

# Achievements of india in science

[Countries](#), [India](#)



The space program had its genesis in the Indian National Committee of Space Research, which was established in 1962 as part of the Department of Atomic Energy. In 1972 the Department of Space and the Space Commission were established as the executive and policy wings of the program. The Department of Space operates the Indian Space Research Organization (ISRO, established in 1969) and four independent projects: the Indian National Satellite Space Segment Project, the Natural Resource Management System, the National Remote Sensing Agency, and the Physical Research Laboratory. The department also sponsors research in various academic and research institutions. The ISRO is headquartered in Bangalore and has operating units at twenty-two sites throughout the country that deal with space systems, propulsion, communications, telemetry and tracking, research, launches, and other facets of the space program. The major achievements of the space program have been in the area of the domestic design, production, and launching of remote sensing and communications satellites.

The primary goal of the space program is to have independent remote sensing and communications satellite systems with launcher autonomy. In 1992 the ISRO set up the Antrix Corporation to market space and telecommunications products to help recover some of the costs of the annual space budget. That budget increased from Rs3. 8 billion in FY 1990 to an estimated Rs7. 5 billion in FY 1994. The majority of the FY 1994 expenditures were slated for rocket development (50 percent) and communications and remote sensing satellite operations (26. percent).

Space research began with the establishment of the Thumba Equatorial Rocket Launching Station near Thiruvananthapuram, Kerala. From Thumba Indian scientists launched United States-made rockets carrying French satellites to study the upper atmospheric winds over the magnetic equator. From this station, Indian scientists also have carried out original research in electrojet currents over the magnetic equator, vertical profiles of airglow, and cosmic X-ray background radiation. The first Indian experimental satellite was launched in 1975, followed by four others; operational communications and remote sensing satellites have been launched as part of the Indian National Satellite System (Insat). Insat is an interagency project operated by the Department of Space for domestic radio relay, computer network, television, rural telegraph network, and weather, emergency, and other radio communications. Three satellites operated by Insat were in use in the mid-1990s in cooperation with the International Telecommunication Union's International Telecommunications Satellite (Intelsat) system. The three satellites (the first-generation Insat-1D in June 1990, the second-generation Insat-2A in July 1992, and Insat-2B in July 1993) were indigenously built under the direction of the ISRO and put into geostationary orbit over the Indian Ocean using French rockets launched in French Guiana. Additional and more advanced communications satellites--Insat-2C, Insat-2D, and Insat-2E--were planned for launch in FY 1994, FY 1995, and FY 1996. Although early Indian satellites were launched by the Soviet Union, the United States, and the European Space Agency, in 1980 India began using domestically produced launch vehicles for its Rohini and Stretched Rohini experimental satellites. The ISRO has launch ranges at Thumba, Sriharikota

Island on the east coast of Andhra Pradesh, and Balasore in Orissa. Foreign observers in 1993 believed that the launch vehicle program was the least developed part of the space program and had fallen behind the satellite program in technological capability. Supporting this belief was the September 1993 launch of India's liquid-and-solid-fuel Polar Satellite Launch Vehicle (PSLV), designed to carry a 1,000-kilogram satellite, at Sriharikota. Although the PSLV-D1 was successfully launched, it malfunctioned before reaching orbit. Despite such setbacks, the national goal of achieving launcher autonomy has been set for 2000.

In May 1994, after several failed launches, India's five-stage, solid-fuel Augmented Satellite Launch Vehicle (ASLV) program, which started its test phase in 1987, succeeded in deploying a 133-kilogram satellite and placing it in a low earth orbit via a solid-fuel launch vehicle, the ASLV-D4. The ASLV-D4 was launched from Sriharikota. In March 1995, the head of the ISRO announced that India would become self-reliant in launchertechnologyby 1997-98 when the first Geostationary Launch Vehicle (GSLV) flight was planned. Through international cooperation programs, India also has put a man in space with the Soviet Union, has participated in various French and German space ventures, and has had a payload aboard the United States Space Shuttle. It also provided technical expertise to the Arab SatelliteCommunicationOrganization (Arabsat) and entered into a cooperative space research agreement with the Ukrainian National Space Agency. Indian weather satellites help nations throughout the Indian Ocean littoral by providing weather information and real-time distress alert

services. Like the nuclear energy program, the space program has military implications that are contentious international political issues.

Other Leading Institutions Although much of the top executive authority of the science and technology infrastructure in India resides in New Delhi, some premier science and technology institutions are located elsewhere.

