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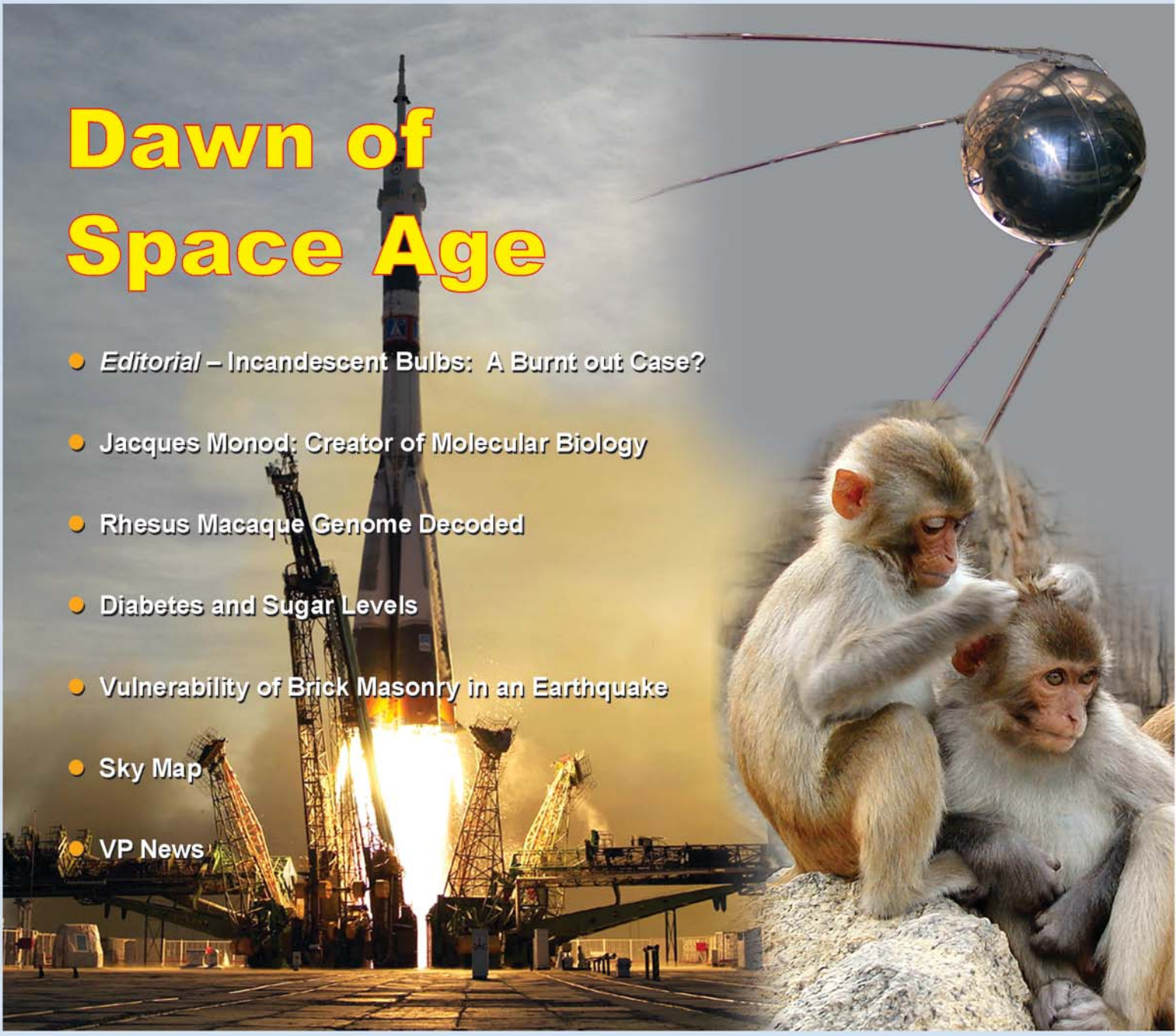

Dawn of Space Age

... think scientifically, act scientifically... think scientifically, act scientifically... think scientifically, act...

Incandescent Bulbs
A Burnt out Case?

Before the invention of the incandescent bulb, or the electric light as it is commonly called, illuminating the world after the Sun went down was a messy, arduous, and hazardous affair. It took a bunch of candles, oil lamps or torches to fully light up a house. Though fairly effective, they tended to leave a residue of soot on anything close to them. Indeed, this situation continued in our country for decades even after Independence. There is no gainsaying the fact that the incandescent bulb has profoundly changed human existence and our lifestyle ever since its invention. It is one of the few technologies still in use more than a century after it was pioneered in the last quarter of the nineteenth century by Thomas Alva Edison in America and Joseph Swan in England.

Over a century after lighting the world, the humble light bulb finally seems to be on way out making way for the newer, more efficient technologies. Only five per cent of the electrical energy fed into the bulb generates light. The rest is simply wasted as heat. Hence it makes sense switching over to energy-efficient technologies that offer scope for reducing the amount of electricity produced by the power stations that burn fossil fuels; and thereby cutting down carbon dioxide released into atmosphere by them. This is why several governments across the world have proposed legislation to ban the iconic invention of Edison and switch over to the newer energy-saving light bulbs in a bid to cut down carbon dioxide emissions that contribute to global warming. First to propose this was the state of California in the United States. On 31 January 2007, it proposed to ban the traditional bulbs by 2012. Soon after, Australia followed the suit. European Union with its 27 member states would phase them out by 2009.

What are the reliable replacements to the traditional incandescent bulb, then? Already available in the market are the compact fluorescent lamps (CFLs) that are coiled up versions of the fluorescent tube lights. Then there are bulbs and lights based on the light emitting diodes (LEDs), used in car headlights and display screens, that give out huge amounts of light for their size, and use a fraction of the energy of conventional bulbs. However, a few technical deficiencies will need to be overcome before LEDs could replace them. Today, a conventional bulb costs about Rs.10, while a CFL costs about Rs. 80. LED assembly is rather expensive – about Rs. 1,000 to 2,500. Hence, until LEDs become cheaper, CFLs could serve as a stopgap energy-saving alternative.

Since lighting accounts for nearly one sixth to one fifth of the electrical energy consumed, it is obvious that savings in terms of energy and money by switching over to CFLs would be considerable. According to an estimate, if all in Delhi start using CFLs, the city could save over 500 megawatts of electricity. Incidentally, the requirement of electricity in Delhi in peak summer is about 3,500-3,800 megawatts.

How does a CFL work? The CFL tube contains a gas (mercury vapour) that produces ultraviolet (UV) light when an electric current passes through it. When the UV light strikes the phosphor coating on the inside of the tube, it generates white light – the same way as in the familiar fluorescent tube light. The primary difference between the two, however, is in size. Compact fluorescent bulbs are made in special shapes (which require special technologies) to fit in standard household light sockets, like table lamps and ceiling fixtures. In addition, CFLs come with their own built-in transformers that can fit ordinary light sockets unlike a familiar fluorescent tube light. True, there are concerns regarding the use of mercury in CFL, which may prove to be injurious and harmful in case CFL breaks. Consumers hence need to be suitably informed to use CFLs with caution.

LEDs are semiconductor devices that emit light when a voltage is applied across them. The most remarkable change in the way we light our homes

(Contd. on page 31)

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Jacques Lucien Monod
Creator Molecular Biology

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"In France the rise to power of the molecular biologists was assisted by Jacob, Monod, and Lwoff's Nobel Prize (1965). The Nobel Prize confers enormous prestige and gives the prizewinner influence at all levels of the decision-making process in his or her field – recruitment, financing, and the construction of new laboratories. Monod, who was also appointed professor at the prestigious College de France, then became director of the Pasteur Institute in1971, was able to intervene directly in the development of molecular biology in France."

Michael Morange in *A History of Molecular Biology*, Oxford University Press, 1998

"Jacques Monod had one of the most creative minds of our time, but not because he was a leader of righteous causes, a creator of molecular biology, or a founder and director of an institute of learning. He had one of the most creative minds simply because he thought deeply and aesthetically, and in a Socratic way, about how knowledge is acquired, and it is this process that he insisted should be the only basis for a system of ethical and aesthetic values."

Melvin Cohn, Monod's friend and colleague

Jacques Lucien Monod was an internationally acclaimed molecular biologist, a fine musician, an accomplished writer on philosophy of science, a political activist and a military strategist. Monod is mostly known for the work done jointly with Francois Jacob on the control of expression of genes by Lac operon (the operon that regulates the lactose metabolism in the bacterium *Escherichia coli* and which was first postulated by Monod and Jacob). This work helped to formulate a theory explaining how genes act, particularly how genes are 'switched on and off', as necessary. Monod and Jacob introduced the term operon to describe a closely linked group of genes, each of which controls a different step in a particular metabolic pathway. Monod's contribution to the science of biology goes far beyond the development of operon model. Along with Jacob he suggested the existence of a molecule, which was later called messenger RNA (or mRNA), that takes the information coded in DNA to ribosome, where proteins are made. Monod made important contributions to the field of enzymology. The 1965 Nobel Prize for Physiology or Medicine was awarded jointly to Andre Lowff, Monod and Jacob "for their discoveries concerning genetic control of enzyme and virus synthesis."

