ORGANISATION ON SCIENCE AND TECHNOLOGY

1. ISRO – Indian Space Research Organization

Indian Space Research Organisation, formed in **1969**, superseded the erstwhile INCOSPAR. Vikram Sarabhai, having identified the role and importance of space technology in a Nation's development, provided ISRO the necessary direction to function as an agent of development.

Headquarters

The Secretariat of DOS and ISRO Headquarters are located at **Antariksh Bhavan in Bangalore**.

Objectives

- Operational flights of Polar Satellite Launch Vehicle (PSLV).
- Developmental flight of Geo-synchronous Satellite Launch Vehicle (GSLV- Mk II).
- Development of heavy lift Geo-synchronous Satellite Launch Vehicle (GSLV-Mk III).
- Design, Development and Realization of Communication Satellites.
- Design, Development and Realization of Earth Observation Satellites.
- Development of Navigation Satellite Systems.
- Development of satellites for Space Science and Planetary Exploration.
- Earth Observation Applications.
- Space based systems for Societal Applications.
- Advanced Technologies and newer initiatives.
- Training, Capacity building and Education.
- Promotion of Space technology.
- Infrastructure / Facility Development for space research.
- International Cooperation.

Vision

Harness space technology for national development, while pursuing space science research and planetary exploration.

Mission

- Design and development of launch vehicles and related technologies for providing access to space.

- Design and development of satellites and related technologies for earth observation, communication, navigation, meteorology and space science.
- Indian National Satellite (INSAT) programme for meeting telecommunication, television broadcasting and developmental applications.
- Indian Remote Sensing Satellite (IRS) programme for management of natural resources and monitoring of environment using space based imagery.
- Space based Applications for Societal development.
- Research and Development in space science and planetary exploration.

Genesis

1. The space research activities were initiated in our country during the early 1960's, when applications using satellites were in experimental stages even in the United States. With the live transmission of Tokyo Olympic Games across the Pacific by the American Satellite 'Syncom-3' demonstrating the power of communication satellites, Dr. Vikram Sarabhai, the founding father of Indian space programme, quickly recognized the benefits of space technologies for India.
2. Dr. Sarabhai was convinced and envisioned that the resources in space have the potential to address the real problems of man and society. As Director, Physical Research Laboratory (PRL) located in Ahmedabad, Dr. Sarabhai convened an army of able and brilliant scientists, anthropologists, communicators and social scientists from all corners of the country to spearhead the Indian space programme.
3. To spearhead the space research activities, Indian National Committee for Space Research (INCOSPAR) was set up in 1962 under the Department of Atomic Energy. Subsequently, Indian Space Research Organisation (ISRO) was established in August 1969, in place of INCOSPAR. The Government of India constituted the Space Commission and established Department of Space (DOS) in June 1972 and brought ISRO under DOS in September 1972.
4. Since inception, the Indian space programme has been orchestrated well and had three distinct elements such as, satellites for communication and remote sensing, the space transportation system and application programmes. In

1967, the first 'Experimental Satellite Communication Earth Station (ESCES)' located in Ahmedabad was operationalized, which also doubled as a training centre for the Indian as well as International scientists and engineers.

5. To establish that a satellite system can contribute to the national development, ISRO was clear that it need not wait for its own satellites to begin application development, while foreign satellites could be used in the initial stages. However, before trying out a full-fledged satellite system, some controlled experiment to prove the efficacy of television medium for national development was found necessary. Accordingly, a TV programme on agricultural information to farmers 'Krishi Darshan' was started, which received good response.
6. The next logical step was the Satellite Instructional Television Experiment (SITE), hailed as 'the largest sociological experiment in the world' during 1975-76. This experiment benefited around 200,000 people, covering 2400 villages of six states and transmitted development oriented programmes using the American Technology Satellite (ATS-6). The credit of training 50,000 science teachers primary schools in one year goes to SITE.
7. SITE was followed by the Satellite Telecommunication Experiments Project (STEP), a joint project of ISRO-and Post and Telegraphs Department (P&T) using the Franco-German Symphonie satellite during 1977-79. Conceived as a sequel to SITE which focused on Television, STEP was for telecommunication experiments. STEP was aimed to provide a system test of using geosynchronous satellites for domestic communications, enhance capabilities and experience in the design, manufacture, installation, operation and maintenance of various ground segment facilities and build up requisite indigenous competence for the proposed operational domestic satellite system, INSAT, for the country.
8. SITE was followed by the 'Kheda Communications Project (KCP)', which worked as a field laboratory for need-based and locale specific programme transmission in the Kheda district of Gujarat State. KCP was awarded the UNESCO-IPDC (International Programme for the Development of Communication) award for rural communication efficiency in the 1984.

