

Fundamentals of Science

Definition - In this, we study physics, chemistry, biology - all these branches, we call the basic principles of science.

Principles of physics

Newton's laws of motion -

❖ **First Law** - An object remains in its state of rest (state of rest-uniform motion) unless an external force is applied. 1 is Newton's first law of motion - sometimes referred to as the **law of inertia**.

Example - When a bus starts suddenly, then passengers in the bus tend to fall backwards.

❖ **Second law** - The rate of change of momentum is proportional to the applied force and the change takes place in the same direction in which the force is applied.

Example - While taking a catch, the player moves his hand backward.

❖ **Third Law** - Every action has an opposite and equal reaction and acts on different things. If they act on the same object, the resultant force will be zero. This is called the principle of **conservation of momentum**.

Example - When a gun is fired, the gunner gets pushed backward.

❑ **Principle of Conservation of Momentum** - When two or more objects interact with each other and no external force is acting on them, then their total momentum is always conserved.

Example - Motion of rockets, Air-filled balloons

❑ **Newton's Law of Gravitation** - The result of the force acting between any two bodies is proportional to the product of the masses of the bodies and inversely proportional to the square of the distance between them.

❑ **Pascal's Law** - The pressure of matter in equilibrium is equal all around.

❑ **Hooke's Law** - Within the limit of elasticity, stress is always proportional to strain.

❑ **Archimedes' principle** - The upward force acting on a solid immersed in a liquid is equal to the weight of the liquid displaced by the solid.

❑ **Boyle's Law** - The volume of a given amount of gas at a given temperature is inversely proportional to its pressure.

❑ **Charles' law** - If the pressure is constant, the volume of the gas is directly proportional to the temperature.

❑ **Kinetic principle of gasses** - If gas is placed in a cubical vessel, then the pressure of the gas is equal to the pressure produced by the gas, which is produced by the gas in the unit area of the wall of the vessel in the unit seconds.

❑ **Newton's law of cooling** - The rate of cooling of an object is directly proportional to the average temperature of that object and the temperature inside the atmosphere, provided the temperature difference is less.

❑ **Joule Thomson Effect** - If the flow of gas is allowed to spread freely in a porous medium under a pressure, then the difference in temperature of the gas is called the Joule Thomson effect. It is used for effective cooling.

Laws Of Thermodynamics

First Law -

1. The heat produced in a mechanical action is proportional to the work done.
2. The first law of thermodynamics represents the law of conservation of energy.

Second Law - According to this law, it is not possible to convert the entire part of available heat into mechanical work, but a certain part of it can be converted into work. That is, heat cannot automatically flow from an object of lower temperature to an object of higher temperature.

Doppler's law -

1. If this sound is moving relative to the source and the listener, then the frequency of the sound appears to the listener to be different from the pitch.
2. The phenomenon of apparent change in sound is called Doppler's law.

Ohm's Law - If the physical states of a conductor remain unchanged, the potential difference across its ends is directly proportional to the current in it.

Principles of Chemistry

- Boyle's Law** - The volume of a given amount of gas at a given temperature is inversely proportional to its pressure.
- Charles Law** - If the pressure is constant, the volume of the gas is directly proportional to the temperature.
- Law of pressure** - The pressure of a certain mass of a gas at a constant volume is directly proportional to its absolute temperature, that is, if the temperature of a gas at a constant volume is increased, the pressure increases and if the temperature is decreased, the pressure decreases.
- Rutherford's nuclear theory** - According to this theory, most of the space inside the atom is empty and the atom is spherical, the size of the nucleus is very small as compared to the size of the atom.
- Kinetic Principle of Gasses** - If gas is placed in a cubical vessel, then the pressure of the gas is equal to the pressure produced by the gas in unit seconds of the wall of the vessel.
- Joule Thomson Effect** - If the flow of gas is allowed to spread freely in a porous medium under a pressure, then the difference in temperature of the gas is called Joule Thomson effect. It is used for effective cooling.
- Pascal's Law** - In equilibrium the pressure of matter is equal all around.
- Hooke's Law** - Within the elastic limit, stress is always proportional to strain.
- Principles of Conservation of Energy** - Energy is neither created nor destroyed, that is, the total energy of any body is always fixed, it only changes from one form to another.