Monod was born on 9 February 1910 in Paris, France. His father Lucien Monod was a portrait artist. His mother Charlotte Todd came from Milwaukee, Wisconsin, USA. Monod spent his childhood in Cannes, where every year the internationally famous Cannes Film Festival is held. It is no wonder that Monod was described as having an 'actor's craving for attention'. As a young boy, Monod climbed rocks, sailed yachts, and hunted for fossils. He pursued these childhood interests all through his life. His early interest in biology was influenced by his father, who used to read the works of Charles Darwin.

Jacques Lucien Monod

In 1928, Monod moved to Paris for his higher education. He received his bachelor's degree in natural science 1931 and then started working on the question of origin of life, a problem he was interested in since his school days. In 1934, he was appointed an assistant professor of zoology. He also started working on nutritive requirements of bacteria for his PhD degree.

In 1936, Boris Ephrussi, a collaborator of Thomas Hunt Morgan (1866-1945) helped Monod to visit California Institute of Technology (Caltech) for studying genetics at Morgan's laboratory, the best centre on genetics in those days. But apparently Monod paid more attention to music than to genetics. American millionaires for whom he conducted concerts tried to hire him for their private orchestra. Ephrussi later complained: "I brought him to California to study genetics. He made my life miserable." Monod did learn genetics at Caltech. Commenting on Monod's visit to Caltech, S. Mahadevan of the Department of Molecular Reproduction, Development and Genetics, Indian Institute of Science, Bangalore, wrote: "Though he was not directly involved in any experiments, this visit was significant, as it was Monod's initiation to classical

André Michel Lwoff

genetics in a laboratory where it was actually happening. In America, his musical abilities were appreciated and he became a renowned conductor. However, he gave up his musical career and returned to France in 1936 to continue his doctoral studies in the area of bacterial physiology. These studies were the starting point for the remarkable discoveries in regulatory biology."

Monod finally did not opt for music as a career and returned to the Sorbonne University, Paris to complete his PhD. He received his PhD degree in 1941. While carrying out research on bacterial growth for his PhD degree, Monod characterized and described a phenomenon called 'diauxy' – when two different types of food were added to a microbial culture, the bacteria consumed first one type of food, and then after a gap the other. The phenomenon of diauxy produced a growth pattern that has two phases. Such growth pattern is called biphasic growth. Monod had no idea about what produced this effect. It rather intrigued him. In 1945, Monod joined the Pasteur Institute as laboratory director at Andre Lwoff's department of cellular biochemistry. He continued his work on the unresolved phenomenon of diauxy. It was Lwoff who correctly pointed out that Monod's discovery was really an example of enzymatic adaptation, a phenomenon discovered by the Finnish biologist Henning Karstrom in 1900. Enzymatic adaptation means a cell makes specific enzymes only in response to a given substrate. Thus when a cell finds a new type of food, it synthesizes the enzyme necessary for consuming the food.

During the Second World War, Monod joined the French Resistance. He also became a member of the French Communist Party, from which he later resigned over a policy disagreement. His duties in the War involved parachute drops of weapons, railroad bombings, and mail interceptions. He helped to organize the general strike, which eventually liberated Paris.

In 1954, Monod became the Director of the Cell Biochemistry Department of Pasteur Institute. He continued his research work on bacterial growth. Jointly with George Cohen, Monod proposed the innovative concept of 'bacterial permease'. They proposed that an enzyme is responsible for the permeability of the bacterial cellular membrane to metabolites.

At the Pasteur Institute, Monod started collaborating with Francois Jacob in 1958. This collaboration became a "great collaboration", as called by Francis Crick, which produced fundamental contributions to the development of molecular biology.

Before we discuss about the works jointly done by Monod and Jacob, we will briefly discuss about Jacob's journey in scientific research. Born at Nancy, Paris, Jacob entered the Paris University with the intention of becoming a surgeon. When Germany invaded France in 1940, Jacob fled to London, where he served with the Free French forces. For his war services Jacob earned the Croix de la Liberation. He was severely injured in the War, which made him completely unfit for becoming a surgeon. Nevertheless after he was released from the hospital he resumed his medical studies at the university in 1945. He received his MD degree in 1947 and decided to pursue a career in research. To achieve his goal, he continued approaching Andre Lwoff and Monod for a fellowship. Even after being rejected several times he did not give up. Finally one day Lwoff suggested to Jacob that he start working on "the induction of the prophage". Although he had no idea what that meant, Jacob accepted the offer. And so finally in 1950 Jacob joined the Pasteur Institutes as an assistant to work under Lwoff.

Jacob started his work on lysogenic bacteria, in which bacteriophages can exist in noninfectious phase or the prophage. He obtained his PhD degree in 1954 on his work on lysogenic bacteria and their prophage. He experimentally demonstrated that the expression of the prophage and cytolysis (breakdown of cells usually as a result of destruction or dissolution of their outer membranes) could be stimulated by ultraviolet radiation. After his PhD, Jacob started investigation on bacterial sexuality with Ellie Wollman. They demonstrated how gene transfer takes place between bacteria. They also developed techniques to stop the genetic exchange as and when they wished to do so. These techniques proved a powerful tool for localizing genes on bacterial chromosomes.

Monod started working with Jacob in 1958. They decided to clarify the mechanisms of gene expression. The collaboration of Monod and Jacob produced three theoretical models which

François Jacob

proved to be of fundamental importance for the development of molecular biology. They are: the operon, messenger RNA, and allosteric interaction.

Monod and Jacob conceived an experiment that demonstrated the existence of a double genetic determinism in protein synthesis. This famous experiment, which was conducted in collaboration with Arthur Pardee, has come be known as Pa-Ja-Mo experiment. The experiment showed that two distinct sets of genes intervened during protein synthesis. One set determined the structure of the synthesized protein molecule and the other controlled the expression of the first. Monod and Jacob called each set of such genes "operon".

According to the operon model, a functionally integrated genetic unit for the control of gene expression in bacteria comprises structural genes, coding for protein and adjacent loci controlling their expression – an operator site and a promoter site. Transcription of the structural genes can be prevented by binding of a repressor molecule to the operator site. Transcription is the process by which genetic information of DNA is transferred to a messenger that takes the information to the site where proteins get synthesized. This step constitutes the first step in protein synthesis. Thus the repressor molecule blocks the expression of a given operon. An inducer molecule can bind to the repressor molecule and prevent it from binding to the operator so that it can allow the promoter site to bind the enzyme responsible for initiating transcription. Thus an inducer molecule can initiate transcription. The repressor molecule is encoded by a regulatory gene, which may be close to or away from the operon. The operon model opened up three new avenues of research: (i) the nature of the repressor molecule; (ii) the mechanism of repressor's chemical action; and (iii) the molecular mechanism of the transfer of genetic information.

In 1961, Monod and Jacob proposed the idea of messenger RNA. A messenger RNA molecule carries genetic information from the DNA to the ribosome, the site for protein synthesis. Later Jacob with

Thomas Hunt Morgan

Sydney Brenner produced evidence for the existence of messenger RNA. The same year Monod and Jacob generalized the concept of allosteric transition, a chemical interaction that allows complete freedom in the selection of chemical mechanisms.

Later Monod, jointly with Jean-Pierre Changeux and Jeffries Wyman, developed a more formal model of allostery to explain the properties of regulatory proteins and enzymes. Monod in his Nobel Lecture said: "...a systematic comparison and analysis of the properties of some of the regulatory enzymes led us to conclude that, in most if not all cases, the observed effects were due to indirect interactions between distinct stereo specific receptors on the surface of the protein molecule, these interactions being in all likelihood transmitted by means of conformational modifications induced or stabilized at the time of the formation of a complex between the enzyme and the specific agent – hence the name 'allosteric effects', by which we proposed to distinguish this particular class of interactions, and the term 'allosteric transition', used to designate the modification undergone by the protein."

There were other models proposed for explaining the regulation and many years the acceptability of the allosteric theory was debated. Though it was not universally accepted, X-ray diffraction data of the structures of the proteins generally supported Monod's allosteric theory.

An allosteric enzyme has two structurally distinct forms; one of the two forms is active and the other inactive. In the active form, the quaternary structure of the enzyme is such that a substrate can interact with the enzyme at the active site. In the inactive form, the conformation of the substrate-binding site gets altered and so it cannot interact with the substrate. An allosteric enzyme tends to catalyze the initial step of a certain pathway that leads to synthesis of certain molecules. The end product of the pathway can act as a feedback inhibitor, which converts the active form of the enzyme into its inactive form. This way the amount of product synthesized is controlled.

In 1967, Monod became professor at the prestigious College de France and then in 1971, he became the Director of the Pasteur Institute. His book *Chance and Necessity* became a best seller. In this book Monod brought out the principles of molecular biology, a new science in those days, to the attention of general public. Besides being a firsthand account of the development of the new field, it also highlighted the new view of the biological world projected by the developments in molecular biology. Monod wrote:

"The theory of the genetic code constitutes the fundamental basis of biology. This does not mean, of course, that the complex structures and functions of organisms can be deduced from it, nor even that they are always directly analyzable on the molecular level. (Nor can everything in chemistry be predicted or resolved by means of the quantum theory, which, without question, underlies all chemistry.) But although the molecular theory of the genetic code cannot now – and will doubtless never be able to – predict and resolve the whole of the biosphere, it does today constitute a general theory of living systems."

