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* Available in the Book "The Shaping of Indian Science" Published by University Press (India) Pvt. Ltd., 3-5-819 Hyderguda, Hyderabad 500 029.

As per decision of Council meeting held on May 03, 2014, Presidential Address will not be printed henceforth in Everyman's Science as they are already printed in the above mentioned book.

EDITORIAL**Drug Delivery Through Blood- Brain Barrier: Overcoming The Challenges of Barrier Tightness**

Delivery of drugs to target areas across brain remains a major challenge, and particularly formidable due to blood-brain barrier (BBB). Named in the twentieth century BBB forms a dynamic barrier protecting brain against invasive pathogens, restrict penetration of biomolecules and also forms a barrier impeding drug transport. Despite of recent medical advances and breakthroughs in nanotechnology based approaches we lack in development of central nervous system (CNS) targeted therapeutics. The problem doesn't reside due to the lack of suitable drug candidates but lies in the inability of the therapeutic molecules to cross the BBB to reach the target areas of brain. Thus, targeting transport through BBB forms a new frontier for drug delivery system in brain and CNS associated diseases.

The paracellular and transcellular pathway along with transport proteins are potential transport routes for drug delivery to brain. The tight junction (TJ) forms apical cell- cell junctional complex along with size and charge selective paracellular barrier in polarized epithelia. Temporary opening of tight junction enhances the transport of therapeutic agents like liposomes, nanoparticles or polymer conjugates in the brain. TJ -associated transmembrane groups can be distinguished as claudins, TRAMPs (tight junction associated MARVEL proteins) like occludin, tricellulin and MarvelD3 and JAM-A/-B/-C. Though early investigators led to the assumption that occludin forms the core transmembrane TJ proteins, Furuse and Tsukita have identified claudins playing the major role in formation of high-order TJ stands and maintains its functional selectivity of the

barrier. Further studies establish the key role of claudin-5 and claudin-3 in TJ integrity at the BBB and these proteins are crucial for the "tightness" and the size selective barrier at the mammalian BBB.

The most recent approaches concern TJ opening as a gateway for effective drug delivery across the BBB. To date sodium carboxymethyl dextran (CMC) is one of few TJ modulators with clinical relevance, however its cytotoxic effect on BBB needs to be further studied. Hyposmolar mannitol has also been used to produce temporary BBB disruption, however setbacks to its use includes complex surgical procedures and seizures. Zonula occludens toxin (Zot), an enterotoxin elaborated by *Vibrio cholerae* is an active TJ modulator of BBB which induces reversible concentration-dependent TJ opening without detectable short-term toxicity and has been a promising tool for increasing brain penetration of Methotrexate (MTX) and other chemotherapeutics. Compounds like histamine, bradykinin and VEGF can also increase BBB permeability and hence can be used potentially with imaging materials or drugs for preferential delivery of those compounds to target sites. However, it is important to limit time and duration of the reversible opening of TJ as this permeability may also help in the passage of unwanted molecules and CNS entry of toxins. Thus, with controlled TJ opening of BBB this approach forms efficacy and safety for brain therapy.

Another alternative method has been developed in past years which ensures transient and reversible modulation of BBB involving the use of RNA interference (RNAi). Synthetic small interfering RNA (siRNA) has shown great promise in treatment

of age related muscular degeneration (AMD) along with targeting claudin 5 mRNA and transiently modulate BBB permeability. This approach has also shown great promise with potential application in treating CNS disorders through targeted disruption of TJ proteins at the BBB and further extensive

research are required to ensure transient modulation of BBB limiting potentially damaging blood-borne agents to the brain. Thus, modulation of TJ's remains a key area for research and holds promise for drug delivery and treatment of severe CNS disorders like Alzheimer's disease and brain tumour.

*Paramita Sarkar
Dr. M. K. Chakrabarti
NICED, Kolkata*

“Treat me right and you will see the light...

Treat me wrong and you will be gone!”

- Sir C. V. Raman.

MOULTING: TIME TO DRESS UP GRACEFULLY

Amritpal Singh Kaleka and Gagan Preet Kour Bali*

Life is a series of a thousand tiny miracles. Notice them. Moulting is the manner in which an animal routinely casts off a part of its body either at specific times of the year or at specific points in its life cycle. It is also known as sloughing, shedding, more specifically "Ecdysis" in invertebrates. It can involve shedding the epidermis (Skin), pelage (feathers, wool) or external layer. Cats moult fur around spring-summer time to get rid of their winter coat, chickens generally stop laying eggs when their moulting begins and restart laying when their new feathers have grown, snakes regularly shed off their old skin to get new one. The most abundant arthropods especially insects undergo moulting regularly in larvae when the exoskeleton is outgrown. In insects, moulting is a unique phenomenon and under hormonal control. When an immature insect has reached the point where it needs a larger exoskeleton, the neuro-secretary cells in the brain are activated. It makes the larva to ward off old clothes (exoskeleton) and get new look as an adult.

INTRODUCTION

Moulting is the process by which insects grow. It allows the body of the insect to expand under controlled and protected conditions. Exoskeleton is basically the underlying bone structure that is located on the outside of their bodies with corresponding organs and muscles located underneath this hard shell. So in order to grow i.e. increase in size the insect must shed its current skin in favour of the new skin underneath. Depending on the species, moulting can occur 5-60 times in the life span of an insect and is regarded as one of the most vulnerable processes. Moulting is not limited to insect species alone as even spiders undergo the procedure as needed. Insects grow in increments; in fact, all arthropods do. The time interval between the two subsequent moulting is called as the stadium and the form assumed by the insect in any stadium is called as instar. Each instar ends with moulting, the process of shedding and replacing the rigid exoskeleton. People often think moulting is the simple act of an insect breaking out its skin and leaving it behind but it is a complex process involving hormones, proteins and enzymes.

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WHEN INSECT MOULTS

Insect starts to grow immediately following egg hatch. As the immature insect feeds and grows, its exoskeleton remains as inflexible container. The exoskeleton is for the protection and support of insect and without it the insect could not survive. Eventually, the larva or nymph must have to cast off this unyielding overcoat to continue its development. The old skeleton cannot be shed until a new one is ready underneath, a process that takes days or even weeks.