Principles of Biology

Cell theory -

- ❖ The cell theory was given by Matthias Schleiden in 1838 and 'Theodor Schwann' in 1839. He said that the bodies of plants and animals are made up of cells.
- ❖ 'Rudolf Virchow' was the first to say that Omnis cellula-e-cellula means that the cell divides and new cells are produced by the division of the precursor cells.

Modern cell theory - 'Rudolf Virchow' modified this theory of Schleiden and Schwann to present a new cell theory, which is called modern cell theory. According to –

- ❑ The body of every living being is made up of one or more cells.
- ❑ Cell is the structural and functional unit of living things. All cells are the same. Contains organelles, nucleus and cell organelles.
- ❑ The cell is covered by a thin cell membrane and cell wall.
- ❑ Cell wall is found only in plant cells, not in animal cells.
- ❑ The chemical organization and metabolic activities of all cells are the same. Hence cells are called functional units of living things.
- ❑ New cells are formed by the division of the preceding cells.
- ❑ Cells contain genetic material that is passed on from one generation to another generation. Hence the cell is called the unit of inheritance.

Principles Of Biological Evolution

The theory of biological evolution can be understood as follows - Lamarckism, Darwinism, Neo-Darwinism, Repetition theory.

Lamarckism -

- ❑ There is continuous growth in the living beings and their organs.
- ❑ Organisms that are directly affected by environmental changes.
- ❑ In living beings, the development of the more used organs is more and the less used organs develop less.
- ❑ This theory of Lamarck's was published in 1809 in his book Philosophy Geologic.
- ❑ Lamarckism is also called the principle of less or more use of organs.
- ❑ According to Lamarckism, changes in the environment have a direct effect on the structure, physiology, and behavior of organisms.
- ❑ According to Lamarck's theory of inheritance of acquired traits, acquired traits of animals are inherited. which were transferred from one generation to another.

Darwinism -

- ❑ Development of animals by choice of nature According to this principle, maximum potential of progeny is found in all living beings.
- ❑ Due to the high rate of reproduction in each organism, the organisms have to struggle for their existence. These conflicts are homogeneous (Samjatiya), inter-caste and environmental.
- ❑ Homogeneous organisms are not the same. Such variations are inherited by them from their parents.

Neo-Darwinism - This is also known as mutation theory which was presented by Hugo de Vries of Holland in 1901.

- ❑ Neo-Darwinism is also called the modern communicative hypothesis.
- ❑ It is the result of the interaction of the following processes.
- ❑ Mutations, genetic recombination, variation by changes in the structure and number of chromosomes, segregation.

Recapitulation theory - Ernest Haeckel also called it caste allocation theory. The main feature of this theory is embryonic stages of an organism are similar to the adult stages of its ancestors.

India's Leading Scientific Institutes And Their Achievements

Space research center

ISRO (Indian Space Research Organisation)

Reconstitution of the Indian National Committee on Space Research (formed-1962)
The Indian Space Research Organization (ISRO) was established on August 15, 1969, by Dr. Vikram Sarabhai, who became its first chairman. Dr. Vikram Sarabhai is called the father of the Indian space program. The Space Commission and the Department of Space were formed in 1972 for the smooth functioning of the Indian space programmes.

“Space Technology in the Service of Mankind” is the motto of ISRO. The current Chairman of ISRO 2021 is Shri S. Somnath.