9. During this period, the first Indian spacecraft 'Aryabhata' was developed and was launched using a Soviet Launcher. Another major landmark was the development of the first launch vehicle SLV-3 with a capability to place 40 kg in Low Earth Orbit (LEO), which had its first successful flight in 1980. Through the SLV-3 programme, competence was built up for the overall vehicle design, mission design, material, hardware fabrication, solid propulsion technology, control power plants, avionics, vehicle integration checkout and launch operations. Development of mult-istage rocket systems with appropriate control and guidance systems to orbit a satellite was a major landmark in our space programme.
10. In the experimental phase during 80's, end-to-end capability demonstration was done in the design, development and in-orbit management of space systems together with the associated ground systems for the users. Bhaskara-I & II missions were pioneering steps in the remote sensing area whereas 'Ariane Passenger Payload Experiment (APPLE)' became the forerunner for future communication satellite system. Development of the complex Augmented Satellite Launch Vehicle (ASLV), also demonstrated newer technologies like use of strap-on, bulbous heat shield, closed loop guidance and digital autopilot. This paved the way for learning many nuances of launch vehicle design for complex missions, leading the way for realisation of operational launch vehicles such as PSLV and GSLV.
11. During the operational phase in 90's, major space infrastructure was created under two broad classes: one for the communication, broadcasting and meteorology through a multi-purpose Indian National Satellite system (INSAT), and the other for Indian Remote Sensing Satellite (IRS) system. The development and operationalisation of Polar Satellite Launch Vehicle (PSLV) and development of Geo-synchronous Satellite Launch Vehicle (GSLV) were significant achievements during this phase.

2. DRDO – Defence Research and Development Organisation

The DRDO was established in 1958 by amalgamating the Defence Science Organisation and some of the technical development establishments. A separate Department of Defence Research and Development was formed in 1980 which later

on administered DRDO and its almost 30 laboratories/establishments (there were almost 52 labs before merging).

Headquarters

Headquartered in New Delhi, DRDO was formed in 1958 by amalgamating the Defence Science Organisation and a few technical development establishments. DRDO is India's largest research organisation.

Genesis & Growth

- DRDO was established in 1958 after combining Technical Development Establishment (TDEs) of the Indian Army and the Directorate of Technical Development & Production (DTDP) with the Defence Science Organisation (DSO).
- Starting with 10 laboratories, DRDO has now grown to a network of 52 laboratories which are deeply engaged in developing defence technologies covering various disciplines, like aeronautics, armaments, electronics, combat vehicles, engineering systems, instrumentation, missiles, advanced computing and simulation, special materials, naval systems, life sciences, training, information systems and agriculture.
- Presently, the Organisation is backed by over 5000 scientists and about 25,000 other scientific, technical and supporting personnel.
- Several major projects for the development of missiles, armaments, light combat aircrafts, radars, electronic warfare systems etc are on hand and significant achievements have already been made in several such technologies.

Vision

- Empower the nation with state-of-the-art indigenous systems and technologies for missile based weapon systems deployable from underwater to outer space

Mission

- Design, develop and lead to production state-of-the-art sensors, weapon systems, platforms and allied equipment for our Defence Services.
- Provide technological solutions to the Services to optimise combat effectiveness and to promote well-being of the troops.
- Develop infrastructure and committed quality manpower and build strong indigenous technology base.

Achievements made by DRDO

- Defence Research and Development Organisation (DRDO) is a Mission Mode Organisation, which is primarily engaged in design and development of strategic, complex and security sensitive systems for the Armed Forces. DRDO has developed number of systems/products/ technologies, a large number of which have already been productionised. The value of systems/products/technologies developed by DRDO and inducted into Services or in the process of induction stands at over Rs. 1,90,000 Crore. These include combat vehicles; missiles; multi-barrel rocket launcher; unmanned aerial vehicles; radars; electronic warfare systems; sonars; torpedos; bridging systems; combat aircraft; sensors; NBC technologies; parachutes; combat free fall systems; propellants and explosives; detonators; communication systems; armaments systems; cyber systems, etc. These are helpful in the long run for the country to achieve self-reliance in defence sector.

Significant achievements of DRDO:

Some of the major products/systems developed by DRDO and accepted/inducted by Armed Forces are:

Platforms:

- Light Combat Aircraft 'Tejas'
- Remotely Piloted Vehicle 'Nishant'
- Pilotless Target Aircraft 'Lakshya-I'
- Main Battle Tank 'Arjun Mk-I'
- Armoured Amphibious Dozer Mk-I
- Armoured Engineer Recce Vehicle
- NBC Recce Vehicle
- Bridging Systems 'Sarvatra'

Sensors:

- Airborne Early Warning & Control (AEW&C)
- Integrated Sonar System for EKM Submarine.
- Hull Mounted Sonar.
- Short Range Battle Field Surveillance Radar
- Weapon Locating Radar 'Swathi'
- 3D Low Level Light Weight Radar 'Aslesha' Mk-I

- 3D Surveillance Radar 'Revathi'
- Electronic Warfare System for Navy 'Sangraha'
- Electronic Warfare System for Army 'Samyukta'
- Electronic Warfare System 'Divya Drishti'
- Electronic Support Measure 'Varuna'
- Commander's Thermal Imager Mk-II for T-72, T-90 and BMP tanks
- Holographic Sights for Small Weapons

Weapon Systems:

- Akash Weapon System
- Prithvi Missile for Army and Air Force
- Supersonic Cruise Missile 'BrahMos'
- Multi Barrel Rocket Launcher System 'Pinaka' Mk-I
- Torpedo Advanced Light
- Heavy Weight Ship Launched Torpedo 'Varunastra'

Soldier Support Systems:

- Computerised Pilot Selection System for Indian Air Force
- Telemedicine System for Navy
- Submarine Escape Suit
- Flame Retardant Gloves
- NBC products

3. CSIR - Council of Scientific & Industrial Research

Council of Scientific and Industrial Research (CSIR) is the largest research and development (R&D) organisation in India. CSIR has a pan-India presence and has a dynamic network of 38 national laboratories, 39 outreach centres, 3 Innovation Complexes and 5 units.