LOW OXYGEN TRIGGERS MOTH MOULT

A new explanation for one of the nature's most mysterious processes, the transformation of caterpillars into moths or butterflies, might be best described as breathless. Caterpillar's respiratory system is fixed in size at each stage of development which limits its oxygen intake¹. As a result, the insect eventually begins to suffocate. Sensing it low on oxygen apparently signals to the insect that it cannot continue to grow without proceeding to the next stage of its development, by moulting. This is the first time scientists have figured out a factor- in this case, lack of oxygen is that which regulates an insect's body size during developmental stages.

HOW INSECTS SHED THEIR SKIN (A QUICK GLIMPSE)

When there is no more room for the insect to expand inside its exoskeleton, hormone triggers moulting. The exoskeleton gets separated from the underlying epidermis. Moulting fluid fills the newly created gap underneath. Epidermal cells secrete proteins to form a new cuticle, which serves as a barrier between the body and the moulting fluid. With the new cuticle in place, enzymes in the moulting fluid digest the inner layer of the exoskeleton. Chitin and protein are recycled by the epidermal cells and then secreted under the new cuticle.

Once the new exoskeleton is formed, the insect can begin the familiar step of shedding its old one. A large intake of air helps the insect expand its body and muscular contractions force the outer shell to split, usually down the dorsal side. The bud squeezes from the outgrown exoskeleton. The insect must continue to swell and expand the new cuticle, so it becomes large enough to allow room for more growth. The new overcoat is soft and much paler than the former one, but over a few hours it becomes darker and begins to harden. Within a few days, the insect appears to be slightly larger copy of its former self.

THE MOULTING PROCESS

An insect cannot survive without the support and protection of its exoskeleton. So when it becomes too small for insect's growing body, hormones are released to initiate the process of moulting. The steps involved in the process of moulting are as under.

APOLYSIS: It is the process of separation of the exoskeleton from the underlying skin to create apolystic space. During this process, an insect becomes inactive and hide in order to protect itself for the coming moult. The apolystic space is filled by an inactive moulting fluid, which later digests the inner layer of the old exoskeleton. A new cuticle layer is formed which constitutes the top layer of the new exoskeleton. This layer is often larger than the old one in order to allow growth. Because it is soft when first formed and

is slightly wrinkled until the moulting process is completed. The shed moult appears thin. The protein components of the digested layer are re-absorbed and used in the process of building the new exoskeleton.

ECDYSIS: This is the actual process of shedding the exoskeleton. When the new exoskeleton is ready, an insect takes air or water and contracts its muscles to swell its body until the old exoskeleton breaks along weak spots, often on the dorsal side. An insect then exits the old exoskeleton, leaving its moult behind.

SCLEROTIZATION: It involves the hardening of the new exoskeleton. The tanning agents are secreted through ducts onto the surface of the newly formed exoskeleton. These tanning agents create a chemical reaction, which cross-link the substances of the top layer of the exoskeleton into the hard shell we recognize.

HORMONAL CONTROL OF MOULTING

Kopec, a polish biologist and a pioneer of insect endocrinology, was the first to establish the role of insect brain in moulting². The entire process of insect development is controlled by three main hormones i.e., Prothoracicotropic hormone (PTTH), Ecdysone and Juvenile hormone which are secreted by brain neuro-secretory cells (NSC), Prothoracic gland (JH) and corpora allata respectively³.

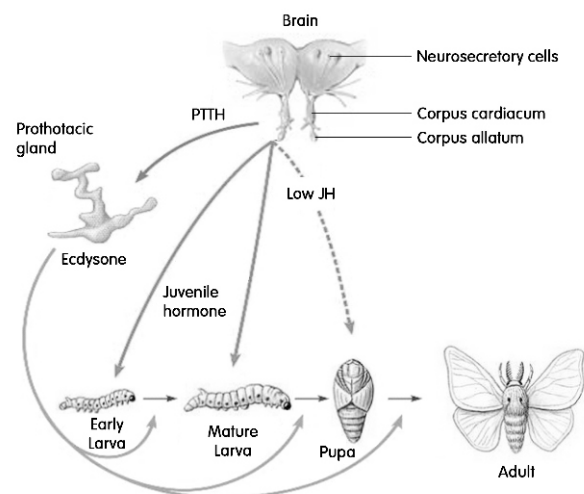


Fig. 1. showing hormonal control of insect development

When the larval or nymphal stage of an insect has grown sufficiently or attained a critical weight and it requires a larger exoskeleton to accommodate its growing body. At this stage, interplay of hormones triggers the growth process (Fig. 1). The growing body of the insect sends sensory signals to the brain for activating the clusters of neurosecretory cells which in turn produce PTTH. It passes down into the neurohemal organ, Corpora Cardiaca (CC) to release stored PTTH into the circulatory system. This stimulates the prothoracic glands to secrete Ecdysone, the moulting hormone⁴. The active form of moulting hormone stimulates a series of physiological events leading to the synthesis of a new exoskeleton by the process of apolysis.

Neurohemal organ not only serves as a hormone release site but also synthesizes hormones. JH is

responsible for maintenance of the young state of the insect. It modifies expression of the moult and acts in conjunction with ecdysone as it can exert its effects only after the moulting process has been initiated. JH hormone is considered as modifying agent that favours the synthesis of larval structures and adult differentiation.

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MANAGING FISHING GEARS AND PRACTICES TOWARDS ECOSYSTEM BASED FISHERY MANAGEMENT

Amrutha Varshini N¹ and S Balasubramanian^{2*}

Ecosystems are complex and dynamic natural units that produce goods and services beyond those of benefit to fisheries. Presently, many fish species are overexploited, and many stocks have collapsed. This crisis, along with increasing concerns over impacts on ecosystems, has caused a re-evaluation of traditional fisheries management practices, and they need to be managed in an ecosystem context. Ecosystem-based fishery management is a new direction for fishery management that prioritizes the management of the entire ecosystem rather than the target species individually. A range of modifications are necessary in the fishing gears and the way of practice aimed at improving their selective properties is available to help achieve EBFM goals, but their effectiveness varies. This approach may require reducing exploitation rates on certain target species or groups to protect vulnerable components of the ecosystem. Benefits to society could be maintained or even increased on the long run although might inflict short term economic hardship on fishers.