In this book Monod debated on the role of chance in evolution. He argued that life originated on Earth by chance and evolved to its present level as a necessary consequence of the pressures exerted by

natural selection. There was no overall plan for it. According to Monod humans are the product of chance, an accident in the universe. The universe itself has no purpose and no meaning. He wrote: "Man knows at last that he is alone in the universe's unfeeling immensity out of which he emerged only by chance." While life was born by accident, Darwin's natural selection made it evolve. Monod highlighted that the structures and processes on the lower level of an organism do not play any restrictive roles on higher-level structures and processes. Not everybody would agree with Monod. Freeman John Dyson (1923-), the British-born American physicist wrote: "The more I examine the universe and study the details of its structure, the evidence I find that the universe in some sense must have known that we were coming."

Monod died on 31 May 1976. He had blood cancer. The last words spoken by Monod just before his death were: "Je cherche a comprendre – I am trying to understand."

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(This article is a popular compilation of the important points on the life and work of Jacques Lucian Monod available in the existing literature. The idea is to inspire the younger generation to know about Monod. The author has given sources consulted for writing the article. However, the sources on the Internet are numerous and so they have not been individually listed. The author is grateful to all those authors whose works have contributed to writing this article.)

Editorial *(Contd. from page 35)*

is expected to come from LEDs when they become cheap and reliable. Let us see why. Despite the fact that CFLs are much more efficient than the incandescent bulb, they still emit only about 30 per cent of the electrical energy fed into them as light. This compares with the 30 per cent efficiency of existing LEDs, which is expected to go up to 70 per cent. Already some LED-based light sources have started appearing for household lighting. The challenge, however, is to develop devices that can create warmer white light. A pioneer of LEDs quotes in a recent article in *New Scientist* (31 March 2007), "It will be CFLs first, but LEDs may eventually bypass them. It's amazing the incandescent bulb has lasted this long!"

The Fourth Assessment Report of the Inter-Governmental Panel on Climate Change (IPCC) released in May 2007 states that between 1970 and 2004, the global greenhouse gas (GHG) emissions have increased by 70 per cent as compared to the times before Industrial Revolution. Carbon dioxide emissions grew during this period by about 80 per cent (28 per cent between 1990 and 2004); and represented 77 per cent of total anthropogenic (that is, man-made) GHG emissions in 2004. If the world continues to burn fossil fuels along current lines, then the dangerous emissions would rise by 90 per cent by 2030. All countries, including India and China, will have to adopt measures to scale back polluting emissions. Every individual and region has a stake in halting global warming. Under the circumstances, switching over to CFL shall have to be one of our first acts to save this planet from heading towards disaster.

CFLs produce light for just 20 per cent of the energy used by the incandescent bulbs. Further, they last for about 10,000 hours compared to the incandescent bulbs that last only for about 1,000 hours. Using a CFL means manufacturing less number of incandescent bulbs. It is interesting to note that in places where coal is used to produce electricity (which is true in most places), each CFL, over its lifetime, will cut carbon dioxide pumped into the atmospheres by the power plants by about 600 kilograms. We shall need to switch over to efficient technologies that are already available and change our lifestyles to arrest global warming in the coming decades. It is imperative that we immediately switched over to more efficient electrical gadgets, better insulation, and active solar design for heating and cooling. This calls for specially designed awareness campaigns and a challenge to be immediately taken up by science communicators. Surely, charity begins at home.

Vinay B. Kamble

Sputnik
Catapult of Space Age

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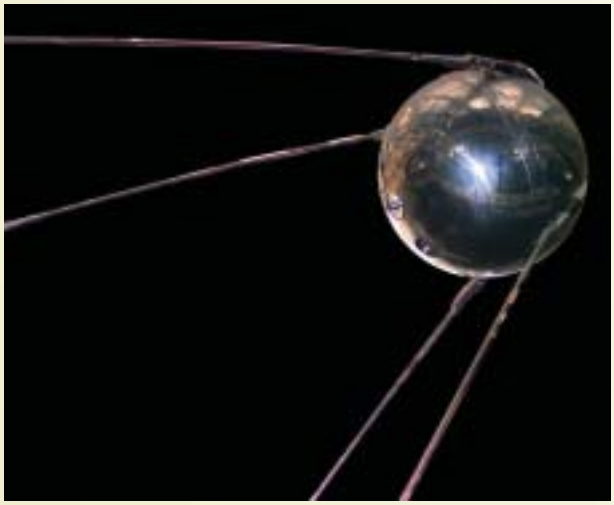
Fourth October 1957 dawned like any other day. People went about their usual chore. Leave alone the ordinary folks, even the god of time Khronos (or *Kal Dev*), was ignorant of its significance. It was on this day first ever artificial satellite, *Sputnik-1* soared into the skies and made history. Fourth October 2007 marks the 50th anniversary of one of the most historic events in the history of our species: the launching of the first artificial satellite and the beginning of space age.


Sputnik-1

As *Sputnik-1* went round the Earth, it was visible at night to those with a small telescope or binoculars as it glittered in the rays of Sun. The radio beacon at frequencies 20 and 40 MHz from its radio transmitter was picked up by many radio operators worldwide. All those who could glimpse the spacecraft or hear its 'beep…beep…beep' signal – a monotonous three-tenths-second-long chirp interspersed with three-tenths second of silence – were exhilarated. *Sputnik's* radio signals, rebroadcast by television and radio stations around the world, immediately captured the public's imagination. One radio station broadcast the signals live and stated that this was the 'sound that forevermore separated old from the new'. Little more than a football in size, weighing about 83.6 kg – a mere speck of dust compared to modern satellites weighing in tonnes – the *Sputnik* became the first ever human made object to reach outer space.

Reaching space was an arduous journey. The journey of *Sputnik-1* (which incidentally mean 'fellow traveller' in Russian) commenced in 1952, when the International Council of Scientific Unions decided to observe 1 July 1957 to 31 December 1958 as the International Geophysical Year (IGY). This period was solar maximum year and scientists knew that the cycles of solar activity would be at a high point then. In October 1954, the Council adopted a resolution calling for artificial satellites to be launched during the IGY to map the Earth's atmosphere. The intent of this unprecedented international scientific collaboration was to obtain data on Earth's upper atmosphere and its interaction with the Sun during the peak of the sunspot cycle between July 1957 and December 1958.

Responding to the challenge, on 29 July 1955, the US administration made announcement of plans for the building and launching of the world's first man-made satellite. Meanwhile the Soviet Academy of Sciences established a 'Permanent Commission for Interplanetary Travel' to study the launching of a Soviet satellite and missions beyond. A Soviet delegate to the conference of the Special Committee for IGY held in Barcelona, Spain, announced on 11 September 1956 that the Soviet Union would launch a satellite during the IGY.

To launch a satellite one would need a powerful rocket that can catapult it into orbit. The Soviets decided to exploit their missile, *R-7*, for this purpose. The *R-7*, nicknamed *Semyorka* (little seven), was truly an enormous rocket that consisted of a cylindrical core surrounded by four tapered strap-on boosters. Standing tall 34 metres (missile and warhead) it weighed 274 tonnes. At lift off the engines of the *R-7* generated 3,904 kilonewtons of thrust. Each booster of the *R-7* was powered by an RD-107 engine that produced 795 kilonewtons of thrust at sea level using kerosene and liquid oxygen (LOX) as propellants. The core used an engine that produced 726 kilonewtons of thrust at sea level and 912 kilonewtons at altitude. The *R-7* was designed so that the core and all four boosters would ignite on the pad, thus avoiding the untried procedure of starting


R7 rocket hoisted into launch pad

launch of Sputnik 1

Table 1: First launch by countries			
Country	Year of first launch	First satellite	Payloads in orbit (as on 2006)
Soviet Union	1957	*Sputnik-1*	1,390
United States	1958	*Explorer-1*	999
France	1965	*Asterix*	43
Japan	1970	Osumi	102
China	1970	*Dong Fang Hong-I*	53
United Kingdom	1971	*Prospero X-3*	23
India	1981	*Rohini*	31
Israel	1988	*Ofeq-1*	6
Both North Korea and Iraq have claimed launches but these are unconfirmed			

large engines at high altitude. After the boosters had exhausted their propellants 120 seconds after lift-off, they would be jettisoned. The core would then would continue alone until the proper velocity had been reached, 320 to 330 seconds after lift-off, at which time the warhead would be released.

The *R-7* was designed to carry a 5-megaton nuclear warhead weighing 5.4 tonnes over a distance of 8,000 kilometres. It was truly the first Intercontinental Ballistic Missile (ICBM). The idea dawned on Soviet engineers in the 1950s that the *R-7* not only could blast a nuclear warhead thousands of kilometres, but it also could carry a payload to such speed and altitude that the payload would go into Earth orbit. In other words, an artificial Earth satellite could indeed be launched using *R-7*.

Construction of new *R-7* launch facilities had begun near the town of Tyuratum in Soviet republic of Kazakhstan about 2,000 km south west of Moscow on 31 May 1955. This new facility, initially known by its railway stop designation of 'Tashkent 50', was to later become the core of the sprawling Baikonur Cosmodrome. On 4 March 1957 the first *R-7* launch pad was completed and fit tests commenced. Though the launch pad was ready, a series of misfortunes and failures beset the Soviet trials, at times even threatening the whole project. The first three test flights of the *R-7* were non-starters. As three tests failed in a row, many expressed scepticism, doubted if ever *R-7* would work. There were pressures on the team to abandon the space project and just concentrate on development of missiles. Persuaded by Sergei Pavlovich Korolev, widely regarded as the founder of the Soviet space program, one last chance was provided. To the delight of Korolev's team, the fortunes changed when *R-7* serial number M1-8 was successfully launched on 21 August 1957. The dummy warhead landed at its target on the Kamchatka peninsula 6,500 kilometres away, establishing firmly space is within reach.