Achievements -

- ❑ On 19 April 1975, Aryabhata, the first Indian satellite built with indigenous technology, was launched with the help of the Soviet Union.
- ❑ On 18 July 1980, India's first satellite launch vehicle SLV-3 was successfully tested from Sriharikota, by Rohini RS-1 is the first Indian satellite launched by an Indian launch vehicle from Indian soil.
- ❑ On 19 June 1981, India's first communication satellite Apple was placed in geostationary orbit.
- ❑ INSAT-IB was launched in the year 1983 with the launch of a series of Indian National Satellite System INSAT which is one of the largest domestic communication satellite systems in the Asia Pacific region, it is used for domestic telecommunication, television broadcasting, radio broadcasting, and scientific studies. It is used for land surveying and data transmission.
- ❑ On 3 April 1984 (from the Soyuz-T-2 spacecraft), Squadron Leader Rakesh Sharma became the first Indian to go into space. The Indian Remote Sensing Satellite System has been developed with the launch of India's first remote sensing satellite IRS-1A in the year 1988, its purpose is to survey and continuously monitor natural resources and to provide authentic information.
- ❑ In 1993, the Polar Satellite Launch Vehicle PSLV was successfully tested.
- ❑ In 2001, the Geosynchronous or Geostationary Satellite Launch Vehicle (GSLV) was partially successfully tested.
- ❑ On 8 May 2003, GSLV-D2 was successfully launched from the Satish Dhawan Space Center, after this success, India joined the elite group after proving its success in GSLV.
- ❑ India's first Chandrayaan mission Chandrayaan-1 was launched from Sriharikota by PSLVC11 on 22 October 2008.
- ❑ M.O.M. (Mars Orbiter Mission) On 5 November 2013, ISRO launched its Mars spacecraft from Sriharikota by PSLV C-25.
- ❑ On 24 September 2014, Mangalyaan entered the orbit of Mars, making India the first country in the world to reach Mars in its first attempt.
- ❑ India is the first country in Asia to enter the orbit of Mars.
- ❑ ISRO is the fourth space agency to enter the Martian orbit after NASA ESA (European Space Agency) and Roscosmos.

- ❑ On 15 February 2017 ISRO successfully launched a record 104 satellites in a single mission from Sriharikota by PSLV C-37, three of which were 101 foreign satellites from India. India has become the first country in the world to launch 104 satellites on Earth with a single rocket.
- ❑ India has become the first country in the world to launch 104 satellites on Earth with a single rocket.
- ❑ On 29 September 2015, India's first observatory dedicated to astronomical research, AstroSight, successfully tested it.
- ❑ The first indigenous reusable space shuttle was launched on 23 May 2016.
- ❑ Chandrayaan-2 was successfully launched by the Indian GSLV-MK3 on 22 July 2019, and the Orbiter, Lander (Vikram) and Rover (Pragyan) have been used, this mission could not be a complete success.
- ❑ On 28 October 2006, India successfully tested the absolute low temperature (cryogenic) state at Mahendragiri in Tamil Nadu.
- ❑ On 28 October 2006, India successfully tested the absolute low temperature state at Mahendragiri in Tamil Nadu.
- ❑ On 5 January 2014, ISRO successfully launched GSLV D5 by developing cryogenic technology for launching heavy satellites.
- ❑ India is the sixth country to successfully test cryogenic technology.

Satellites launched in 2019-2020 :-

- ❑ Cartosat-3 was successfully launched on 27 November 2019 by PSLV C47.
- ❑ RISAT-2BR1 was launched on 11th December 2019 by PSLV C48 which is helpful for disaster management.
- ❑ The successful launch of EOS-01 by PSLV-C49 on 17 November 2020 will also help in disaster management.
- ❑ On 17 December 2021, PSLV-C50 launched a communication satellite named CMS-01 by ISRO.

Future ISRO mission Chandrayaan-3 - To make a soft landing of the satellite on the surface of the moon.