INTRODUCTION

Ecosystems play an important role in human societies by providing services that directly or indirectly benefit humans^{3,5,6}. However, there is growing evidence that ecosystems are being negatively affected by human pressures such as overfishing, eutrophication, toxic pollution, and habitat degradation. In 2005, the Millennium Ecosystem Assessment revealed that about two-thirds of global ecosystem services were in a state of decline and the harmful consequences of this decline could grow significantly worse in the coming decades^{5,10,11}. Overfishing is a typical example of humanity's impact on marine ecosystems. Population of fish and other ecosystem components can be affected by the selectivity and methods of fish removals. Fisheries can also affect ecosystems by vessel disturbance, nutrient cycling, introduction of exotic species, pollution, unobserved mortality and habitat alteration. An ecosystem – based

management strategy would be to minimize potential impacts while allowing for extraction of fish resources at levels sustainable for both the fish stock and the ecosystem. Management measures consistent with an ecosystem – based strategy include conservative and precautionary catch limits comprehensive monitoring and enforcement, by - catch controls, gear restrictions, temporal and spatial distribution of fisheries, marine protected areas, and other considerations.

Many marine fisheries are suffering from overfishing and the overcapacity of fishing fleets². The total number of fishing vessels in the world in 2014 is estimated at about 4.6 million¹³, very close to the figure for 2012. However, most of their stocks are fully fished with no potential for increases in production¹². In 2010, the Food and Agriculture Organization estimated that 85% of the world's marine fish stocks were either fully exploited, overfished, or had collapsed⁷. In addition, the ocean's productivity has also been declining because of marine environment degradation and interference with ecosystems through pollution.

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FISHERIES IN DEVELOPING COUNTRIES

Global capture fishery production of 93.7 million tonnes in 2011 was the second highest ever (93.8 million tonnes in 1996). Moreover, excluding anchoveta catches, 2012 showed a new maximum production (86.6 million tonnes). Nevertheless, such figures represent a continuation of the generally stable situation reported previously. The total number of fishing vessels was estimated at 4.72 million in 2012. The fleet in Asia accounted for 68 percent of the global fleet, followed by Africa (16 percent). Some 3.2 million vessels were considered to operate in marine waters. Globally, 57 percent of fishing vessels were engine-powered in 2012, but the motorization ratio was much higher (70 percent) in marine-operating vessels than in the inland fleet (31 percent). The marine fleet shows large regional variations, with non-motorized vessels accounting for 64 percent in Africa. Several countries have established measures to deal with overcapacity of fishing fleets and implemented restrictions on larger vessels or gear types. Although China may have reduced its vessel numbers, its fleet's total combined power has increased, and its mean engine power rose from 64 to 68 kW between 2010 and 2012. Reduced by the 2011 tsunami, Japan's marine fishing fleet showed a net increase from 2011 to 2012, with the incorporation of new and more powerful units. In the European Union (Member Organization), the downward trend in terms of numbers, tonnage and power has continued. The proportion of assessed marine fish stocks fished within biologically sustainable levels declined from 90 percent in 1974 to 71.2 percent in 2011, when 28.8 percent of fish stocks were estimated as fished at a biologically unsustainable level and, therefore, overfished. Of the stocks assessed in 2011, fully fished stocks accounted for 61.3 percent and underfished stocks 9.9 percent. Stocks fished at biologically unsustainable levels have an abundance lower than the level that can produce the maximum sustainable yield (MSY) and are therefore overfished. They require strict management plans to rebuild them to full and biologically sustainable productivity. Rebuilding overfished stocks could increase

production by 16.5 million tonnes and annual rent by US\$32 billion. With the increasing acceptance of the need to rebuild overfished stocks, the world's marine fisheries can make good progress towards long-term sustainability⁵.

The main reason for this gloomy outlook is unsustainable fishing practices, which follow from six factors: 1) inappropriate incentives, 2) high demand for limited resources, 3) poverty, 4) inadequate knowledge, 5) ineffective governance, and 6) detrimental interactions between fishery sector and other aspects of the environment⁴.

ECOSYSTEM-BASED FISHERY MANAGEMENT

Ecosystem-based fishery management is likely to contribute to increased abundance of those species that have been overfished. It may, however, require reduced harvest of species of critical importance to the ecosystem. Ecosystem-based Fisheries Management (EBFM) has been defined (US National Research Council, 1998) as "an approach that takes major ecosystem components and services - both structural and functional - into account in managing fisheries... It values habitat, embraces a multispecies perspective, and is committed to understanding ecosystem processes... Its goal is to rebuild and sustain populations, species, biological communities and marine ecosystems at high levels of productivity and biological diversity so as not to jeopardize a wide range of goods and services from marine ecosystems while providing food, revenues and recreation for humans"¹⁴.

Objectives

The overall objective of EBFM is to sustain healthy ecosystems and the fisheries they support. In particular, EBFM should

- (i) avoid degradation of ecosystems such as environmental quality and system set-up;
- (ii) minimize the risk of irreversible change to natural assemblages of species and ecosystem processes;
- (iii) obtain and maintain long-term socioeconomic benefits without compromising the ecosystem; and

(iv) generate knowledge of ecosystem processes sufficient to understand the impact of human actions⁸.

An ecosystem approach could help bring about greater control over large-scale fishing operations that employ non-selective fishing gear and methods like bottom trawling, to minimize the cascade effect on fish stocks and on the fisherfolk communities. It could also help prevent destructive fishing operations such as dynamiting and cyanide fishing, and help to regulate the use of fine-meshed nets by small-scale fishers themselves.

ISSUES RELATED TO FISHING

Fishing is by nature a highly selective process. Fishers normally target high-quality species and populations during certain times of the year in selected areas to maximize short-term catch rates and profitability. The selectivity immediately modifies the ecosystem by capturing and removing components, as a result the relative abundance of species, size distributions, and sex ratios, which implies modifications to food web, ecosystem structure and its biodiversity. Sustainability of fisheries is affected due to the alteration of functions.