Meanwhile there was inordinate delay in the construction of the original satellite proposed. Korolev shelved the construction of the original satellite and directed preparation of a simple satellite and the same was completed as early as June 1957 with a plan to launch it to space on 18 September 1957, the 100th birth anniversary Konstantin Tsiolkolvski, father of cosmonautics. Though the anniversary of Tsiolkolvski was missed, the Soviets decided to celebrate their October revolution. On the night of 3 October 1957 the rocket was erected on the launch pad and it was fuelled. A string of technical glitches hampered the launch of the *R-7* all day during 4 October. As night fell, Korolev decided to make one more attempt. Finally at 10:28:04 PM Moscow Time, the engines of the *R-7* ignited, lifting the missile and its payload off the launch pad. The rocket quickly gained speed, pitched on command towards the northeast and disappeared into the night sky.

It was the beginning of anxious wait and tense moments for all those at the launch pad. Out of four test flights of the *R-7*, three had failed. This was the fifth one. They had no answer if this one would make it; they had to wait out. As the rocket soared high, it would hurl itself and the satellite eastward. The satellite would itself

crowds thronged radios to listen to 'beep beep' sound from Sputnik

re-appear over the launch pad only after 90 minutes after making a full journey around Earth. *Sputnik-1* carried a small radio beacon that beeped at regular intervals and helped in locating its position in orbit. A radio receiver and loud speakers were installed at the launch pad where everyone waited to hear 'beeps' from the satellite. After an hour and a half of nail biting wait, "beep, beep, beep" from the satellite's transmitter echoed throughout the control room. There was a nervous moment of disbelief and silence. It took a moment for the scientists and technicians to realise that the satellite indeed had reached its orbit. There was now no doubt about the outcome of the launch.

Apart from a few technical glitches, the telemetry data confirmed that the 83.6-kilogram *Sputnik* was successfully placed into a 228 by 947-kilometre orbit inclined 65.1 degrees to the equator, with a period of 96.17 minutes, travelling at a breakneck speed of 28,000 kilometres per hour. The satellite functioned well for 21 days. Due to the ever-present atmospheric drag, it re-entered and burnt up in the atmosphere on 4 January 1958.

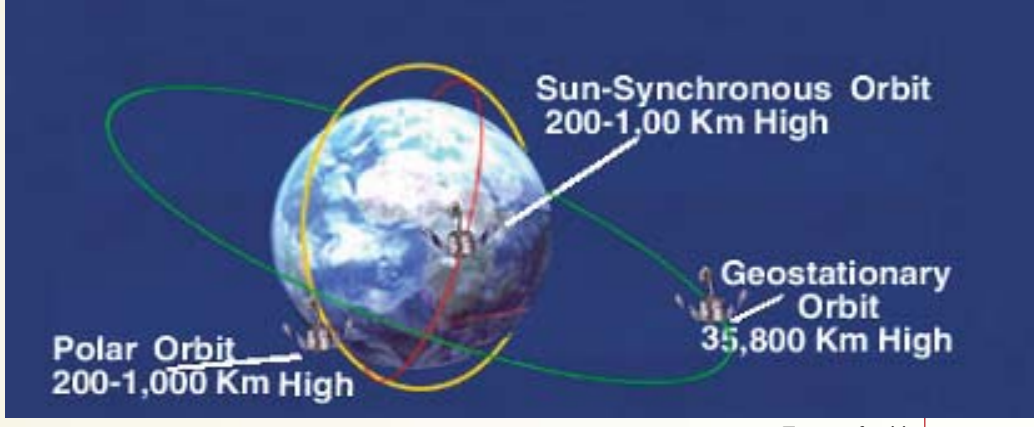
After the cheers died down at the launch centre, Korolev stood before them and solemnly said: "The conquering of space has begun. Today we have witnessed the realization of a dream nurtured by some of the finest minds who ever lived. Our outstanding scientist Tsiolkovsky brilliantly foretold that mankind would not forever remain on the Earth. Sputnik is the first confirmation of his prophecy. We can be proud this was begun by our country."

Children were inspired.

If the first *Sputnik* was a toy, just fitted with transmitter, today's satellites are used for innumerable purposes – astronomical satellites for observation of distant planets, galaxies, and other outer space objects; communications satellites that typically use geosynchronous orbits, elliptical orbits or low Earth orbits for the purposes of telecommunications; navigation satellites that use radio time signals transmitted to enable mobile receivers on the ground to determine their exact location; reconnaissance satellites for military or intelligence applications; earth observation satellites that are used for environmental monitoring, meteorology, map making, etc.; weather satellites used to monitor Earth's weather and climate; and space stations designed for human beings to live on in outer space are up there orbiting Earth today.

Sputnik was just a low 'earth' orbit (LEO) satellite. Low Earth orbits are geocentric orbits ranging in altitude up to 2,000 km. Today satellites are launched into medium Earth orbits (2,000 km to 35,786 km) and geostationary orbits (above 35,786 km). The *Sputnik* had an inclined orbit. Today we can launch satellites into geosynchronous orbit (orbits with an altitude of approximately 35,786 km over the equator). To an observer on the ground such satellites would appear as a fixed point in the sky.

Many remote sensing satellites are launched into polar orbit, where the orbit of the satellite passes above or nearly above both poles of Earth on each revolution. Therefore it has



Types of orbits

an inclination of (or very close to) 90 degrees. Sometimes they are sent on a Polar Sun-synchronous Orbit. In this orbit, the satellite is in a polar orbit, but in addition, passes over the equator at the same local time on every pass. Such an orbit is immensely useful for image taking satellites because with the same Sun angle, shadows would be the same on every pass. For placing in the geostationary orbit, satellites are first launched into a geostationary transfer orbit (GTO), which is a highly elliptic orbit where the perigee is at the altitude of a low earth orbit and the apogee at the altitude of a geosynchronous orbit. The satellite is gradually moved into the geostationary orbit by repeatedly firing the apogee boost motors when the satellite reaches its apogee in successive orbits. The elliptical orbit (also known as the Molniya orbit) is an interesting orbit. It is a highly elliptic orbit with an orbital period of ½ of a sidereal day (roughly 12 hours) and inclination of 63.4°. Such a satellite spends most of its time over a designated area of the globe, thus enabling continuous communication link over the designated area.

Within four years of *Sputnik*, the first human went on a space journey; within a decade of the first *Sputnik*, 30 men and one woman had accumulated more than 100 days of cumulative space-flight experience. As of March 2007, more than 5,898 payloads had been launched, of which 3,161 payloads are still in orbit around Earth. Spacecrafts have reached Moon, all the planets of solar system, and many other small solar system objects. During the last 25 years, space has been inhabited, with at least one human being living in space all the time, thanks to *Salyut*, *MIR* and the new *International Space Station*. *Sputnik-1* was one small step into space that catapulted humankind into the Space Age. ■

Preventing Diabetes

The Simple Thumb Rules

Dr. Yatish Agarwal
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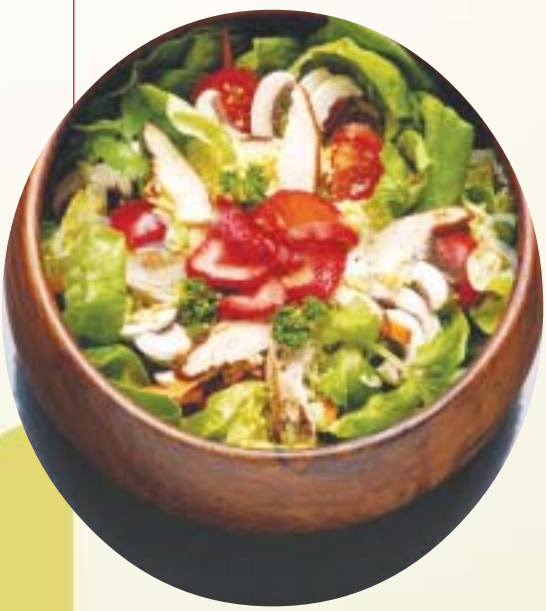
More than 95 per cent of people with diabetes suffer from the type-2 disease. In this form of diabetes, either the cells stop responding to insulin or the pancreas produces it in short supply. As a result, the body's fine act of regulating glucose level in the blood goes awry. Since it can jeopardize life, and carries a high



risk of serious complications such as damage to the eyes, kidneys, nerves, heart, and circulatory system, medical scientists have been trying their best to identify the risk factors that set off the disease, and find out if any changes in lifestyle can prevent or delay its occurrence.

Over the last twenty years or so, scientists have undertaken several cross-sectional community surveys to identify the major culprits that cause the disease, and based on this data, they have tried to evolve strategies for preventive action against diabetes. If this interests you, read on.