- **Established:** September 1942
- **Located:** New Delhi
- CSIR is funded by the Ministry of Science and Technology and it operates as an autonomous body through the Societies Registration Act, 1860.
- CSIR covers a wide spectrum of streams – from radio and space physics, oceanography, geophysics, chemicals, drugs, genomics, biotechnology and nanotechnology to mining, aeronautics, instrumentation, environmental engineering and information technology.

- It provides significant technological intervention in many areas with regard to societal efforts which include the environment, health, drinking water, food, housing, energy, farm and non-farm sectors.

Objectives

- Promotion, guidance and coordination of scientific and industrial research in India including the institution and the financing of specific researchers.
- Establishment and assistance to special institutions or departments of existing institutions for the scientific study of problems affecting particular industries and trade.
- Establishment and award of research studentships and fellowships.
- Utilization of the results of the research conducted under the auspices of the Council towards the development of industries in the country. Payment of a share of royalties arising out of the development of the results of research to those who are considered as having contributed towards the pursuit of such research.
- Establishment, maintenance and management of laboratories, workshops, institutes and organisations to further scientific and industrial research.
- Collection and dissemination of information in regard not only to research but to industrial matters generally.
- Publication of scientific papers and a journal of industrial research and development.

Vision and Mission

CSIR's renewed mission is inspired by the remarks made by President of CSIR Society to CSIR to build. "The new CSIR that will fulfill the aspirations of modern India…" so CSIR's mission is simply – to build a new CSIR for a new India.

CSIR's Vision

"Pursue science which strives for global impact, technology that enables innovation – driven industry and nurture trans-disciplinary leadership thereby catalyzing inclusive economic development for the people of India"

The people and nation-centre thrust to science, technology and societal pursuits remains the cornerstone of CSIR's mission. In view of rising dreams and aspirations of the nation, its expectation from CSIR and the other public funded institutions is

ever increasing. Not only are the pace of scientific and technological growth and the aspirations of higher living standards evident today but also many age old myths of economy and growth have been broken; e.g., the shift from manufacturing to services; capital resources; population as a burden to human resource as an asset; national needs to international opportunities and so on. The changed scenario has inspired CSIR towards:

- Science and Engineering leadership;
- Innovative technology solutions;
- Open innovation and crown sourcing;
- Nurturing talent in transdisciplinary areas;
- Science based entrepreneurship; and
- Socio-economic transformation through S&T intervention.

"CSIR is 65 years old and was built by Dr. Bhatnagar to meet the challenges of that time. I would like to build the new CSIR that will fulfill the aspirations of modern India."

CSIR and Health

Breathtaking Breakthrough:

ASMON, the novel herbal medicine for asthma is based on CSIR technology. Asmon blocks both asthma-causing pathways. Unlike the commonly used steroidal drugs, Asmon has no side effects and is safe for all groups. Its unique mechanism of action provides quick relief.

Fighting Malaria:

Thanks to the emergence of resistant varieties of the parasite, Malaria remains a resurgent menace affecting nearly 200 million people today. There is no incentive for advanced nations to work on these diseases that are largely restricted to developing nations. CSIR has developed two effective drugs to combat malaria. Elubaquine is an anti- relapse anti-malarial quite effective against chloroquine-resistant malaria. Arteether (E-mail) a drug that can combat cerebral malaria is being exported to 48 countries.

Once-a Week –Pill:

- Oral contraceptive
- Safer alternative to conventional steroids.
- Progesterone-estrogen combination pill

- No adverse effect on lipid profile
- Anti breast cancer property

Tapping Bio-resources:

There is now a growing realization that the diversity, power, and safety of bio-active molecules found in nature is far greater than the molecules created in laboratories for pharmaceutical use. CSIR has initiated one of the largest coordinated exploration programmes on drugs. It is based on India's rich bio-resources and its traditional knowledge. This initiative involves 20 CSIR laboratories, 13 Universities and also institutes of traditional medicinal systems. This path-breaking programme has so far screened 23,000 samples and identified 44 potential bio-active molecules.

The Healing Touch:

Records show that the Indian drug and pharma industry excelled in process chemistry of known drugs, but hardly created any new drugs. Then CSIR showed the way! Eleven of the fourteen new drugs of India have come from CSIR's stables. These drugs include anesthetics, contraceptives, antimalarials, anti-depressants and memory enhancers.

CSIR Achievements

- **Strategic Sector:**
  Drishti transmissometer: It is an Indigenous - Innovative –Cost-effective visibility measuring system that provides information to pilots on visibility for safe landing & take-off operations and is suitable for all airport categories.
- **Head-Up-Display (HUD): CSIR-National Aerospace Laboratories (NAL)** made a significant contribution by developing indigenous Head-Up- display (HUD) for Indian **Light Combat Aircraft, Tejas.**
  - HUD aids the pilot in flying the aircraft and in critical flight manoeuvres including weapon aiming.
- **Indigenous Gyrotron:** Design and development of indigenous gyrotron for nuclear fusion reactor have been accomplished.
  - A gyrotron is a **vacuum electronic device (VED)** capable to generate high-power, high-frequency THz radiation.