Table 1: Issues related to target species and gear

	Issues	Impacts
Target species	Selectively targeting a single species	Imbalance in food webs/ecosystems
	Targeting spawning aggregations	Overexploitation; disrupted spawning; changes in sex ratios
	Catching threatened/protected species	Further reduction in the size of threatened populations
	Targeting large individuals	Loss of large egg-bearing females; changes in sex ratios
Damaging gear and methods	Explosives, commercial poisons, plant poisons	Collateral damage to corals and wider ecosystem
	Intensive gleaning, fish drives	Physical damage to fringing reef corals
	Gear that makes contact with the sea floor	Habitat damage
	Gear that requires setting by walking on reefs	Coral damage
	Breaking corals to catch sheltering species	Collateral damage to corals
Overly efficient gear and methods	Gill nets	Excessive catches and ghost fishing when lost
	Seine nets	Excessive catches of schooling species
	Barrier nets (Set across passages and channels)	Excessive catches of schooling species
	Fence traps	Excessive catches, bycatch issues; ghost fishing
	Scuba gear	Overexploitation of lobsters; trochus; sea cucumber
	Fish traps	Habitat damage; bycatch species
	Throw nets	Habitat damage; bycatch species
	Underwater lights, night spear fishing	Devastation of large key reef species

Source : A community-based ecosystem approach to fisheries management: Guidelines for Pacific Island countries, Secretariat of the Pacific Community, Noumea, New Caledonia, 2010¹⁶.

of the ecosystem like energy flow, recycling of the components, species interactions, productivity, and resilience, which are the consequences of ecosystem degradation

Commercial fisheries that employ a narrow range of fishing gear to capture a narrow range of fish species results in an ecological imbalance, whereas artisanal and subsistence fishers, employ many different fishing methods and catch a wide range of species within an ecosystem which is less damaging. This is based on the view that an ecosystem is less affected by the removal of sizes and species from many different trophic levels rather than just one or two; this is supported by the fact that the size and species composition in artisanal catches often resembles the structure found in ecosystems. This sort of balanced approach towards exploitation would help to alleviate fisheries crises arising from overfishing on a few selected target species. Regulations must be modified to bring down the effort especially on the overexploited species, while maintaining or even increasing overall efficiency in utilization of fishery resources because utilization of the entire complex of harvested species is more balanced¹.

MEASURES TO BE TAKEN TO MANAGE FISHING GEARS TO ENCOURAGE ECOSYSTEM BASED MANAGEMENT

Retention of undersized fish results from a mismatch between the selectivity characteristics of the gear due to the legal minimum mesh size (MMS) and the legal minimum landing size (MLS). Fisheries targeting species suffering from overexploitation tend to be characterized by relatively high discard rates. Not only is the natural balance shifted towards an excess of relatively small individuals in the population, but fishers may also increasingly target smaller fish to maximize catches of fish above MLS. Increasing the mesh size under such circumstances can result in an unacceptably large loss of landings, however, a simple increase in mesh size to reduce discarding would result in considerable short-term losses of marketable fish (ICES, 2005)⁹. Fishes at the MLS tend to have the greatest market value of all size

grades. For example, L 50% of mesh size is the length at which a particular gear allows 50% of the fish to escape and 50% retained.

While regulating mesh size in a trawl fishery, the survival rate of the fishes that escape through codend meshes is to be considered. If mortality takes place due to the gilling of fishes by the meshes, the anticipated benefit of larger meshes may not be achieved. Selectivity can be improved through a variety of methods other than mesh size, including the use of square mesh, sorting grids and other devices which enable the unwanted portion of the catch to escape. Fishers began experimenting with rigid grids and turtle excluder devices (TED) inserted in their trawls. These devices allowed the passage of small fishes and turtles through the horizontal bars, while physically inhibiting the passage of larger fish that were guided up the bars and out of an escape hole inserted above the grid¹⁰. Simply increasing the mesh size to release sublegal fish in sufficient quantities was believed to result in the loss of substantial quantities of marketable fish, because of the large selection range of conventional diamond mesh codends.

Bottom trawling is one of the most destructive ways to catch fish, and is responsible for up to half of all discarded fish and marine life worldwide. The fishing gear that touches or scrapes the bottom during fishing operations is likely to produce negative impact on the biotic and abiotic habitats. Use of towed gear with reduced bottom contact is a technical option in such areas. Prohibition of certain gear in some habitats is another solution, e.g. trawling in coral reef and seagrass areas. A third option is to replace a high-impact fishing method with one with less impact on the bottom, e.g. trapping, longlining, trolling or gillnetting.

Vessels can also be requested to move to alternative fishing areas during closures if their catch exceeds the composition limits/trigger levels determined during a coastguard inspection. Relocation must be to an area at least five nautical miles away, and if the catch composition still exceeds the bycatch limit, the vessel needs to move again.

CONCLUSION

A key step towards EBFM would be to critically rethink, revise, management regulations at the operational level that adversely impact biodiversity and a sustainable fishery in the long term. For example, zero-by catch goals, minimum fish size and mesh limits, should be critically reviewed for each fishery. A feasible approach may be to undertake much broader sustainability assessments for fishing effects¹⁵ to ensure sustainability for all affected species. Although it is the responsibility of states to efficiently manage its fishery resources, it is in the interest of all stakeholders to reduce the uncertainties associated with current fishery management systems. Among the main, medium and long-term beneficiaries will be the industry itself and the fishermen, hence it will be in their interest to meet the challenge and take a more prominent role in the promotion and design of EBFM approaches. A successful EBFM must be founded on their will to meet these challenges.

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IT'S TIME TO KNOW THE BODY CLOCK

Swati Srivastava, Ankita Srivastava,
Niharika Chandra and Sunil Kumar

A clock that runs in our body is often overlooked but is found in all major groups of organisms. It tells us to maintain the rhythmicity in our daily life and has certain characteristics like period, free-running rhythm, entrainment, Zietgebers, masking etc. Based on the period of the rhythm, we come across three major types of rhythm: circadian (20-28 hours), ultradian (20 hours) and infradian rhythms (28 hours). Photoperiod is known to play an important role in synchronizing the circadian cycle. It has also been observed that if the clock is disturbed it leads to depression, seasonal effective disorder and many more. Shift workers and jet lag are some of the common examples of altered biological clock and we can keep this clock in time by maintaining a good routine life with a sound sleep.