Factors that increase your risk

Just diametrically opposite to what people commonly think, diabetes is not caused by eating too much sugar. Although many of its secrets probably still remain uncovered, researchers have been able to make major breakthroughs in identifying the major links in the chain that eventually cause diabetes. Several lifestyle issues and health conditions may be at fault.

Family history : You are more likely to develop diabetes if someone in your immediate family has the disease, whether that person is your father, mother, brother or sister. This genetic connection of the disease was known as long ago as 600 BC. The *Susruta Samhita* states this possibility in clear terms.

Today, scientists are studying genes that may be linked to diabetes, but tests are still under development and not available for routine clinical use. Although people who develop diabetes may have inherited a tendency toward the disease, an environmental factor usually triggers this tendency.

Weight : Being overweight (BMI over 25) is by far the greatest risk factor for type-2 diabetes. More than 80 per cent of people who develop this type of diabetes are overweight or obese. The more fat you carry on your body, the more resistant your muscle and tissue cells become to your own insulin. This is especially true if your excess weight is concentrated around your abdomen and your body is an apple shape rather than a pear shape, where the weight is mostly on the hips and thighs.

Many people with diabetes who are overweight can improve their blood glucose simply by losing weight. Even small weight loss can have beneficial effects, reducing blood glucose levels or allowing diabetes medications to work better.

Physical inactivity : People who lead a sedentary life and do not find time for physical exercise run a major risk of developing diabetes. The less active you are, the greater your risk of type-2 diabetes. Physical activity helps you control your weight, uses up glucose as energy, makes your cells more sensitive to insulin, increases blood flow and improves circulation.

Studies indicate that the risk for developing type-2 diabetes increases by eight per cent for every kilo of excess weight a person carries. It is as though the fat blocks insulin from doing its job.

The number game with blood pressure and cholesterol : If your blood pressure is high and has crossed 140/90 mm Hg, triglycerides are over 250 mg/dl and/or HDL cholesterol is less than 35 mg/dl, than it is time to pull your socks and bring some quick healthy changes in your lifestyle. These numbers are clear indicators that unless you make rapid lifestyle adjustments, you are under a definite risk of developing diabetes.

Womanly risks : A woman who has suffered from polycystic ovarian disease in her younger years, had had high blood sugar while she was pregnant or has given birth to a baby weighing more than 9 pounds must be vigilant to the possibility of being affected by diabetes.

Age : As you grow older, your risk of type-2 diabetes increases. The risk grows once you go past the age of 45,

but even younger people in the 20s, 30s and early 40s must be careful. Type-2 diabetes is increasingly being diagnosed in the younger people. This probably reflects the changing lifestyle, which has little need for physical activity, consents to a surfeit of calories due to the change in eating habits and allows less and less time for self care.

How to check your body mass index?

Body mass index (BMI) is a measurement based on a formula that takes into account your weight and your height in determining how much fat you carry around your body.

To determine your BMI, locate your height on the Body Mass Index chart and follow that row across until you reach the column with the weight nearest yours. Look at the top of that column for the corresponding BMI rating. A BMI of 19 to 24 is considered healthy. A BMI of 25 to 29 signifies being overweight, and a BMI of 30 or more indicates obesity.

habits. No age is too early, and the sooner you recognize the benefits of physical activity, restriction of weight and balanced nutrition the better are your chances of progressing in life without being hit by diabetes. Those who are careful can reduce the risk of developing diabetes by a good 50-60 per cent.

Eat healthy : Cut down on the intake of total calories. Take plenty of fibre, restrict the fat intake to a total of less than 30 per cent of total daily calories and reduce the saturated fat intake to less than 10 per cent of total calories. The less processed food you eat, and the more natural food you partake, the healthier it is.

Get moving : Exercise regularly. Take a 30- to 45-minute brisk walk most days of the week. If you find it dull, you can swim, do cycling, aerobic dancing or play a sport such as badminton or tennis. The goal is to do at least 150 minutes of power exercise every week.

Maintain a healthy weight : Watch your weight. If your BMI is 24 or over, you must take active measures to shed weight. In 95 per cent cases, the reason of obesity is straightforward: intake of too many calories, and too little physical activity. You must take active steps to reverse this equation, and soon you will see the difference. ■

Body Mass Index

	Healthy		Overweight		Obesity				
BMI →	19	24	25	29	30	35	40	45	50
Height (cm)	Weight (in kilograms)								
147.3	41	52	54	63	65	75	87	98	108
149.9	43	54	56	65	67	79	90	101	112
152.4	44	56	58	67	70	81	93	105	116
154.9	45	58	60	70	72	84	96	108	120
157.5	47	60	62	72	75	87	99	112	124
160.0	49	62	64	74	77	90	102	115	128
162.6	50	64	66	77	79	93	105	119	132
165.1	52	65	68	79	82	95	109	123	136
167.6	54	67	70	81	85	98	112	126	140
170.2	55	70	72	84	87	101	116	130	145
172.7	57	72	75	86	90	105	119	134	149
175.3	58	74	77	89	92	107	123	138	154
177.8	60	76	79	92	95	110	126	142	158
180.3	62	78	81	95	98	114	130	146	163
182.9	64	80	84	97	100	117	134	150	167
185.4	65	81	86	100	103	120	137	155	172
188.0	67	85	88	102	106	124	147	159	177

The preventive steps to stop diabetes

You may greatly reduce your risk of developing diabetes if you take timely steps to bring in healthy changes in your living

Earthquake Tip-12

How do Brick Masonry Houses Behave during earthquakes?

Behaviour of Brick Masonry Walls

Masonry buildings are brittle structures and one of the most vulnerable of the entire building stock under strong earthquake shaking. The large number of human fatalities in such constructions during the past earthquakes in India corroborates this. Thus, it is very important to improve the seismic behaviour of masonry buildings. A number of earthquake-resistant features can be introduced to achieve this objective.

Ground vibrations during earthquakes cause inertia forces at locations of mass in the building. These forces travel through the roof and walls to the foundation. The main emphasis is on ensuring that these forces reach the ground without causing major damage or collapse. Of the three components of a masonry building (roof, wall and foundation) (Figure 1a), the walls are most vulnerable to damage caused by horizontal forces due to earthquake. A wall topples down easily if pushed horizontally at the top in a direction perpendicular to its plane (termed 'weak direction'), but offers much greater resistance if pushed along its length (termed 'strong direction') (Figure 1b).

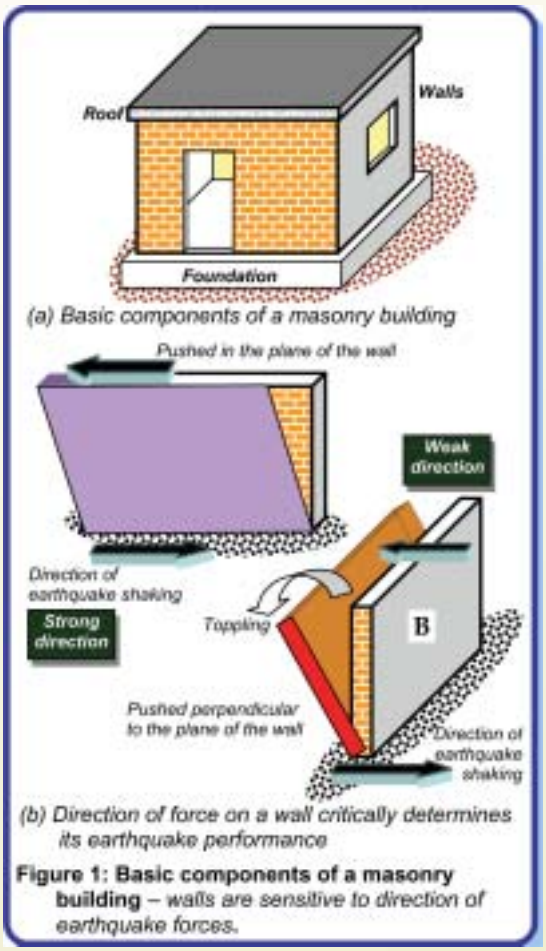


Figure 1: Basic components of a masonry building – *walls are sensitive to direction of earthquake forces.*

The ground shakes simultaneously in the vertical and two horizontal directions during earthquakes (IITK-BMTPC Earthquake Tip 5). However, the horizontal vibrations are the most damaging to normal masonry buildings. Horizontal inertia force developed at the roof transfers to the walls acting either in the weak or in the strong direction. If all the walls are not tied together like a box, the walls loaded in their weak direction tend to topple (Figure 2a).