❖ **Energy & Environment:**

- **Solar Tree:** It designed by **CSIR- The Central Mechanical Engineering Research Institute (CMERI)** lab in Durgapur. It occupies minimum space to produce clean power.
- **Lithium-Ion Battery:** The **Central Electrochemical Research Institute (CECRI), Karaikudi in Tamil Nadu,** has set up the first indigenous Li-ion fabrication facility that has applications in defence, solar-powered devices, railways and other high-end usages.

❖ **Agriculture:**

- **Medicinal and Aromatic Plants:** Enhanced cultivation of medicinal and aromatic plants in the country brought through the development of new varieties and agro-technologies.
- **Samba Mahsuri Rice Variety:** CSIR in collaboration with ICAR developed an improved **bacterial blight resistant** Samba Mahsuri variety.
- **Rice Cultivar (Muktashree) for Arsenic Contaminated Areas:** A rice variety has been developed which restricts assimilation of Arsenic within the permissible limit.
- **White-fly resistant Cotton variety:** Developed a **transgenic cotton line** which is resistant to whiteflies.

❖ **Healthcare:**

- **JD Vaccine for Farm Animals:** Vaccine developed and commercialized for Johne's disease (JD) affecting Sheep, Goat, Cow and Buffalo so as to immunize them and increase milk & meat production.
- **Plasma Gelsolin Diagnostic Kit for Premature Births, and Sepsis-related Deaths:** It is developed to diagnose premature birth and sepsis.
- **GOMED:** A programme called **GOMED (Genomics and other omics technologies for Enabling Medical Decision)** has been developed by the CSIR which provides a platform of disease genomics to solve clinical problems.

❖ **Food & Nutrition:**

- **Ksheer-scanner:** It is a new technological invention by **CSIR-Central Electronics Engineering Research Institute (CEERI)** to detect the level of milk adulteration and adulterants in 45 seconds at the cost of 10 paise, thereby putting adulterators in the milk trade in notice.

- **Double-Fortified Salt:** Salt fortified with iodine and iron having improved properties developed and tested for addressing anaemia in people.
- **Anti-obesity DAG Oil:** Oil enriched with **Diacylglycerol (DAG)** instead of conventional triacylglycerol (TAG) developed.

❖ **Water:**

- **Aquifer Mapping of Water Scarce Areas: Heliborne transient electromagnetic and surface magnetic technique** based aquifer mapping carried out in six different geological locations in Rajasthan (2), Bihar, Karnataka, Maharashtra and Tamil Nadu.
- **Understanding the Special Properties of the Ganga Water:** An assessment of water quality & sediment analysis of Ganga from different parts being done.

❖ **Waste to Wealth:**

- **Non-toxic Radiation Shielding Material for X-ray Protection:** Non-toxic radiation shielding materials utilizing industrial waste like red mud (from aluminium industries) and fly ash (Thermal Power Plants) developed which has been accredited by **Atomic Energy Regulatory Board (AERB)** for application in diagnostic X-Ray rooms.
- **Waste Plastic to Fuel:** Process for conversion of waste plastics to gasoline/diesel or aromatics developed.

❖ **The Indelible Mark:** The Indelible ink used to mark the fingernail of a voter during elections is a time-tested gift of CSIR to the spirit of democracy.

- Developed in 1952, it was first produced in-campus. Subsequently, the industry has been manufacturing the Ink. It is also exported to Sri Lanka, Indonesia, Turkey and other democracies.

❖ **Skill development:** CSIR is building a structured large scale Skill development Initiative using the state of the art infrastructure and human resources of CSIR.

- About 30 High Tech Skill/Training programmes are being launched for imparting skills to over 5000 candidates annually.
- **The skill development programmes cover the following areas:** Leather process Technology; Leather Footwear & Garments; Paints & coatings for corrosion protection; Electroplating & Metal Finishing; Lead Acid Battery maintenance; Glass Beaded Jewellery / Blue Pottery; Industrial

Maintenance Engineering; Internet of Things (IoT); and Regulatory – Preclinical Toxicology.

- **Aviation:** The CSIR-National Aerospace Laboratories has designed a plane 'SARAS'.
  - In 2011, successfully tested India's 1st indigenous civilian aircraft, NAL NM5 made in association with National Aerospace Laboratories and Mahindra Aerospace.
- **Traditional Knowledge Digital Library:** CSIR has established the first-ever 'Traditional Knowledge Digital Library' **in the world.** It is accessible in five international languages (English, German, French, Japanese and Spanish).
  - CSIR successfully challenged the grant of patent in the USA for use of Haldi (turmeric) for wound healing and neem as an insecticide on the basis of traditional knowledge.
- **Genome sequencing:** CSIR has completed the sequencing of the Human Genome in 2009.