Gaganyaan -

- ❖ There is a plan to send humans to space by 2022 by ISRO mission.
- ❖ Aditya L1 is ISRO's solar mission, whose purpose is to collect information by going near the Sun, ISRO plans to launch it by 2022.
- ❖ **Mangalyaan-2** :- Sending satellites on the surface of Mars by 2024.
- ❖ **Shukrayaan-1** :- ISRO plans to launch the Shukrayaan-1 mission by 2023 to collect information about the atmosphere of the planet Venus.
- ❖ ISRO X-chief K. Sivan has been awarded the 2020 Von Karman Award by the International Academy of Astronautics Paris. Sivan is the third Indian to receive this award, before Krishna Swami Kasturirangan in 2005 and U.R. Rao in 2007.

ISRO related institutes

1. Vikram Sarabhai Space Center Thiruvananthapuram :- The largest and most important center of ISRO, here manufacture of rocket launch vehicles and artificial satellites and the development of technology related to the works are performed. This center was established on 21 November 1962 as

Thumba Equatorial Rocket Launch Center, it was renamed in honor of the father of the Indian space program Dr. Vikram Sarabhai, all the launch vehicles till date SLV-3, ASLV, PSLV, GSLV were developed in this center.

VSSC is a completely indigenous facility working on the development of sounding, rocket, Rohini and Maneka launchers and launch vehicles of PSLV, GSLV, GSLVMK-3 families.

2. Liquid Propulsion Systems Center Bengaluru - Liquid Propellant Systems Center was established on 1 June 1987 by reorganization of the Liquid Propellant Systems Unit (30 November 1985), its current Director is Dr. V. Narayanan. LPSC is a major center for the development and acquisition of more advanced propulsion stages from Earth for launch vehicles and in space propulsion systems for spacecraft. LPSC's activities and facilities are divided into two centers -

A. LPSC Valiyamala Thiruvananthapuram :- Valiyawala Center the headquarters of the LPSC which is responsible for Research & Development, Systems Design, Engineering and Project Management functions are located here, apart from the Cryogenic Propulsion Institutions handling the major functions of the Center, the Fluid Control Components Unit and the Materials and Mechanical Engineering Unit.

B. LPSC Bangalore :- This center focuses on satellite propellant design attainment of propellant system, Integration of spacecraft propellant systems for remote sensing and communication satellites, development and production of transducers are other major activities at LPSC Bangalore.

Achievement -

- ❖ On 27 October 1989, the first stage of liquid fuel (PS4) stage trials for the fourth stage of PSLV were conducted.
- ❖ Tested the first Liquid Developed engine in the year 1987 and the first indigenous liquid engine was tested in the year 1988.
- ❖ Cryogenic Engine Testing Facility was started at Mahendra Giri in the year 1997. The Mahendra Giri branch of LPSC has a testing facility for Liquid Fueled Rocket Engines.
- ❖ Successfully tested Green Propulsion System (H₂O₂) based in the year 2019.
- ❖ Developed the propellant system for Chandrayaan-2 the same has been done for the development of the entire propellant system for the Aditya L1 mission.

3. Space Applications Center Ahmedabad SAC - SAC was established in 1972 as a space agency, its headquarter is in Ahmedabad, Gujarat, its director (2021) is Nilesh M. Desai. It was founded by Dr. Vikram Sarabhai. The main functions of this center include the use of satellites in telecommunications and television, remote sensing for survey and management of natural resources, meteorology, earth measurement, environmental survey etc.

Achievements -

- ❑ In the year 1975-76, the American satellite ATS-6 was tested for use (satellite instructional television experiment).
- ❑ SAC has developed communications and meteorological payloads for the INSAT satellite. Developed optical and microwave payloads for the IRS satellite.
- ❑ It provides training courses and infrastructure for students of space science and technology in the Asia Pacific region. Indian Regional Navigation Satellite System (IRNSS) and GPS Aided Geo Augmented Navigation (GAGAN) have been developed by this center.

4. U.R. Rao Satellite Center Bangalore (URSC) :- It was established in 1993 and the current 2021 director is Kunhikrishnan, earlier it was known as ISRO Satellite Center ISAC, this center is responsible for the design, construction, testing and management of satellite projects.