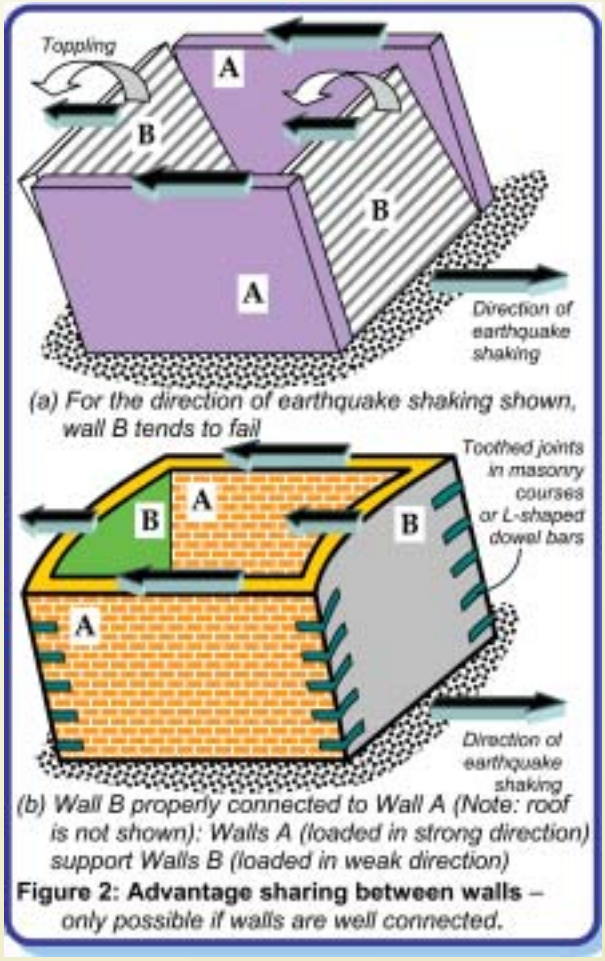


Figure 2: Advantage sharing between walls – *only possible if walls are well connected.*

To ensure good seismic performance, all walls must be joined properly to the adjacent walls. In this way, walls loaded in their weak direction can take advantage of the good lateral resistance offered by walls loaded in their strong direction (Figure 2b). Further, walls also need to be tied to the roof and foundation to preserve their overall integrity.

How to Improve Behaviour of Masonry Walls

Masonry walls are slender because of their small thickness compared to their height and length. A simple way of making these walls behave well during earthquake shaking is by making them act together as a box along with the roof at the top and the foundation at the bottom. A number of construction aspects are required to ensure this box action. Firstly, connections between the walls should be good. This can be achieved by (a) ensuring good interlocking of the masonry courses at the junctions, and (b) employing horizontal bands at various levels, particularly at the lintel level. Secondly, the sizes of door and window openings need to be kept small. The smaller the openings, the larger is the resistance offered by the wall. Thirdly, the tendency of a wall to topple when pushed in the weak direction can be reduced by limiting its length-to-thickness and height-to-thickness ratios (Figure 3). Design codes specify limits for these ratios. A wall that is too tall or too long in comparison to its thickness is particularly vulnerable to shaking in its weak direction (Figure 3).

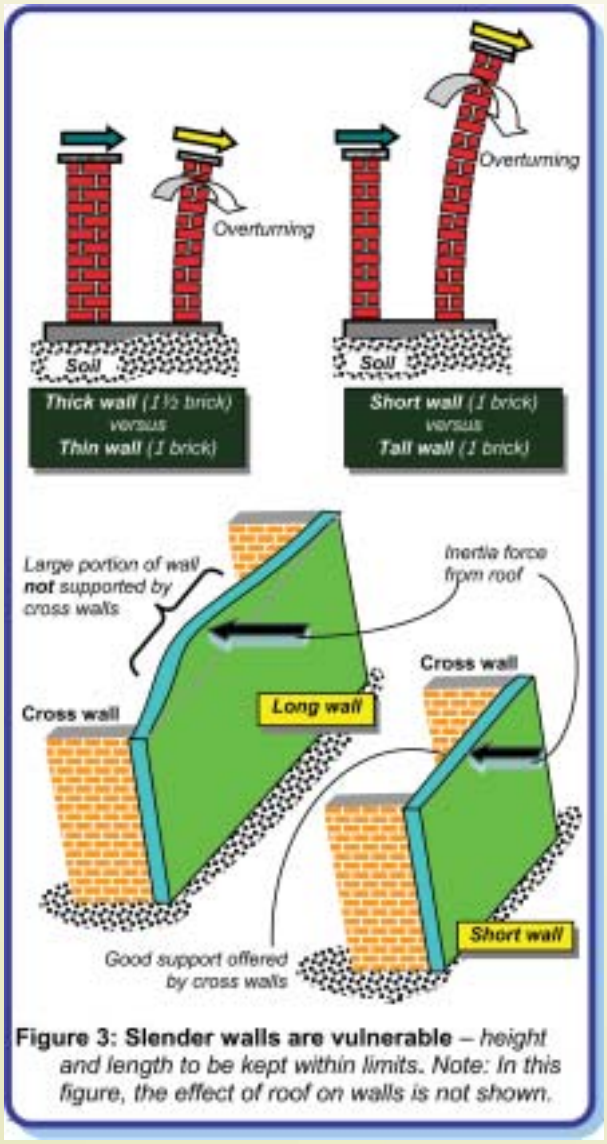


Figure 3: Slender walls are vulnerable – *height and length to be kept within limits. Note: In this figure, the effect of roof on walls is not shown.*

Choice and Quality of Building Materials

Earthquake performance of a masonry wall is very sensitive to the properties of its constituents, namely masonry units and mortar. The properties of these materials vary across India due to variation in raw materials and construction methods. A variety of masonry units are used in the country, e.g., clay bricks (burnt and unburnt), concrete blocks (solid and hollow), stone blocks. Burnt clay bricks are most commonly used. These bricks are inherently porous, and so they absorb water. Excessive porosity is detrimental to good masonry behaviour because the bricks suck away water from the adjoining mortar, which results in poor bond between brick and mortar, and in difficulty in positioning masonry units. For this reason, bricks with low porosity are to be used, and they must be soaked in water before use to minimise the amount of water drawn away from the mortar.

Various mortars are used, e.g., mud, cement-sand, or cement-sand-lime. Of these, mud mortar is the weakest; it crushes easily when dry, flows outward and has very low earthquake resistance. Cement-sand mortar with lime is the most suitable. This mortar mix provides excellent workability for laying bricks, stretches without crumbling at low earthquake shaking, and bonds well with bricks. The earthquake response of masonry walls depends on the relative strengths of brick and mortar. Bricks must be stronger than mortar. Excessive thickness of mortar is not desirable. A 10mm-thick mortar layer is generally satisfactory from practical and aesthetic considerations. Indian Standards prescribe the preferred types and grades of bricks and mortars to be used in buildings in each seismic zone.

Related IITK-BMTPC Earthquake Tip

Tip 5: What are the seismic effects on structures?

Resource Material

1. IS 1905, (1987), *Indian Standard Code of Practice for Structural Use of Unreinforced Masonry*, Bureau of Indian Standards, New Delhi.
2. IS 4326, (1993), *Indian Standard Code of Practice for Earthquake Resistant Design and Construction of Buildings*, Bureau of Indian Standards, New Delhi.
3. IS 13828, (1993), *Indian Standard Guidelines for Improving Earthquake Resistance of Low-strength Masonry Buildings*, Bureau of Indian Standards, New Delhi.
4. Paulay,T., and Priestley, M.J.N., (1992), Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley & Sons, New York.

Acknowledgement :
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Sponsored by : Building Materials and Technology, Promotion Council, New Delhi, India

Recent Developments in Science and Technology

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The macaque genome decoded

The common rhesus monkey, rhesus macaque (*Macaca mulatta*) has become the third primate (after humans and chimpanzees) of which the entire genome has been sequenced. The work, led by the Baylor College of Medicine in Houston, Texas, USA, involved an international team of more than 170 scientists from 35 institutions. The findings of the team show that the rhesus monkey, chimpanzees and humans share about 97.5% of the same genes (*Science*, 13 March 2007).

Sequencing of the rhesus macaque genome is significant for the medical world because from the discovery of the Rh (Rhesus) factor, an important blood type determinant in 1940, to modern-day trials of AIDS vaccines, the rhesus macaque has played a vital role in biomedical research. In fact, it is the most commonly used nonhuman primate for studies on human health and disease. Their close genetic, physiological, and metabolic similarity to humans means that macaques offer invaluable insight into areas ranging from neuroscience, aging, and endocrinology to infectious diseases. The macaque's genome sequence, and new genome-based tools (such as microarrays), would now enable researchers to perform more sophisticated experiments aimed at better understanding of genetic underpinnings of disease and behaviour in humans.

One surprising finding from the macaque genome is that several gene variants, which cause disease in humans, have no effect on healthy rhesus macaques. One example is a variant associated with phenylketonuria, PKU, a disease that affects about 1 in 15,000 people. It is a genetic disorder that is characterized by an inability of the body to utilize the essential amino acid, phenylalanine. People suffering from PKU have a defect in their gene for the enzyme phenylalanine hydroxylase (PAH) – an enzyme needed to break down phenylalanine. Untreated, the build-up of phenylalanine in the brain can poison neurons and cause mental retardation. The surprising thing is that in macaques, that same defective gene is considered normal and has no effect on the animal. Further study of this anomaly may help in finding cures for such disorders.

The aging process in rhesus macaques is remarkably similar to human aging in terms of changes in body structure, physiology, and behaviour. For this reason macaques have been used routinely for investigating the biology of aging – from the beneficial effects of diet restriction to age-related declines in metabolic rate, immune function, and vision. Besides, the development of chronic diseases including cardiovascular disease, cancer, diabetes, and oesteoporosis, and experience age-related reduction in nerve cell function are also similar in humans and macaques, making the latter valuable models for neurodegenrative diseases like Alzheimer's and Parkison's in humans. So, information derived from the macaque genome has the potential to advance our understanding of the molecular mechanisms of aging and may offer insight into possible interventions into the human aging process.