Bangalore, the capital of Karnataka, is a center for high-technology industry and a major research and development site. Much of the activity in Bangalore's "Silicon Valley" is carried out through collaborative arrangements with multinational corporations in fields such as aeronautics, communications, electronics, and machine tools. By 1990 there were more than 100,000 people employed by 3,000 companies in the electronics industry alone. The Tata Institute of Fundamental Research in Bombay conducts fundamental research in astronomy, mathematics, molecular biology, and physics; and applied research in computer science, ion accelerators, material science, and solid state electronics. Organizationally, the institute is a component of the Department of Atomic Energy. When the atomic energy program began in 1948, the Tata Institute provided trained staff, and in 1955, because of the important role it played in nuclear energy research, the institute was recognized as the National Centre of the Government of India for Advanced Study and Fundamental Research in Nuclear Science and Mathematics.

In this capacity, the institute became a world-class nuclear research facility, recognized for its discoveries in the field of strange particles. Research on applied mathematics, astrophysics, deoxyribonucleic acid (DNA), high-power

microwaves, stratospheric and underground nuclear physics, theoretical computer science, and other high-technology fields is carried out by the Tata Institute in Bombay and at its facilities in Bangalore and Kolar in Karnataka, Hyderabad in Andhra Pradesh, Pachmarhi in Madhya Pradesh, Pune in Maharashtra, and Udthagamandalam (Ooty) in Tamil Nadu. Tata Institute scientists designed the first Indian digital computer in the 1960s and since then have contributed directly to the manufacture of microwave components and devices. Joint work has been conducted with foreign laboratories, such as accelerator experiments with Switzerland and the United States. The Tata Institute also provides both formal and informal science education aimed at improving the quality of science education and developing remedial measures for improving scholastic performance. Significant achievements have been made in the areas of nuclear and space science, electronics and defence. The government is committed to making S&T an integral part of the socio-economic development of the country.

| | India has the third largest scientific and technical manpower in the world; 162 universities award 4, 000 doctorates and 35, 000 postgraduate degrees and the Council of Scientific and Industrial Research runs 40 research laboratories that have made some significant achievements. In the field of Missile Launch Technology, India is among the top five nations of the world. Science and technology, however, is used as an effective instrument for growth and change. It is being brought into the mainstream of economic planning in the sectors of agriculture, industry and services. The country's resources are used to derive the maximum output for the benefit of society and improvement in the quality of life. About 85 per cent of the funds for S; T

come directly or indirectly from the Government. The S; T infrastructure in the country accounts for more than one per cent of the GNP.

S; T in India is entering a new frontier. Atomic Energy The prime objective of India's nuclear energy programme is the development and use of nuclear energy for peaceful purposes such as power generation, applications in agriculture, medicine, industry, research and other areas. India is today recognized as one of the most advanced countries in nuclear technology including production of source materials. The country is self-reliant and has mastered the expertise covering the complete nuclear cycle from exploration and mining to power generation and waste management. Accelerators and research and power reactors are now designed and built indigenously. The sophisticated variable energy cyclotron at Kolkata and a medium-energy heavy ion accelerator 'pelletron' set up recently at Mumbai are national research facilities in the frontier areas of science. As part of its programme of peaceful uses of atomic energy, India has also embarked on a programme of nuclear power generation.

Currently eight nuclear stations are producing eight billion kilowatt of electricity. Four more nuclear power stations are planned. The new nuclear reactors are designed in India. The peaceful nuclear programme also includes producing radioisotopes for use in agriculture, medicine, industry and research. | | SpaceThe Indian Space Research Organisation (ISRO), under the Department of Space (DOS), is responsible for research, development and operationalisation of space systems in the areas of satellite communications, remote sensing for resource survey, environmental

monitoring, meteorological services, etc. DOS is also the nodal agency for the Physical Research Laboratory, which conducts research in the areas of space science, and the National Remote Sensing Agency, which deploys modern remote-sensing techniques for natural resource surveys and provides operational services to user agencies. India is the only Third World Country to develop its own remote-sensing satellite.