INTRODUCTION

One of the most common phenomena that we are living with is the biological rhythms. These are found in all major groups of organisms, but very few of us are concerned about it. One of the major characteristics of biological rhythms is period which in simple words is length of time required to repeat a rhythmic cycle called the period and it has been used to categorize rhythms into three major groups: circadian (20–28 hours), ultradian (20 hours), and infradian (28 hours). In nature, there occurs synchronization between circadian rhythms and cyclic changes in light dark cycle or temperature. When these environmental cues are not present, the rhythm continues but in the form of free running rhythm and it has a period slightly longer or shorter than just 24 hours. Some typical examples of biological variables for rhythms include (a) change in body temperature in humans and leaf movements of plants show circadian rhythmicity (b) brain waves of humans and twining of movements of bean shoots have ultradian rhythmicity and (c) the menstrual cycle of human females and the annual germination of certain seeds are common examples of infradian rhythms. The

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term circadian comes from the Latin word *circa*, meaning "around" and *Diem* or *dies*, meaning "day"¹. Collectively, the proper study of different biological temporal rhythms is called as chronobiology or in other words the science that describes timing in biological clocks and their associated rhythms is called chronobiology. By nature circadian rhythms are endogenous or self-sustaining but they are adjusted to the native environment by external cues or signals called Zietgebers the most important of them is the daylight. Light is known to influence the circadian rhythms very strongly as it turn on and turn off certain genes that control the body's internal clock. Circadian rhythms can influence some of the significant body functions which include sleep-wake cycle, hormone release, body temperature and so on. Irregular circadian rhythms generally end with obesity, diabetes, depression, bipolar disorder and seasonal affective disorder. There are rhythms that are known to be synchronized with the monthly cycle of tides. These are called lunar and semilunar rhythms. This type of behavior is observed in shoreline fish species such as grunions, whose spawning activity is synchronized with the monthly cycle of the tides. A mixed rhythm between annual and lunar rhythm is known to be exhibited by the palolo worm, *Eunice viridis*, of the South Pacific.

TERMINOLOGY AND CHARACTERISTICS

Table 1: A glossary of terminology used here

Sl. No.	Term	Definition or description
1.	Biological Rhythm	Changes in a biological variable that recur with a similar pattern and systematic interval(period)
2.	Cycle	A recurring pattern
3.	Entrainment	Coupling of the period and phase of a biological rhythm (e.g., circadian) with another cycle (e.g., 24 h solar day)
4.	Free-running	Desynchronization of the period of a biological rhythm from the period of a known environmental synchronizer (e.g., LD); status of a rhythm under constant conditions (absence of synchronizers)
5.	LD cycle	Light span followed by a Dark span (e.g., LD 12:12 12 h of L followed by 12 h D)
6.	LL	Continuous illumination
7.	Masking	Superficial change of rhythm characteristics (e.g., amplitude) by external environmental conditions
8.	Phase-shift	A change in the timing of the phase a rhythm to occur earlier or later

PROPERTIES OF A BIOLOGICAL CLOCK

Time keeping is important at two levels: to time changes in physiology and behavior within each day and within each year. For the former, birds have a system of at least three independent circadian clocks present in the retina of the eyes, the pineal gland, and the hypothalamus². This differs from the situation in mammals in which the input, pacemaker, and output are localized in different structures. When it comes to the biological clock, it is necessary to mention about the master clock that is present in brain and

coordinates all the body clocks so that they are in sync. Now the question arises what is there in the master clock that regulates the different body clocks in a coordinated manner? This master clock controls circadian rhythms with the help of a group of nerve cells in the brain called the suprachiasmatic nucleus, or SCN. The SCN which is located in the hypothalamus, an area of the brain just above where the optic nerves from the eyes cross contains about 20,000 nerve cells.

Biological clocks have certain properties that describe them, regardless of where they are found :

They continue to run under constant conditions: Biological clocks produce rhythmic patterns even if the environmental cues called Zietgebers are removed. This phenomenon is called free running in terms of chronobiology.

They are temperature compensated: Biological clocks are one of the few biological systems that are not subtle to temperature changes. Normally the activity of many systems alters according to temperature e.g. enzymes catalyse reactions at a faster rate at a warm temperature than a cold one. An important property of the clock is temperature compensation, and it is maintained by the clock irrespective of environmental temperature changes or there will be disruptions in clock when there will be temperature variations.

They are altered by light: Biological clocks are altered or entrained by light levels and changing lengths of photoperiod. Thus anticipation of changing day length helps different organisms to adjust accordingly.

They are under Genetic Control: It has been observed that the period length of the clock runs shorter or longer than 24 hours if there is alteration in the clock gene expression.

They are adjustable: The external environmental cues called Zietgebers which mainly include photoperiod, temperature and social cues allows the clock to run with a rhythm most appropriate for the organisms surroundings.

ENDOGENOUS AND EXOGENOUS RHYTHMS

Generally, there are two types of biological rhythms on the basis of external environmental influence or no environmental influence, exogenous and endogenous respectively. The effect of external cues like light, temperature on any biological rhythm is considered as exogenous biological rhythms. There are several examples from our surrounding where we can observe these rhythms. The hopping of sparrows on a perch when a light is turned on is the most common example. Another known example is the use of sun by the honey bees to orient and incorporate information about directions to food sources into their dances³. However, as the sun moves all over the day and simultaneously bees must be able to incorporate this information into their dances.

In contrast, endogenous biological rhythms are driven by internal biological clocks and are maintained even when environmental cues are removed. There are many examples of endogenous biological rhythms from our daily life which include the wake-sleep cycle and the daily body temperature cycles⁴. Sometimes these two rhythms mask each other so in that case it is very difficult to determine whether the activity of an animal is due to exogenous or that of an endogenous biological clock.

PHYSIOLOGY OF THE BIOLOGICAL CLOCKS

To study the physiological location of biological clocks a number of animal systems, including humans were studied and it was observed that in most vertebrates other than mammal for example sparrows, biological clock was found to be located in the pineal gland. This gland is located at the base of the brain and is responsible for the production of melatonin, a hormone produced in high levels at night and low levels during the day.

In mammals, additional cells responsible for biological clock functions were located in the hypothalamus, in two clusters of nerve cells called the suprachiasmatic nuclei (SCN). Light receptors in the retina are connected by nerves to the SCN. The

SCN and the mammalian pineal gland are linked, by both nervous connections and by the presence of melatonin receptors on SCN cells. A cascade is observed in the flow of light transmission from eyes to SCN, which in turn passes the information on to the pineal gland, controlling melatonin production. We are still not able to understand the exact function of melatonin in mammals but. Scientists believe the role of this hormone in many aspects of biology including the sleep wake cycle, body temperature control, and sexual maturity and reproduction.