Behavioural science is another field that has benefited from the studies of the rhesus macaque, because macaques share a number of behaviour traits with humans, including maternal care, anxiety, communication through facial expressions, and social play. Information gathered from the macaque genome can help researchers understand how genes influence these and other complex behaviours in humans.

Blood for all

Experiments with blood transfusions, the transfer of blood or blood components into a person's blood stream, have been carried out for hundreds of years. Many patients died and it was not until 1901, when the Austrian biologist Karl Landsteiner discovered human blood groups, that blood transfusions became safer. Landsteiner's work made it possible to determine blood types and thus paved the way for blood transfusions to be carried out safely. For this discovery he was awarded the Nobel Prize in Physiology or Medicine in 1930.

The differences in human blood are due to the presence or absence of certain protein molecules called antigens and antibodies. The antigens are located on the surface of the red blood cells and the antibodies are in the blood plasma. Individuals have different types and combinations of these molecules. The blood group one belongs to depends on

what one has inherited from one's parents.

There are more than 20 genetically determined blood group systems known today, but the ABO and Rh systems are the most important ones used for blood transfusions. Not all blood groups are compatible with each other, and mixing incompatible blood groups trigger immune reaction leading to blood clumping or agglutination, which can even cause death.

According to the ABO blood typing system there are four different kinds of blood types: A, B, AB and O. A person with blood group B has B antigens on the surface of his/her red blood cells and A antibodies in the blood plasma. A person with blood group A has A antigens on the surface of his/her red blood cells and B antibodies in the blood plasma. A person with blood group AB has both A and B antigens on the surface of his/her red blood cells and no A or B antibodies in the blood plasma. In case of a person with blood group O there is neither A or B antigens on the surface of the red blood cells but both A and B antibodies are present in the blood plasma. People with blood group O are called 'universal donors' and people with blood group AB are called 'universal receivers.'

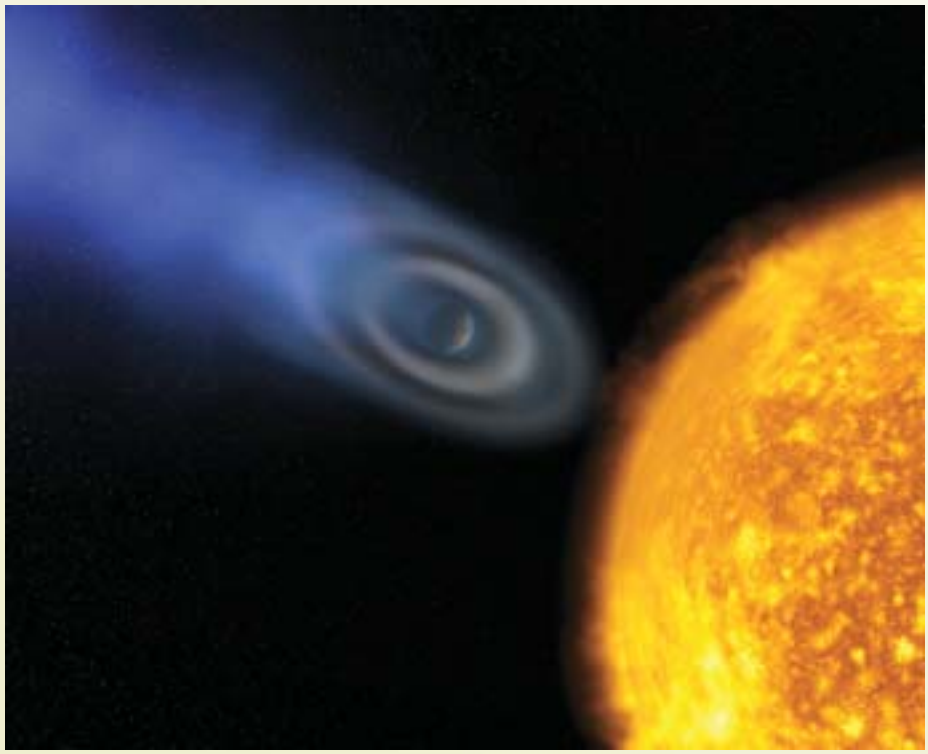
The difference blood groups pose a serious hurdle in the easy availability of blood for transfusion, which always seems to be in short supply. But a recent finding of a research team in Denmark may change all that. An international team led by Henrik Clausen of the University of Copenhagen in Denmark has discovered two novel enzymes in bacteria that can efficiently convert blood groups A, B and AB into the 'universal' O group. The bacterial enzymes strip the antigens present on A, B and AB blood cells away, making them free from immune reaction (*Nature Biotechnol*., Vol. 25 No. 4, April 2007)..

The antigen-stripping property of enzymes first came to light in the early 1980s, when an enzyme was discovered in coffee beans that removes B antigens from red blood cells. Early-stage clinical trials showed that the converted blood could be safely transfused into individuals of different blood groups without any adverse reaction. But the coffee bean enzyme reaction was far too inefficient to be of any practical use.

Clausen's team screened 2,500 extracts from different bacteria and fungi for their ability to cleave off A and B antigens from red blood cells. They found the newly discovered bacterial enzyme to be nearly 1,000 times more efficient than the coffee bean enzyme. The team also discovered an enzyme to remove A antigens from blood cells thus making it possible to convert all blood types into the O-type. The recent discovery does not address the problem of another blood group factor called the Rh factor. But, still, it can be considered a major breakthrough in medical history.

Water on extra-solar planet

For the first time, water has been identified in the atmosphere of an extra-solar planet. The discovery was made by Travis Barman, an astronomer at Lowell Observatory in Flagstaff, Arizona, USA. He used previously published Hubble Space Telescope measurements alongwith new theoretical models and found strong evidence for water absorption in the atmosphere of a large, Jupiter-like gaseous planet named HD209458b, located 150 light years from Earth in the constellation Pegasus (*Astrophysical Journal*, arXiv: 0704.1114v1, 2007).



The detection of the presence of water vapour was possible because this planet, from the vantage point of Earth, orbits directly in front of its star every 3½ days, allowing crucial measurements to be made. As the planet passes in front of a star, its atmosphere blocks a different amount of the starlight at different wavelengths. In particular, absorption by water in the atmosphere of a giant planet makes the planet appear larger across a specific part of the infrared spectrum compared to wavelengths in the visible spectrum.

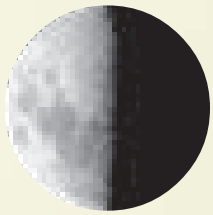
The significance of the discovery stems from the fact that liquid water is essential for life, as we know it, and identifying locations where water is present is an essential step in estimating the number of potentially habitable environments in the Universe. The result is also important because it would help astronomers understand the atmospheres of other planets around other stars. ■

Sky Map for June 2007

Full Moon

01 June

Moon - Last Quarter

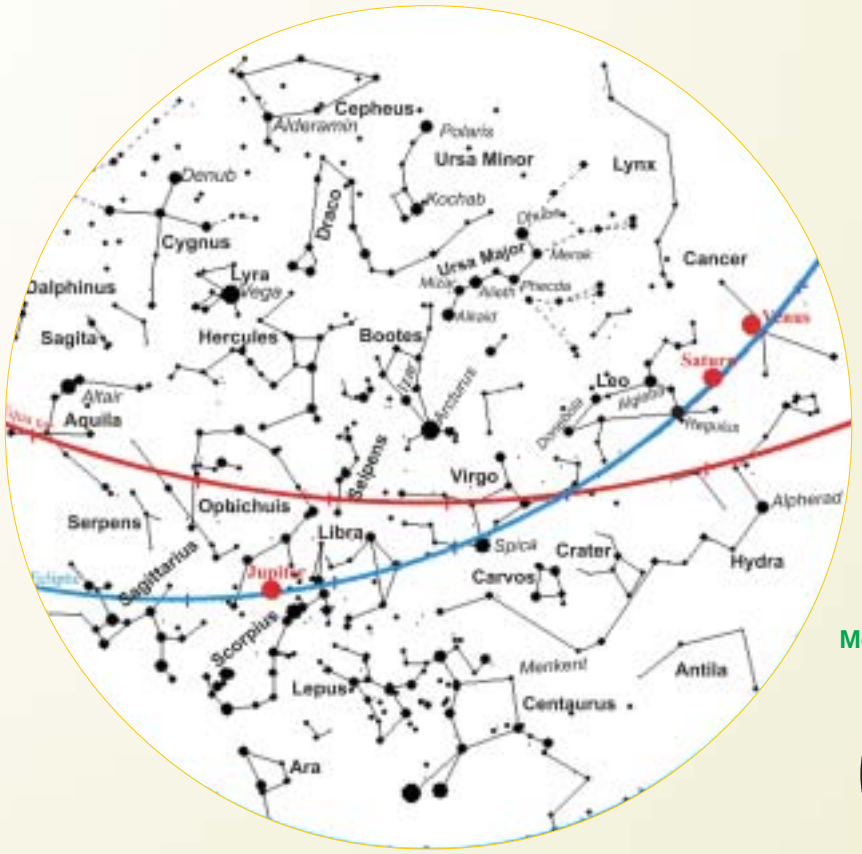


8 June

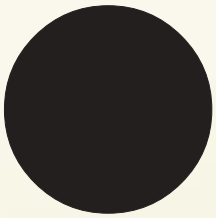
North

East

West

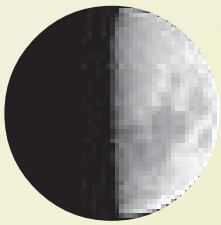


New Moon



15 June

Moon - First Quarter



22 June

South

The sky map is prepared for viewers in Nagpur (21.09^0 N, 79.09^0 E). It includes bright constellations and planets. For viewers south of Nagpur, constellations of the southern sky will appear higher up in the sky, and those of the northern sky will appear nearer the northern horizon. Similarly, for viewers north of Nagpur, constellations of northern sky will appear higher up in the sky, and those of the southern sky will appear nearer the southern horizon. The map can be used at 10 PM on 01 June, at 9:00 PM on 15 June and at 8 PM on 30 June.