Role of CISR in controlling pandamic

Council of Scientific & Industrial Research (CSIR) has advantageously positioned itself to pursue the focused R&D to develop, integrate, scale-up, and deploy necessary technological interventions for combating Coronavirus pandemic in the Country. Considering the multifarious problems created by coronavirus which require interventions in several areas and multi-pronged strategy, CSIR has set up five technology verticals for addressing the emerging situation due to pandemic, namely:

i. Digital and Molecular Surveillance;
ii. Rapid and Economical Diagnostics;
iii. Repurposing of Drugs, Vaccine and Convalescent Plasma Therapy;
iv. Hospital Assistive Devices and PPEs; and
v. Supply Chain and Logistics Support Systems.

Considering the nature of the problem, Innovation Management Directorate gave Call for Proposals to CSIR labs to submit projects in the following areas:

1. Diagnostics for COVID 19

Proposals from CSIR labs were invited to develop cost effective, rapid diagnostics to test COVID cases on mass scale. Following categories of diagnostics to test coronavirus were proposed:

1. Crispr/ Cas based Paper Diagnostics;
2. PCR or any RNA/DNA based diagnostics;
3. Antigen-antibody based diagnostics;

2. Protective Gears for COVID 19

Proposals from CSIR labs were invited for developing and deploying protective gears to control the spread of COVID cases on mass scale. Following categories of protective gears were proposed:

1. Ventilator, Oxygenator and other Assistive Devices;
2. Spray Devices for sanitizers and disinfectants;
3. Sanitizers and disinfectants including herbal products; and
4. Masks

3. Drugs and APIs for COVID 19

Viruses are generally difficult to treat, because antibiotics do not kill them. For this reason, elderly and immunocompromised individuals are at high risk. The best natural defence and treatment of Coronavirus (and viruses in general) is a strong immune system. Some molecules and APIs such as hydroxychloroquine, Azithromycin, Remdesivir, Lupinivir etc. have been found to be useful in the treatment of corona virus disease. The repositioning of launched or even failed drugs to viral diseases provides unique translational opportunities, including a substantially higher probability of success to market as compared with developing new virus-specific drugs and vaccines, and a significantly reduced cost and timeline to clinical availability.

The repurposing of antivirals or APIs would be a welcome approach and can be supported if the Proof of Concept strongly justifies its mechanism of action.

Proposals from CSIR labs were invited for developing and deploying drugs for the treatment and control of Covid-19. Following categories of drugs were proposed:

1. Prophylactics such as Hydroxy-chloroquine;
2. Repurposing, including past CSIR leads from phytopharma/ drugs from sea; and

3. Intermediates, API, Formulations.

4. Vaccine for COVID-19

An experimental COVID-19 vaccine is being tested Moderna Therapeutics. Although clinical trial on the vaccine will take at least a year to complete, the work could provide valuable information about how the immune system can fight coronaviruses and could give scientists a head start if any new outbreaks of the virus were to occur. Whole world including India is attempting to develop a vaccine against corona virus.

Further, though a vaccine for COVID-19 is a long approach but novel cost effective ways of repurposing the known vaccines/molecules that can boost the immunity in suspected COVID cases or can revive the serious COVID cases are welcome. The Proof of Concept is however required to be in place to justify the fast track development of such vaccines.

Proposals from CSIR labs were invited for developing vaccine to control Covid-19. Following categories of vaccines were proposed:

1. Novel vaccines; and
2. Repurposed vaccines.

4. Indian Council of Medical Research (ICMR)

ICMR was established on **November 15, 1911**, by the name of Indian Research Fund Association (IRFA) by Sir Harcourt Butler. It was renamed the Indian Council of Medical Research in the year 1949.

The Indian Council of Medical Research (ICMR), **New Delhi**, the apex body in India for the formulation, coordination and promotion of biomedical research, is one of the oldest medical research bodies in the world.

Vision

Translating Research into Action for Improving the Health of the Population.

Mission

- **Generate**, manage and disseminate new knowledge.
- **Increase** focus on research on the health problems of the vulnerable, the disadvantaged and marginalized sections of the society.
- **Harness** and encourage the use of modern biology tools in addressing health concerns of the country.

- **Encourage** innovations and translation related to diagnostics, treatment, methods/ vaccines for prevention.
- **Inculcate** a culture of research in academia especially medical colleges and other health research institutions by strengthening infrastructure and human resource.

Objective

- ICMR, with its 30 state-of-the-art Institutes/Centers, is amongst research organizations in the field of Bio Medical Sciences.
    1. The Indian Council of Medical Research provides financial assistance to promote biomedical and health research.
    2. Proposals in fundamental research; development and evaluation of a tool, Clinical and operational research are considered for ICMR support.

Achievements of ICMR

1. ICMR started its research on indigenous drugs in 1919.
2. In 1937, ICMR published 'Nutritive Value of Indian Foods and Planning of Satisfactory Diets' for the first time in the country.
3. In 1941, ICMR initiated the first-ever 'Biomedical Research Fellowship' aimed at nurturing health research in the country.
4. In 1949, ICMR initiated the National Programme for the control of Filariasis.
5. In 1955, the first nationwide tuberculosis survey was conducted by ICMR.
6. ICMR discovered Kyasanur Forest Disease in the Sagar-Saroba district of Karnataka
    - ICMR has been conducting annual rounds of vaccination in the region since 1990.
7. ICMR made home-based treatment of Tuberculosis known worldwide. In 1959, it demonstrated the success of TB home-based treatment which is as good as hospital-based treatment.
8. ICMR, in 1967 discovered Chandipura Virus (The causal agent for human encephalitis.)
9. In 1980, Human Hepatitis E was discovered.
10. In 1984, ICMR compiled the first genetic atlas of the Indian tribes.
11. In 2013, it launched a vaccine against Japanese encephalitis, "JENVAC."