The circadian rhythms of humans can be entrained to slightly shorter and longer periods than the Earth's 24 hours. Recent studies by researchers at Harvard have reported that human subjects can at least be entrained to a 23.5-hour cycle and a 24.65-hour cycle (the latter being the natural solar day-night cycle on the planet Mars). The action of light on the body rhythms and on the biological clocks is of prime importance as many of the fundamental processes of the body are controlled by these rhythms. These internal rhythms are usually (via the retinal perception and the clock system) showing up as daily rhythms with a 24 h period.

WHAT IF THE CLOCK IS DISTURBED?

Systems, like hunger, mental alertness, mood, stress, heart function, and immunity also operate on a daily rhythm. The existence of the biological clock can be clearly understood when it is out of harmony or imbalanced as in the case of Jet lag and shift workers. These phenomena disturb our normal biological clock and affect our physical and mental health badly. Even shifting the clock an hour forward or backward when daylight saving time begins or ends can disrupt our biological clocks. Many studies have shown that when we work late in night and lose 1-2 hours of sleep, we observe more frequent accidents and workplace injuries due to sleep disturbance.

JET LAG

The best example of jet lag that we come across is when we move abroad to a place with a huge time lag from our own country. When jet lag sets occurs, we feel disoriented, foggy, and sleepy at the wrong times

of day because, after changing time zones, our body clock tells us it's one time and the outside environment tells us it's another. In fact, jet lag can be considered one type of circadian rhythm disorder⁵. It can be treated simply by allowing the body to adjust to the new time, although it may take several days for external cues (light) to help the internal clock to match with its new cycle.

SHIFT WORK

Shift work is another example of how we can get ourselves off-cycle, and it also leads into a circadian rhythm disorder over the long term. People who work in the night shift not only have a hard time with their sleep patterns (feeling sleepy at work or experiencing insomnia during the day), but other systems in their bodies can also feel the effects and they can be chronic. In many cases, weight gain and metabolic disturbances are observed but no connection has still been found⁶.

RHYTHM AND MOODS

The emotional up and downs are also regulated by our internal clock. The altered circadian rhythms are generally observed in people with mood disorders like depression, bipolar disorder, and seasonal affective disorder (SAD). In fact, sleep disturbances, both sleeping too much and too little, are one of the key symptoms of depression and other mood disorders. The relationship between body rhythms and mood is a complex one, and likely has to do with how the brain chemical serotonin which fluctuates in relation to the light-dark cycle and throughout the year as the days become longer and shorter. It has been found that people's serotonin levels increase during the part of the day when there is more light available. The circadian rhythm is also known to have a connection with the mental health which in turn leads to disease states like Alzheimer's, Parkinson's, and Huntington's, and even autism spectrum disorder⁷.

If the internal clock (system) of the body is malfunctioning, different physiological rhythms might be desynchronized or even show arrhythmicity. Studies have shown that Since the normally functioning biological clock is sensitive to light

input, so light treatment can be used as a therapy to restore the proper timing of the body rhythms and in terms of biological clock we call it as chronotherapy. This special form of light therapy is sometimes used as an approach for treating depressive disorders.

Biologically, circadian rhythms are controlled by a cyclical expression of circadian genes. Mutations in these genes could result in alteration or disruption of the circadian oscillator and therefore it is important to explore genetic factors that may contribute to circadian disruption. Future research will need to include genetic data, as well as pharmacologic and environmental factors in the maintenance and restoration of human circadian rhythms (Figure 1).

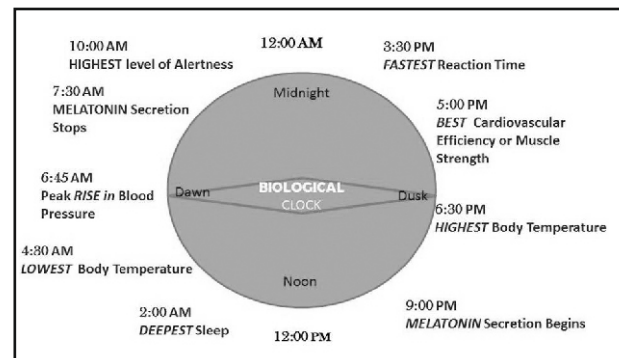


Fig.1. Maintenance and restoration of human circadian rhythms.

CIRCANNUAL RHYTHMS

Although discussed earlier, circannual rhythms have a period that is about a year and unperturbed by environmental signals. However, long term experiments of several years can be conducted on different organisms by giving regular light/darkness cycles and their activity pattern is recorded. Some of the best examples of circannual rhythms that are observed in nature are the seasonal onset of hibernation of many animals and the seasonally determined flowering time of plants. The timing of the onset of such events is often regulated by the day/night length, the photoperiod³. Temperature though plays as an important role but it is found to be a much less precise signal than the photoperiod and therefore, it does not govern the precise time of the year to start the processes. The role of circadian

rhythms as clock in determining photoperiod was first demonstrated by Erwin Bünning. Experiments corresponding to circadian experiments can be done on circannual rhythms⁸.

KEEPING THE CLOCK IN TIME

In today's time, paying attention to our body's natural rhythms is undoubtedly more important to our health than we realize. Most of the times we feel that it's only the sleep deprivation that affects our body, but it's also the variation in our biological rhythms that affect so many body functions, making us more prone to health problems like infection, mood problems, and even heart disease⁹ (Figure 2).

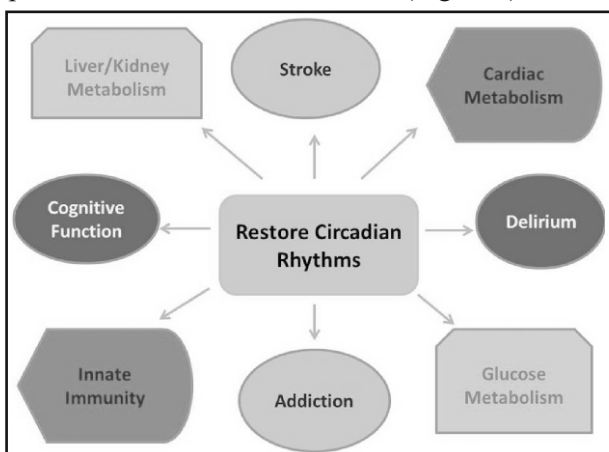


Fig. 2. Biological rhythms that affect body functions.