Tips for watching the night sky :

(1) Choose a place away from city lights/street lights (2) Hold the sky-map overhead with 'North' in the direction of Polaris (3) Use a pencil torch for reading the sky map (4) Try to identify constellations as shown in the map one by one.

Planet Round Up:

Venus: In the constellation Gemini (*Meethun Rashi*), up in eastern horizon.

Saturn: In the constellation Leo *(Simha Rashi)*, up at zenith.

Jupiter: In the constellation Ophichuis (*Bhujandhari*) near eastern horizon.

Prominent Constellations: Given below are prominent constellations with brightest star therein (in the parenthesis). Also given are their Indian names.

Eastern Sky : Aquila (Altair) / *Garuda (Sravan)*, Cygus (Denub) / *Hansa*, Delphinus / *Dhanishtha*, Lyra (Vega) / (*Abhijeet*), Ophichuis / *Bhujandhari*, Sagita, Serpens.

Western Sky : Cancer / *Karka Rashi*, Hydra (Alpherad) / *Vasuki*, Leo (Regulus) / *Simha Rashi (Magha)*.

Southern Sky : Ara, Antila, Carvus / *Hast*, Centaurus / *Narturang*, Crater, Lepus / *Shashak*, Libra / *Tula Rashi*, Sagittarius / *Dhanu Rashi*, Scorpius / *Vraschik Rashi*.

Northern Sky: Cepheus (Alderamin) / *Vrashaparva*, Draco / *Kaleey*, Lynx, Ursa Major (Dhube) / *Saptasirshi (Krutu)*, Ursa Minor (Polaris) / *Dhruvamatsya (Drhuvataraka)*.

Zenith : Bootes (Arcturus) / *Bhutaap (Swati)*, Corona Borealis, Hercules / *Shaurii*, Seipens, Virgo (Spica) / *Kanya Rashi (Chitra)*.

□ **Arvind C. Ranade**

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Astronomy

Interactive CD on Innovative Experiments in Physics

The objective of this interactive CD is to illustrate and demonstrate a series of novel activities that may help enhance interest in physics amongst students and teachers.

It is expected that students of class VIII to XII would be able to perform most of the experiments using commonly available objects/equipment.

The experiments were jointly developed by Department of Physics, Indian Institute of Technology, Kanpur and Vigyan Prasar.

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- **Manual**
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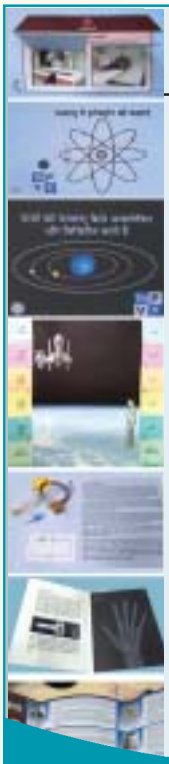
Emergence of Modern Physics

AN ACTIVITY KIT



The activity kit contains simple activities that explain the underlying concepts of modern physics. Attempt has been made to explain some of the abstract concepts like relativistic length contraction and time dilation, curvature of space-time, deflection of light through gravitational fields, photoelectric effect and so on through 28 innovative activities in this kit. The kit has been brought out both in English and Hindi.

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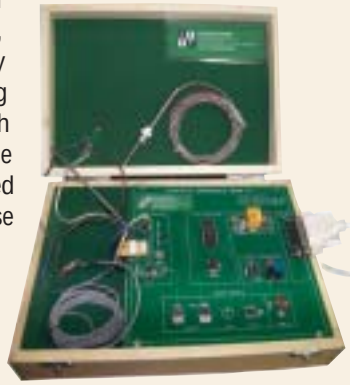
New

Vigyan Prasar is engaged in the development of new training modules/methodologies/ equipment/ devices for S&T communication. Scientific Experiments using Computer is a novel effort to explain to the students how computer is useful in measuring and controlling physical parameters and processes.

VP has developed a PC interface to do a number of experiments on temperature, light, sound, humidity, pH etc. Through this interface not only physical parameters can be measured, controlling the same within set value is also possible through closed loop feedback control mechanism. The interface provides real time plot of the measured parameter and data is stored in backend database for data analysis.

A kit is now available which include about 15 experiments.



Some of the experiments

1. Experiments on Temperature
2. Experiments on Light Intensity
3. Experiments on Humidity
4. Experiments on Sound Intensity
5. Experiment on pH
6. PC as Multimeter
7. Oscilloscope Limited Applications

To know more about the kit please write to:

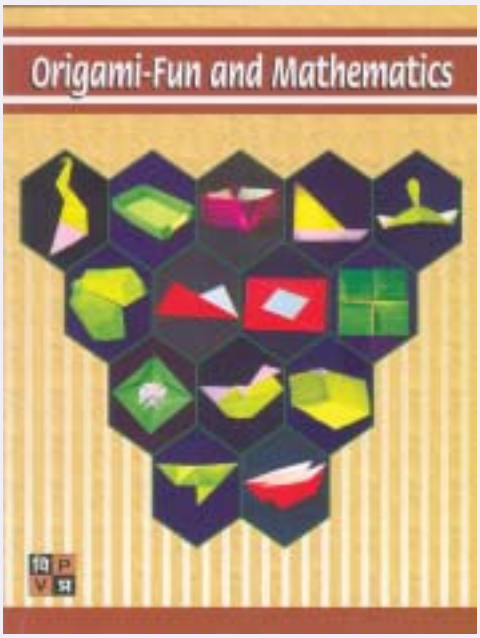
Director
Vigyan Prasar
A-50, Institutional Area, Sector-62, NOIDA 201 307 (U.P.)
E-mail: info@vigyanprasar.gov.in Website: vigyanprasar.gov.in

VP Software

VP News

New Release

Origami-Fun and Mathematics
(Author : V.S.S. Sastry)
ISBN:81-7480-125-1
Rs. 65/-
First Edition: April 2007
Reprint : June 2007



Workshop on Innovative Experiments in Physics and VIPNET Orientation Programme at Puducherry

Vigyan Prasar organized a three day workshop on Innovative Experiments in Physics and VIPNET orientation programme for physics teachers of Puducherry from 2 to 4 May 2007, jointly with Pondicherry Science Forum. Dr. K Porchezhiyan, Head of the Department of Physics, Pondicherry University, inaugurated the workshop. More than 70 teachers of physics from various districts of Pondicherry and Tamil Nadu attended the workshop. After the inauguration, Ms. K. Dasgupta Misra, Scientist, VP made a presentation on Vigyan Prasar and its activities. In the VIPNET orientation programme participants were briefed about the VIPNET Science clubs and its various activities by Shri Arvind C. Ranade, Scientist, VP, who also gave a demonstration of the Astronomy kit.

Dr. Mukesh Roy of IITM, Jabalpur and Smt. Susmita Roy gave a demonstration of around 80 innovative experiments in physics. Ms. Hemavathy, Vice President, PSF translated the entire demonstration sessions into Tamil for the benefit of the participants.

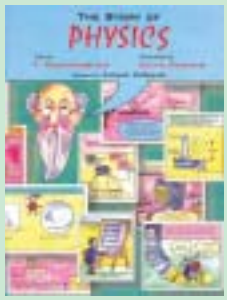
Demonstration of Innovative Experiments in Physics by Dr. Mukesh Roy

A resource material kit containing a CD on innovative experiments in Physics, copies of *Dream 2047* and *VIPNET News*, and Astronomy kit was given to each participant.

Other Publications

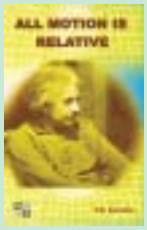
Music of Life
(Author : Prof. D.P. Burma)
Rs. 150/-

Hands On
(Author : Arvind Gupta)
Rs. 55/-



The Story of physics (Colour)
(Author : T. Padmanabhan)
Rs. 85/-

The Unknown Einstein
(Author : Bal Phondke)
Rs. 75/-



All Motion is Relative
(Author : V.B. Kamble)
Rs. 15/-

The Quest for New Materials
(Author : S.T. Lakshmikumar)
Rs. 120/-

Letters to the Editor

I thoroughly enjoy reading every issue of *Dream2047*. Not only as a scientist practising biology, but as a student of general science. I learned more from *Dream2047* during the last one year and I am proud that in India we have a wonderful journal to tell the youngsters and the old alike what we are progressing. I am sure that even if one student in every school "studies" *Dream*, we will be the best knowledge bank in the world. History of science is very lovely and written interestingly in every issue. In fact, *Dream* is the primary data source for many of my lectures to school children and educated public. My heartfelt congratulations to the editorial group.

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