12. ICMR-National Institute of Cancer Prevention and Research became the world's 7th knowledge hub on smokeless tobacco of WHO-FCTC (Framework Convention on Tobacco Control.)
13. In 2017, it released India's first comprehensive state-wise disease burden estimation.
14. In 2018, Zika, Nipah and Canine Distemper Virus were successfully contained.
15. In 2019, ICMR partnered with the **World Health Organization (WHO)** and 10 nations to launch 'RESEARCH'.
    - RESEARCH stands for Regional Enabler for South East Asia Research Collaboration.
    - The aim of the initiative is to combat emerging and reemerging infectious diseases in the region of Southeast Asia.
16. Also in 2019, IMCR launched an initiative to fast track the elimination of Malaria, called 'MERA'.
    - It stands for Malaria Elimination Research Alliance.
17. In September 2019, The Prohibition of Electronic Cigarettes Bill was passed by the Indian Parliament. ICMR had provided an evidence report against e-cigarettes.
18. To promote health research between India and Africa, India-Africa Health Sciences Collaborative Platform (IAHSP)) was launched.
19. ICMR and COVID-19:
    - RT-PCR and ELISA were developed in 2019.
    - Covaxin has been developed.

5. Bhabha Atomic Research Centre (BARC)

The Bhabha Atomic Research Centre (BARC) is India's premier nuclear research facility, headquartered in Trombay, Mumbai, and Maharashtra. Founded by Homi Jehangir Bhabha Atomic Energy Establishment, Trombay (AEET) in **January 1954** as a multidisciplinary research program essential for India's nuclear program.

Objectives

BARC's fundamental objective is to preserve secure nuclear energy activities, mainly for energy production. It handles all aspects of atomic energy, including theoretical

reactor technology to computerized modelling and simulation, new reactor fuel materials development, risk analysis & evaluation, etc.

Vision

Under automation program of Department of Atomic Energy, Bhabha Atomic Research Centre has **developed a vision based robotic system that enables measurement and assembly of components with accuracy up to 100 micron**. In this system, objects are carried along a conveyor into a vision station.

Mission

BARC's core mandate is **to sustain peaceful applications of nuclear energy**. It manages all facets of nuclear power generation, from the theoretical design of reactors to, computer modeling and simulation, risk analysis, development and testing of new reactor fuel, materials, etc.

Achievements of BARC:

Ever since its establishment, Bhabha Atomic Research Centre has done marvelous job in a number of fields and also made a number of achievements in the same.

- **BARC has till date successfully established multiple five power reactors.**
  Earlier, the first power reactors were brought in from the USA. India is now fully equipped to carry on research and designing nuclear reactors independently. Apsara in 1956 was the first reactor. CIRUS is another reactor provided by Canada. India used the spent fuel (Converted into Plutonium) from CIRUS for 1st nuclear test in 1974.
- **Pressure Heavy water Reactors (PHWRs):**
  Bhabha Atomic research centre designed India's first pressurised water reactor with 80 MW capacity at Kalpakkam. Since India does not have very good resources of Uranium, thus it becomes inevitable that it uses natural uranium only.

  A pressurized heavy-water reactor (PHWR) is a nuclear reactor that uses heavy water as its coolant and neutron moderator. PHWRs frequently use natural uranium as fuel, sometimes even very low enriched uranium. The heavy water's low absorption of neutrons greatly increases the neutron economy of the reactor, avoiding the need for enriched fuel. The high cost of the heavy water is offset by the lowered cost of using natural uranium and/or alternative fuel cycles.

- Fast Breeder Test Reactor (FBTR): DAE has been running a Fast Breeder Test Reactor for more than 20 years. India is only the seventh country to develop a breeder reactor. The best part about breeder reactors, as their name suggests, is that they produce more fuel when run than they consume. It's like running a car with tank half full and after travelling for 200 Km, you still have a quarter full of tank and also have supply for your Truck. In short, these reactors produce both power and fuel for a different kind of reactors.
- A Prototype Fast Breeder Reactor (PFBR) of 500 MW capacity has completed construction and awaiting regulatory clearances. This will bring a new era, as after this reactor, we will be able to utilise huge reserves of Thorium available in India.
- Heavy Water Production: For controlled and sustained nuclear chain reaction, fast neutrons produced from nuclear reactors must be slowed down. Hydrogen (in water) is a very efficient moderator but it absorbs more neutrons which in turn requires relatively enriched fuel. As fuel economy is one of the prime motive of Bhabha Atomic Research center's program, it needed Deuterium (Heavy water) as moderator which absorbs less neutrons allowing BARC to use natural uranium in PHWRS. After initial hiccups, DAE has now mastered Heavy Water production technology. An individual unit, Heavy Water Board, looks after the production and supply of heavy water. India has now even become an exporter and have exported to many countries including USA and China.
- **Nuclear Reprocessing:** One very peculiar thing about nuclear power production is that most of the fuel which goes inside a reactor comes out unused. That fuel, if reprocessed, can be used again and again multiple number of times. Along with the fuel, many useful isotopes are also obtained which can be then used in a number of applications including medical applications. A nuclear power production cycle with reprocessing then reuse is known as Closed Fuel Cycle which BARC has chosen. DAE has mastered technology of reprocessing fuel. Bhabha Atomic Research Centre has plants in multiple locations. The latest one at Tarapur, PREFRE-2, has continually been operated and has performed with more than 100% capacity. Similar plant has been planned in Kalpakkam also.
- **Bhabhatron- I and II:** Bhabha Atomic Research Centre has a big number of options to offer for BARC Careers and even in BARC internship. BARC results