Why the biological clock becomes disordered in certain people, or naturally with age, is not completely clear, but some have recently suggested that it could in part have to do with the aging of the eyes as from the studies it has already been known that the light is also perceived by the retina and is connected to the nerves with the SCN or the suprachiasmatic nucleus which plays an important role in maintaining our biological clock stable. Therefore, the natural changes in the lens and even the development of cataract reduce the light perceived into the eye and, therefore, the brain; and this can affect biological rhythms. There are

many other reasons which lead our bodies' clocks to go out of sync, which possibly involve a combination of genetic susceptibility and lifestyle choices. We have already talked about the disturbance of our clock through jet lag or shift work and in every case we try until our body and its clock are in equilibrium again.

CONCLUSION

Waking up a little earlier, reducing the intake of caffeine late in the day and finishing the last piece of work late night rather than getting up earlier in the morning makes a huge difference in the clock functioning and the way of our living. Therefore we conclude that keeping our schedule on track as much as possible is probably the best advice. We should have a pretty good sense of our body's natural rhythms intuitively. Avoid disruptions to our eat-sleep cycles. Practice good sleep hygiene, and stick to a sleep schedule that works well for your body to keep the system in its natural rhythm.

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APPLICATIONS OF ENZYMES IN INDUSTRIES

Gautam Kumar Meghwanshi

Enzymes (biocatalysts) are produced by all living beings to catalyze various biochemical reactions essential for their survival and reproduction. Enzymes increase the rate of a (bio-) chemical reaction by several thousand times and work under mild reaction conditions (temperatures below 100°C, atmospheric pressure and neutral pH) with great specificity. Enzymes have been in use from ancient time and presently are used in many industries viz. food and feed, textile, beverages, pharmaceutical, polymer synthesis, agrochemicals, waste management and many others.

INTRODUCTION

Enzymes (biocatalysts) are produced by all living beings to catalyze various biochemical reactions essential for their survival and reproduction. Enzymes are either proteins or in few cases nucleic acids (*ribozymes*; some RNA molecules which catalyze the hydrolysis of RNA). Like chemical catalysts, an enzyme increase the rate of a (bio-) chemical reaction (without being changed itself) by several thousand times, e.g. urease can give a rate enhancement of 10^{14} times. Unlike many chemical catalysts, enzyme catalyzed reactions occur under relatively mild conditions (temperatures well below 100°C, atmospheric pressure and neutral pH) with great specificity, i.e. less or no byproducts are generated.

The exploitation of enzymes in various industrial processes dates back to many centuries. Presently, enzymes are used in many industries viz. food and feed, textile, beverages, pharmaceutical, polymer synthesis, agrochemicals, waste management and many others.

PRODUCTION OF ENZYMES

Enzymes can be obtained from plant, animal and microbial sources. However, due to ease of production and great range of diversity microbial enzymes are preferred over other

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sources. Foreign proteins from animal and plants can be cloned and produced through recombinant microbes or through cell lines using fermentation technology¹. An outline of production and downstream processing for microbial enzymes is shown in Fig. 1.

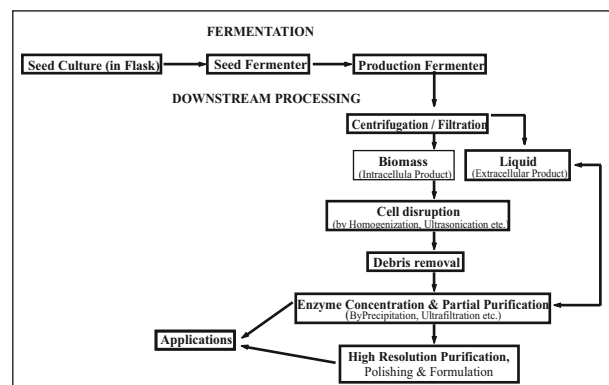


Fig. 1. Fermentative production and downstream processing of microbial enzymes.

The microbial enzymes (wild types and recombinants) are commonly produced through submerged fermentation (SmF). Solid state fermentation (SSF) methods are however used for the production of certain food enzymes, e.g. amylase from *Aspergillus oryzae* is produced through "Koji Process".

The SmF is the preferred fermentation process for cultivating enzyme producing microorganisms.

The microbial cells are maintained in suspension through constant agitation and under controlled growing conditions (pH, temperature, nutrients, dissolved oxygen concentration). The medium is an aqueous solution of substances readily available in large quantities at low cost such as starch hydrolysate, molasses, corn steep liquor, whey and many cereals. At the completion of the fermentation the enzyme may be present within the microorganism or excreted into the medium. When inside the cell, then the suspension is centrifuged or filtered and the supernatant or filtrate is discharged and the cell cake collected; otherwise the cell cake is discharged and the liquid phase is collected (Fig. 1).

A few commercial enzymes and their source organisms are listed in Table 1.

Table 1. Some commercial enzymes and source microorganisms.

Enzyme	Source Microorganism
Fungal Amylases	<i>Aspergillus oryzae</i> , <i>A. niger</i>
Fungal Glucosidases	<i>Aspergillus flavus</i> , <i>Trichoderma sp.</i> , <i>Penicillium sp.</i>
Fungal Proteases	<i>Aspergillus niger</i> , <i>A. oryzae</i>
Fungal Pectinases	<i>Aspergillus niger</i> , <i>Fusarium sp.</i>
Fungal Cellulase	<i>Aspergillus niger</i> , <i>Trichoderma reesei</i> , <i>Fusarium solani</i>
Fungal Lipase	<i>Aspergillus niger</i> , <i>A. terreus</i> , <i>A. carneus</i>
Bacterial Amylases	<i>Bacillus subtilis</i> , <i>B. amylolequefaciens</i> , <i>B. licheniformis</i>
Bacterial Proteases	<i>Bacillus subtilis</i> , <i>Pseudomonas spp.</i>
Bacterial Lipase	<i>Bacillus spp.</i> , <i>Pseudomonas spp.</i>
Bacterial Cellulase	<i>Cellulomonas sp.</i> , <i>Cytophaga sp.</i> , <i>Bacillus pumilus</i>
Yeast Invertase	<i>Saccharomyces cerevisiae</i>
Yeast Lactase	<i>Saccharomyces fragilis</i>
Yeast lipase	<i>Candida antarctica</i> , <i>C. rugosa</i> , <i>Hansenula sp.</i>

APPLICATIONS OF ENZYMES

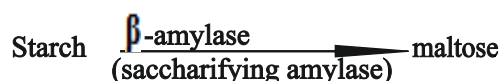
Uses of enzymes in food, pharmaceutical, textile, paper, leather, and other industries are numerous and are increasing rapidly². The more

important current uses are listed in table 3. Most of the industrially important enzymes are hydrolases, which catalyze the hydrolysis of natural organic compounds.