It was established in the year 1982 at Hassan, Karnataka. The second main control facility by ISRO is located in Bhopal, Madhya Pradesh, established in April 2005. Its main function is to establish the satellite in orbit, to establish regular contact of the satellite with the center and all the satellites in the orbit. To establish monitoring and control over actions.

5. National Atmospheric Research Laboratory Tirupati NARL - Established in the year 1992 in Tirupati, Andhra Pradesh, it is an autonomous research institute funded by the Department of Space, Government of India. This institute works in the field of fundamental research in the field of atmospheric science.

6. Satish Dhawan Space Center Sriharikota SHAR SDSC :- SHAR was established on 1 October 1971 and renamed Satish Dhawan Space Center on 5 September 2002 after the name of ISRO Chairman Satish Dhawan. This center is located in Sriharikota Nellore, Andhra Pradesh. It is a rocket launch center operated by ISRO and its current director for 2021 is Arumugam Rajarajan.

Achievements :- Rohini-125 (Sounding Rocket) was first launched from this center on 9 October 1971. Here there are two launchpads, the second launch pad was started in 2005 as Universal Launch Pad, Programs like Mangalyaan, Chandrayaan-2, Gaganyaan etc. have been launched from this center.

In this center, various stages of the rocket of the Indian launch vehicle are tested on Earth and processing of the propellant is also done.

7. National Remote Sensing Center Hyderabad NRSC :- It was established in the year 1974, Headquarter is in Hyderabad. Since 1st September 2008, it has been given the status of a center of ISRO, earlier it was an autonomous body under the Department of Space which was known as the National Remote Sensing Agency. Responsible for satellite data acquisition and resource data distribution, aerial remote sensing and disaster management decision support.

Achievements :- Currently NRSC is providing data from Cartosat-1, 2 and 2A, Resourcesat-1, Ocean Set, TES, IRS ID, IMS-1.

8. ISRO Telemetry Monitoring and Control Network ISTRAC :- Its Headquarters and Satellite Control Center are located in Bangalore. It has ground stations at Sriharikota, Thiruvananthapuram, Bangalore, Lucknow, Port Blair and Mauritius. Its main function is to provide telemetry monitoring and control facilities to ISRO's launch vehicles and satellite missions and other space agencies.

9. Indian Institute of Remote Sensing IIRS - It was established in the year 1966 in Dehradun, then it was known as the Indian Photo Interpretation Institute (IPI), in July 1976 it was merged with the National Remote Sensing Agency. IIRS has been recognized as a separate body from ISRO since April 2011. Indian Institute of Remote Sensing is a premier teaching, training and research institute for capacity building in the area of geo-information positioning, navigational technology and related applications. IIRS is also the host institution and headquarters of the Center for Space Science and Technology Education for Asia and the Pacific area under the auspices of the United Nations. It is the first of its kind in the region to offer regular post graduate and short term courses in Remote Sensing and GIS. Its current director for 2021 is Dr. Prakash Chauhan.

Achievements :- Around 800 university teachers have been trained by IIRS at the All India level. IIRS has initiated an EDUSAT based distance education program to impart training on basic knowledge of remote sensing, GIS and GPS.

10. Indian Deep Space Network IDSN :- The Indian Deep Space Network is an Indian network with a large antenna and communication facility. It was established on 17 October 2008 in Vyalalu, Karnataka, and is used by the Indian Space Research Organization for India's planetary spacecraft missions. Here antennas of 32 meters, 18 meters and 11 meters are installed respectively.

Achievements :- The Indian Deep Space Network was used for tracking orbit control and housekeeping operations of India's moon mission, Chandrayaan-1. IDSN started tracking Chandrayaan 17 minutes after its launch. The IDSN is being used to track the Mars Orbiter Mission.

11. Indian Space Science Data Center Bengaluru (ISSDC) - The Indian Space Science Data Center is a ground segment facility established by ISRO in October 2008 to serve as the primary data center for the payload data archives of Indian space science disciplines.

