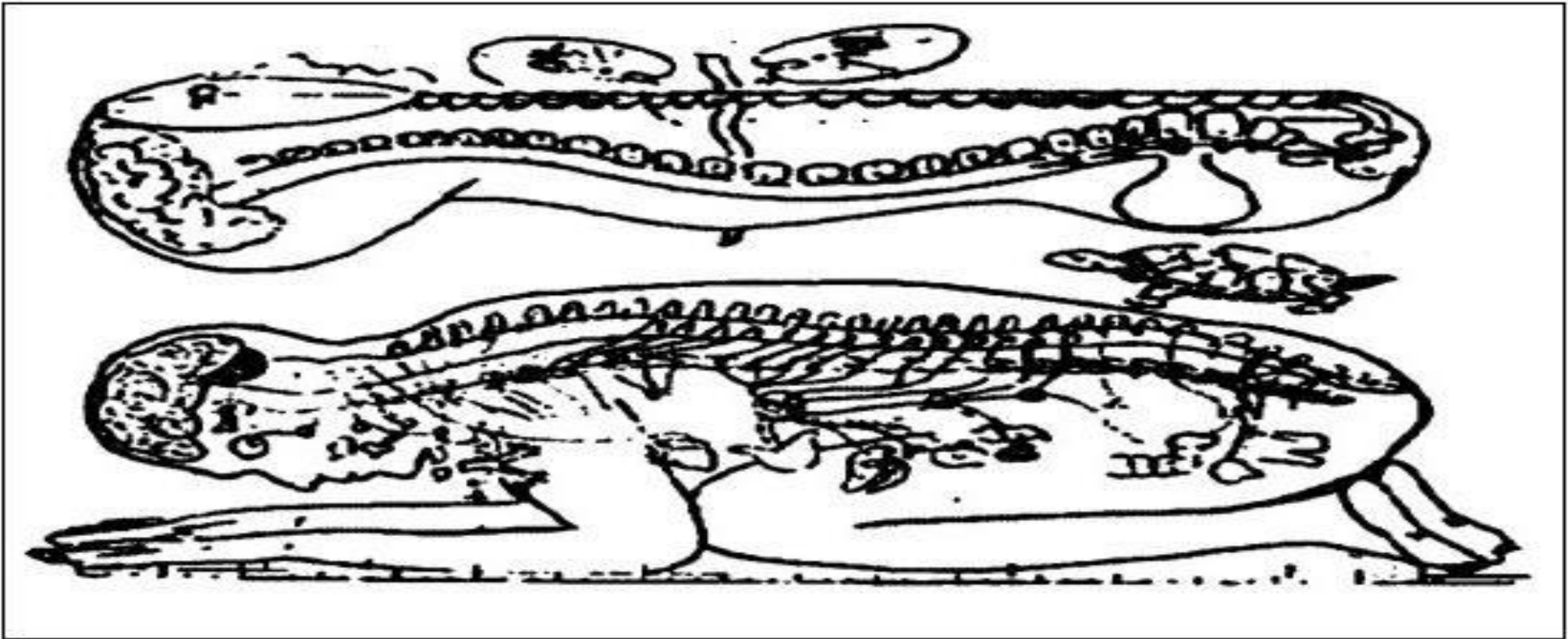


Figure 5 : Representation of the musical instrument Veena (above) with spinal cord of a human being (below).

Science from Modern Era

Satyendra Nath Bose

- discovery of 'Higgs Boson' or popularly called the 'God Particle'. work in Quantum Physics.
- 'Bose-Einstein Theory' and a kind of particle in atom has been named after him as Boson.

Meghnad Saha astrophysicist,

- chemical and physical conditions in stars.
- built a cyclotron, the first of its kind in the country.
- invented an instrument to measure the weight and pressure of solar rays and helped to build several scientific institutions

SIR C.V. Raman

- 'Scattering Effect of the Sunlight'. This discovery is called 'The Raman Effect'.

Jagadish Chandra Bose

- Physics to the study of metals and then plants
- invented an instrument to record the pulse of plants.

Homi Jehangir

- Indian Atomic Energy programme. Bhabha,
- carried out outstanding original research relating to cosmic radiation.

M.K. Vainu Bappu

- a senior astronomer in the Nizamiah Observatory, Hyderabad. creation of the Indian Institute of Astrophysics.
- revival of optical astronomy in independent India.
- father of modern Indian astronomy.

Anil Kakodkar

- the famous Indian nuclear scientist,
- became the youngest Director of the BARC after Homi Bhabha himself.

A. P. J. Abdul Kalam

- a man of great distinction. Known as the Missile Man of India worldwide,
- became very popular as India's eleventh president.
- He also played a pivotal organizational, technical and political role in India's Pokhran-II nuclear tests in 1998.

Kalpana Chawla

- Chawla joined NASA's space programme in 1994 and her first mission to space began on 19 November 1997 as part of a six-astronaut crew on Space Shuttle Columbia Flight STS87

Sunita Williams Pandya

- holds three records for female space travellers—longest space flight (195 days), number of space walks (four) and total time spent on space walks (29 hours and 17 minutes).

Thank

You