have shown success not only in research and power generation, but also contributed significantly in the field of medicine and therapy. Bhabhatron is a state of the art tele-therapy unit for cancer patients which uses a Cobalt-60 source. BARC has also developed a radiotherapy simulator to assist the doctors in ensuring that the dose is targeted and adequate. It is way more cost-effective than the similar machines used to be imported earlier. All over India, in many hospitals, it is being used to save lives of people, simultaneously, reducing the financial burden on them. Recently, the current prime minister of India, Mr. Modi also handed over a model of Bhabhatron-2 machine to a Mongolian representative for cancer treatment.

Defence:

- BARC has produced most important arsenal for the country in collaboration with other organizations. A very significant partnership, with that of ECIL has developed antenna systems, encryption system, satellite communication systems, platforms for RADARs, Missile support systems etc. which are being used in multiple ways by our defence establishments. ECIL in association with ECI (Election commission of India) has also developed EVMs, which has significantly changed the way elections are been conducted in the country.
- KALI (Kilo Ampere Linear Injector)has been developed by Bhabha Atomic Research Centre (BARC) and Defence Research and Development Organization (DRDO) as a very high speed electron gun which can be targeted towards enemy systems such as missiles to destroy their on board electronic systems. BARC has also developed bullet proof materials which will be very helpful to India's defence forces.
- **Water Technologies:** BARC has developed multiple technologies ranging from cleaning water to finding the flow path of ground water. Low cost domestic water purifier has also been developed which kills bacteria up to >99.99% that too without need of electricity, harmful chemicals or wastage of water. The technology has been transferred to many parties and the country's citizens are continuously being benefited by that.
- A large scale Nuclear Desalination Demonstration Plant (NDDP), near Chennai, which uses multi stage flash evaporation and reverse osmosis technologies has been running for more than a decade. It is coupled to Madras Atomic Power

Station (MAPS) and cleans nearly 6.3 million litres of water every day. Similar projects are being planned by Bhabha Atomic Research Center in future and engineers and aspirants can find potential options of BARC Careers and BARDC internships in the same.

- **Waste Management:** BARC has developed solid waste management solution with the philosophy of zero effluent and zero garbage. Nisagruna (Nisarg + Runa = Nature's debt) is a biogas plant developed by BARC, which has been installed in 100s of places and is continuously being installed in new locations. It produces methane which is then used for cooking purposes and the leftover manure with high nitrogen content is used for soil conditioning.

6. India-based Neutrino Observatory (INO)

The India-based Neutrino Observatory (INO) project is an ambitious basic science project aimed at studying the properties and interactions of the elusive elementary particle called neutrino. The Government approved the INO project in January 2015. This included the construction of an underground laboratory at Bodi West Hills (BWH) in Theni district, Tamil Nadu, setting up the flagship Iron Calorimeter (ICAL) detector there and the Inter-Institutional Centre for High Energy Physics (IICHEP) in Madurai.

IICHEP would be the nodal centre for Research & Development of the associated detector technology and would run the underground laboratory in Theni.

Objectives

- The objective of the project was to study neutrinos in a 1,200-metre deep cave.
- The project is proposed to be set up at Pottipuram village in Theni district in Tamil Nadu.
- The project was initially mooted by the Institute of Mathematical Sciences and then by the Tata Institute of Fundamental Research.

7.National Environmental Engineering Research Institute (NEERI)

The CSIR-National Environmental Engineering Research Institute (CSIR-NEERI) is a research institute created and funded by Government of India. It was established in Nagpur in the year 1958 with focus on water supply, sewage disposal, and communicable diseases and to some extent on industrial pollution and occupational diseases found common in post-independent India.

The National Environmental Engineering Research Institute (NEERI), Nagpur was established in 1958 as Central Public Health Engineering Research Institute (CPHERI), when environmental concerns were limited to human health with a focus on water supply/sewage disposal/ communicable diseases and to some extent on industrial pollution and occupational diseases.

Vision

Leadership in Environmental Science and Engineering for Sustainable Development

Mission

CSIR-NEERI would continue to strive for providing innovative and effective solutions for environmentally sustainable development and to help Government, industry and the society, especially the 800 million underprivileged people of India.

Achievements of CSIR - NEERI

National Environmental Engineering Research Institute (NEERI), Nagpur is a constituent of Council of Scientific & Industrial Research (CSIR), New Delhi and has a nation-wide presence with its five zonal laboratories at Chennai, Delhi, Hyderabad, Kolkata and Mumbai.