This data center is located on the Indian Deep Space Network campus in Bengaluru, responsible for the ingestion, collection, processing and dissemination of payload data and associated supporting data for space science missions, along with principal investigators of science payloads, to other institutions and the general public scientists will be able to make use of this facility.

Achievements :- The facility is instrumental in Chandrayaan-1, AstroSat, YouthSat, Mars Orbiter Mission and Megha Tropic, etc. and will support other future space science missions.

12. Indian Institute of Space Science and Technology Thiruvananthapuram (IIST) :- The Indian Institute of Space Science and Technology is the first space university in India and Asia, located in the Valiyamala area of Thiruvananthapuram city. It was inaugurated by Dr. Madhavan Nair on 14 September 2007. This institute is sponsored by ISRO and the Department of Space, Government of India. This is the only place in India, which provides B.Tech courses in the field of space science and offers masters and PhD degrees also.

Major Center for Nuclear Research and Development

Indian Institute of Atomic Research :- The Indian journey of atomic energy research began with the establishment of the Atomic Energy Commission on 10 August 1948 under the chairmanship of Dr. Homi J. Bhabha. The Department of Atomic Energy was established on August 3, 1954, under the chairmanship of the Prime Minister of India, for the implementation of atomic energy programs.

Bhabha Atomic Research Center (BARC) :- Bhabha Atomic Research Center established in the year 1954 at Trombay (Mumbai) in the name of Atomic Energy Institute is the country's leading research center working in nuclear science and related fields. BARC assists in the research and development of nuclear power programs and units in the industry and minerals sector.

Manages all aspects of nuclear power generation, from theoretical design of reactors to computerized modeling and simulation, risk analysis, development and testing of new reactor fuel materials, etc. On 12 January 1967, the Institute of Atomic Energy was renovated and renamed as Bhabha Atomic Research Center, it comes under the Department of Atomic Energy, Government of India.

Achievements -

- ❑ BARC launched Apsara, India's oldest research reactor, on 4 August 1956, it was designed and built by BARC. BARC, in collaboration with Canada, commissioned a thermal reactor named CIRUS in 1960.
- ❑ The Dhruv reactor was developed by BARC in 1983, to produce radioisotopes in the reactor as well as research on nuclear technology and materials.

- ❑ The design of a thorium-powered reactor of about 300 MW has been completed by BARC, which has been named Advanced Thermal Reactor.
- ❑ The Bulletproof Jacket named 'Bhabha Kavach' has been developed indigenously by Ordnance Factory Board and Alloys Ltd after the transfer of Carbon Nanomaterial technology by BARC.

KALI (Kilo Ampere Linear Injector) - Kali is a protector weapon working on electromagnetic waves. Several versions were developed by BARC such as Kali 80, Kali 5000, Kali 10000, etc. Jarlina, Poornima-I, Poornima-II and Poornima-III are the other major nuclear reactors developed by Bhabha Atomic Research Center.

TIFR (Tata Institute Of Fundamental Research) :- The Tata Institute of Fundamental Research was established on 1 June 1945 by Dr. Homi Jehangir Bhabha with the help of the Sardorabji Tata Trust.

The Tata Institute of Fundamental Research is the National Center for Nuclear Science and Mathematics under the Department of Atomic Energy, Government of India. It is also a deemed university that confers degrees for the postgraduate and Ph.D programs run in the institute. The Institute carries out original research work in the areas of Physics, Chemistry, Biology, Mathematics, Computer Science, Science Education. This main hub is located in Mumbai. This research is divided into three main categories –

1. A Mathematics School
2. School of Natural Sciences
3. School of Technical and Computer Science

TIFR was recognized as an honorary university in the year 2003, its current president is Sandeep Tiwari in 2021.

TIFRAC (TATA INSTITUTE OF FUNDAMENTAL RESEARCH AUTOMATIC CALCULATOR) :-

The first digital computer developed in India was developed in Mumbai. It is one of India's premier institutes for research in the fields of natural sciences, mathematics, biological sciences and theoretical computer science. Scientists at the Tata Institute of Fundamental Research have described the role of glucose in regulating liver functions in a report.