India joined a select group of six nations on October 15, 1994, when the Polar Satellite Launch Vehicle (PSLV) successfully accomplished its mission of placing the 800 Kg remote sensing satellite, IRS-P2, in the intended orbit. Earlier in May, the fourth developmental flight of the Augmented Satellite Launch Vehicle (ASLV) achieved its mission by placing the 113 Kg SROSS-C2 scientific satellite in a near-earth orbit. India is well on its way to developing a Geosynchronous Satellite Launch Vehicle (GSLV) capable of putting 2000 Kg satellites into space. The Indian Space Research Organisation (ISRO) is currently trying to develop an indigenous cryogenic engine for GSLV. A GSLV model has already been tested in wind tunnel. The INSAT series of satellite launched earlier are performing well and provide vital services for telecommunications, television, meteorology, disaster warning and distress detection. The latest INSAT series include new features like Ku-band transponders and mobile satellite services transponders.

The remote-sensing satellites, launched in 1988 and 1991, have already become the mainstay of the natural resource management system of the country. The projected launch of advanced remote sensing satellites will not only enhance the scope of their application, but will also offer commercial



service to other countries. The Indian achievement in the application of space-based remote sensing technology has led a US company to enter into an agreement for marketing the data from Indian satellites globally. India's progress in space technology has attracted worldwide attention and demand, with leasing agreements for marketing of IRS data and supply of space hardware and services. India also believes in co-operation in space with agencies all over the world. A high-level UN team selected India for setting up a UN Centre for Space Science and Technology Education. India is on the threshold of achieving self-reliance in the launch capability.

It will be a befitting tribute to the father of the Indian space programme, Dr. Vikram Sarabhai, whose 80th birth anniversary was observed in August 1996. Electronics The Department of Electronics plays the promotional role for the development and use of electronics for socio-economic development. Many initiatives have been taken for a balanced growth of the electronics industry. The basic thrust has been towards a general rationalization of the licensing policy with an emphasis on promotion rather than regulation, besides achieving economy of scale with up-to-date technology. A multi-pronged approach has been evolved for result-oriented R; D with special emphasis on microelectronics, telematics, and high-performance computing and software development. Application of electronics in areas such as agriculture, health and service sectors has also been receiving special attention.

For upgrading the quality of indigenously manufactured products, a series of test and development centers and regional laboratories have been set up.

These centers for electronic design and technology help small and medium electronics units. A number of R; D projects have been initiated to meet the growing requirements of the industry. Oceanography India has a coastline of more than 7, 600 km and 1, 250 islands, with its Exclusive Economic Zone covering over 2 million sq. km and continental shelf extending up to 350 nautical miles. The Department of Ocean Development was established in 1981 to ensure optimum utilisation of living resources, exploitation of non-living resources such as hydrocarbons and minerals, and to harness ocean energy. Two research vessels, ORV Sagar Kanya and FROV Sagar Sampada, are assessing and evaluating the resource potential.

Survey and exploration efforts have been directed to assess seabed topography, and concentration and quality of mineral nodules. In August 1987, India was allotted a mine site of 150, 000 sq. km in the central Indian Ocean for further exploration and development of resources. India is the only developing country to have qualified for Pioneer Status by the UN Conference on the Law of the Sea in 1982, and it is the first country in the world to have secured registration of a mine site. India has sent 13 scientific research expeditions to Antarctica since 1981, and has established a permanently manned base, Dakshin Gangotri. A second permanent station, an entirely indigenous effort, was completed by the eighth expedition. The objective is to study the ozone layer and other important constituents, optical aurora, geomagnetic pulsation and related phenomena.

By virtue of its scientific research activities, India acquired Consultative Membership of the Antarctic Treaty in 1983 and acceded to the Convention

on the Conservation of Antarctic Marine Living Resources in July 1985. India is also a member of the Scientific Committee on Antarctic Research, and has played a significant role in adopting a Minerals Regime for Antarctica in June 1988. A National Institute of Ocean Technology was set up for the development of ocean-related technologies. It is also responsible for harnessing resources of the coastal belts and islands. Biotechnology India has been the forerunner among the developing countries in promoting multi-disciplinary activities in this area, recognizing the practically unlimited possibility of their applications in increasing agricultural and industrial production, and in improving human and animal life. The nucleus of research in this area is the National Biotechnology Board, constituted in 1982. A Department of Biotechnology was created in 1986.

Recently, the Biotechnology Consortium India Ltd. was set up. It will play the role of a catalyst in bridging the gap between research and development, industrial and financial institutions. Some of the new initiatives taken include developing techniques for gene mapping, conservation of biodiversity and bio-indicators research, special biotechnology programmers for the benefit of the scheduled castes and scheduled tribes and activities in the area of plantation crops. The areas which have been receiving attention are cattle herd improvement through embryo transfer technology, in vitro propagation of disease resistant plant varieties for obtaining higher yields, and development of vaccines for various diseases.