The mandate of NEERI is:

- To conduct research and developmental studies in environmental science and engineering
- To render assistance to the industries of the region, local bodies, etc. in solving the problems of environmental pollution through S&T intervention
- To interact and collaborate with academic and research institutions on environmental science and engineering for mutual benefit
- To participate in CSIR thrust area and National mission projects

❖ CSIR-NEERI has successfully transferred two technologies, viz. Phytorid wastewater treatment technology to 15 MSME entrepreneurs and Solar Electrolytic Defluoridation technology of water to 9 MSME entrepreneurs. CSIR-NEERI entered into several agreements with various Agencies/Organizations for technology transfer/ implementation of R&D projects / academic collaboration.

❖ CSIR-NEERI has developed indigenous “Electronic Nose (e-nose)”, in association with C-DAC Kolkata, which has a potential to substitute imported “e-nose”. This e-nose consisting of 8 array of sensors (metal oxide) is useful in monitoring of sulphurous odorants in pulp & paper industry, tannery and distillery.

- The Institute provided a technological solution to M/s Mahindra Vehicle Manufactures Limited (MVML), Pune for treatment and safe disposal of its effluent using high rate transpiration system. The HRTS model designed by the Institute was implemented in the field at M/s MVML, Pune. The HRTS design consists of filter media which provides more surface area for interaction of pollutants and also removes the suspended solids present in the wastewater was prepared.
- Hand pump attachable Iron Removal (IR) plants based on the CSIR-NEERI's technology were installed at 66 locations by Public Health Engineering Department, Chhattisgarh in Rajnandgaon, Durg and Kanker districts. These plants helped to bring down the iron concentrations in water from 3-8 mg/L to less than 0.1 mg/L. Capacity of each plant is about 1000 L/hr.
- Electro-oxidation technology developed by CSIR-NEERI was implemented at Nandesari Industries Association, Vadodara on pilot scale for effective treatment of recalcitrant chemical industry wastewater. The first ever CETP scale electro oxidation plant has been designed in India for treatment of highly recalcitrant chemical industry effluents, based on the technology developed by CSIR-NEERI. This technology helps to meet the effluent discharge norms (COD of 250 mg/l) with low foot print area (4m x4 m per reactor) and is easy to install, operate and cost-effective.
- CSIR-NEERI has taken up Carrying capacity based developmental projects such as "carrying capacity based planning for proposed development in Sambalpur-Jharsuguda region, Odisha"; "Tourist impact assessment and carrying capacity study for environmental protection of world heritage sites – TajMahal, Agra and Ajanta Caves, Aurangabad".
- The Institute provided 100 units each of NEERI-ZAR water filters to the Uttarakhand and J&K Government to provide safe drinking water for flood affected people.
- A multi-fuel domestic cook stove has been developed and tested for its high thermal efficiency and reduced emissions. Village women have shown encouraging response to this product.
- A Mobile Laboratory for Toxic Emission Monitoring &and Flue gas treatment is developed for application in Small and Medium Scale Industries.

- Low cost water recycle and reuse Nawatech Natural Water Technologies (Field demonstration two in Pune and two in Nagpur) and Phytoremediation technology (Three Field Demonstration) under Water4crops project are under implementation.
- A Technology Park to show case processes and products of 12th Five Year Plan projects on Waste to Energy is under construction stage.

8. Agriculture Research Institutions

Agricultural research institutions formulate the agricultural practices based on recent research results and farmers' needs. Using suitable media and methods, they disseminate those information for the welfare of the people. Indian Agricultural Research Institute and Indian Council of Agricultural Research are some of the institutions which are involved in agricultural research.

1. Indian Agricultural Research Institute (IARI)

The Indian Agricultural Research Institute is a national institute for agricultural research, education and extension. IARI is commonly known as the Pusa Institute.
It is financed and administrated by the ICAR (Indian Council of Agricultural Research). This was responsible for research leading to the green revolution in India during 1970s. The policies, plans and programs of IARI have helped to meet the needs of the nation. Several popular high yielding varieties of major crops have been developed by IARI.

2. Indian Council of Agricultural Research (ICAR)

The Indian Council of Agricultural Research is an autonomous body responsible for co-ordinating agricultural education and research in India. The union minister of agriculture serves as its president. It functions under the Department of Agricultural Research and Education, Ministry of Agriculture. It is the largest network of agricultural research and education institutes in the world.

3. Krishi Vigyan Kendra

Krishi Vigyan Kendra is a farm science centre. These centres serve as the ultimate link between ICAR (Indian council of Agricultural research) and farmers. Their aim is to apply agricultural research findings in practical localized settings. The first KVK was established in 1974 at Pondicherry. Since then, KVKs have been established in all states and the number continues to grow. KVKs are expected to undertake their own projects. They are also expected to serve as a resource center for extending

government initiative to local areas. KVKs can be formed under a variety of host institutions, including agricultural universities, state departments, ICAR institutes and other educational institutions or non government organisations.

Responsibilities of KVK

Each KVK operates a small farm to test new technologies, such as seed varieties or innovative farming methods developed by ICAR institutes. This allows new technologies to be tested at the local level before being transferred to farmers. It also organizes programs to show the efficacy of new technologies on farmer's fields. KVKs organise workshops to discuss modern farming techniques with groups of farmers. KVKs provide advisory service to the farmers about weather and market pricing through radio and mobile phones. It focuses on crops and cultivation methods. It also facilitates rapport between the institution and the local community.