Some of the organizations related to TIFR are as follows -

- ❖ Homi Bhabha Science Learning Center Deonar Mumbai
- ❖ National Center for Radio Astrophysics Pune
- ❖ National Center for Biology Bangalore
- ❖ TIFR Center for Mathematics Bengaluru

Raja Ramanna Center for Advanced Technology (RRCAT) :- The Department of Atomic Energy is a Government of India unit engaged in research and development in non-nuclear frontier areas of laser particle accelerators and related technologies. It was established on 19 February 1984 by the President of India, Giani Zail Singh. It is located in Indore city of Madhya Pradesh, its current director for 2021 is Devashish Das.

Achievements –

- ❖ Working as a national facility at this center, two synchrotron radiations INDUS-I and INDUS-II are indigenously designed, developed.
- ❖ INDUS-I is a 450 MeV electron storage ring emitting radiation up to X-rays.
- ❖ INDUS-II is a 2.5 GeV electron storage ring designed to produce X-rays.

- ❖ INDUS-II is currently the largest and highest energy accelerator in the country and is also involved in the development and application of a variety of laser systems for applications in industry, medicine and research.
- ❖ Various types of crystals have also been developed here for laser technology.
- ❖ Various laserbased instruments have been developed like uranium analyzer, ground leveler, compact N-II laser, photo coagulator, fiberbased temperature sensor and surgical CO2 laser system.

Indira Gandhi Atomic Center (IGAC) :- Indira Gandhi Center for Atomic Research is the apex body for the construction of nuclear plants in India. This center was established in the year 1971 at Kalpakkam Tamil Nadu. At present, the institution is building an indigenous nuclear plant here. Indira Gandhi Atomic Research Center is the secondlargest Department of Atomic Energy after Bhabha Atomic Research Center. Its objective is to conduct a multidisciplinary program of excellent scientific research and advanced engineering towards the development of Sodium Cooled Rapid Breeding Reactor (FBR) technology in India. Its current director is Dr. A.K. Bhaduri.

Achievements -

- ❖ A balanced start was made in October 1985 with the construction of a 40 MW sodium fastbreeder reactor based on the French reactor Refsodi.
- ❖ Plutonium -It is the first reactor of its kind in the world to use uranium alloy carbide as a driving fuel.

Variable Energy Cyclotron Center (VECC) :- The Variable Energy Cyclotron Center is a research and development center of the Department of Atomic Energy, Government of India, where research is done in basic and applied nuclear science, it is located in the city of Kolkata, India.

It was established in the year 1977 to obtain beams of protons, deuterons, alpha particles and other heavy ions of different energies. This center is a national center for advanced studies of nuclear physics, nuclear chemistry, production of radioisotopes for various industries and damage caused by different levels of reactors, its current chairman is 2021 Dr. Sumit Som.

Atomic Minerals Directorate (AMD) :- The Directorate of Atomic Minerals Exploration and Research is a research and development center of the Department of Atomic Energy, it was established in the year 1948 in Hyderabad, Andhra Pradesh. Its objective is to identify and evaluate the uranium resources required for the successful implementation of India's nuclear power program, for which exploration is being conducted across the country by Regional Research Centers at Delhi, Bangalore, Jamshedpur, and Hyderabad.

Defense Research and Development Organization (DRDO) :- This organization is the country's leading organization for research related to the defense of India, this organization works as a subsidiary unit of the Indian Ministry of Defense. This institute was established in 1958 as the technical department of the Indian Army and Defense Science Institute.

The head and director-general of the Defense Research and Development Organization is the scientific advisor to the Defense Minister, the headquarters of this organization is in New Delhi. The current chief of DRDO 2021 is Dr. G. Satheesh Reddy.

The objective of DRDO is to enrich India by establishing a world-class science and technology base and to provide a decisive advantage to its military by equipping it with internationally competitive systems and solutions.