CARBOHYDRASES

Carbohydrases (maltases, amylases, sucrases and lactases) hydrolyze polysaccharides and oligosaccharides. Among carbohydrases amylases have vast commercial applications.

The various starch-splitting enzymes are known as amylases, the actions of which may be expressed in greatly simplified form as shown below:



The terms "liquefying" and "saccharifying" amylases are general classifications denoting the principal types of amylase action. β -Amylase, is a true saccharifying enzyme, forming maltose directly from starch by cleaving disaccharide units from the open ends of chains. The α -amylases usually have good liquefying ability, but may vary widely in saccharifying ability and thermal stability. Amyloglucosidase is a saccharifying enzyme unique in that it attacks starch and 1,4-linked glucose oligosaccharides with direct formation of glucose. A range of amylases, suitable for almost any kind or extent of starch conversion, is now available from microbial sources.

Amylases are used in brewing to supplement the low diastatic malt, and especially for initial liquefaction of adjuncts such as rice and corn grits. They are used in conversion of partially acid hydrolyzed starch to sweet syrups. Amylases find extensive use in baking as a supplement to the low diastatic activity of flour. The fungal amylase has low inactivation temperature, permitting its uses in high amount in baking. This improves sugar production,

Table 2. Uses of enzymes in industrial processes

Industry	Application	Enzyme	Source
Baking and milling	Bread baking	Amylase	Fungal, malt
		Protease	Fungal
Beer	Mashing	Amylase	Malt, bacterial
	Chillproofing	Protease	Papain, bromelain, pepsin, fungal, bacterial
Cereals	Precooked baby foods	Amylase	Malt, fungal
	Breakfast foods	Amylase	Malt, fungal
	Condiments	Protease	Papain, bromelain, pepsin, fungal, bacterial
Chocolate, cocoa	Syrups	Amylase	Fungal, bacterial
Coffee	Coffee bean fermentation	Pectinase	Fungal
	Coffee concentrates	Pectinase, hemicellulase	Fungal
Confectionery, candy	Soft center candies and fondants	Invertase	Yeast
	Sugar recovery from scrap candy	Amylase	Bacterial, fungal
Dairy	Cheese production	Rennin	Animal
	Milk, prevention of oxidation flavor	Protease	Pancreatin
	Milk, protein hydrolyzates	Protease	Papain, bromelain, pancreatin fungal, bacterial
	Evaporated milk, stabilization	Protease	Pancreatin, pepsin, bromelain, fungal
	Whole milk concentrates	Lactase	Yeast
	Ice cream and frozen desserts	Lactase	Yeast
	Whey concentrates	Lactase	Yeast
Distilled beverages	Mashing	Amylase	Malt, fungal, bacterial
Dry cleaning, laundry	Spot removal	Protease, lipase, amylase	Bacterial, pancreatin, fungal
Feeds, animal	Pig starter rations	Protease, amylase	Pepsin, pancreatin, Fungal
Flavors	Removal of starch, clarification	Amylase	Fungal
Fruits and fruit juices	Clarification, filtration, concentration	Pectinases	Fungal
	Low methoxyl pectin	Pectinesterase	Fungal
	Starch removal from pectin	Amylase	Fungal

Industry	Application	Enzyme	Source
Leather	Bating	Protease	Bacterial, pancreatin, fungal
	Unhairing	Protease, mucolytic	Bacterial, fungal, pancreatin
Meat, fish	Meat tenderizing	Protease	Papain, bromelain, fungal
	Tenderizing casings	Protease	Papain, bromelain, fungal
	Condensed fish solubles	Protease	Papain, bromelain, fungal
Paper	Starch modification for paper coating	Amylase	Bacterial, malt
Starch and syrup	Corn syrup	Amylase, dextrinase	Fungal
	Production of glucose	Amylase,	Fungal
	Cold swelling laundry starch	Amylase	Bacterial
Pharmaceutical and clinical	Digestive aids	Amylase	Fungal, pancreatin
		Protease	Papain, pancreatin, bromelain pepsin, fungal
		Lipase	Pancreatin
		Cellulase	Fungal
	Wound debridement	Streptokinase-streptodornase, trypsin, bromelain	Bacterial, animal, plant
Photographic	Recovery of silver from spent film	Protease	Bacterial
Textile	Desizing of fabrics	Amylase	Bacterial, malt, pancreatin
		Protease	Bacterial, fungal, pancreatin
Vegetables	Liquefying purees and soups	Amylase	Fungal
Wine	Pressing, clarification, filtration	Pectinases	Fungal
Miscellaneous	High test molasses	Invertase	Yeast
	Resolution racemic mixtures of amino acids	Protease	Fungal
	Wall paper removal	Amylase	Bacterial

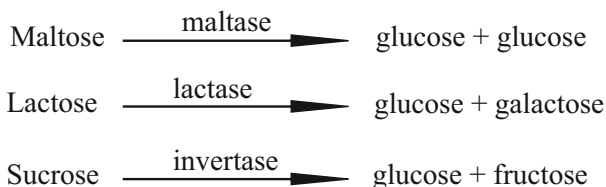
gas formation and crust color, without danger of excessive dextrinization of the starch during baking. Fungal amylases are also used for starch removal from flavoring extracts and from fruit extracts and juices, and for modifying starch in vegetable purees,

and in treating vegetables for canning³.

An important pharmaceutical application of fungal amylase is as a digestive aid.

Several disaccharide-splitting carbohydrases have considerable industrial importance. For the

purpose of demonstrating analogous action, the three enzymes, maltase, lactase, and invertase may be considered together:



These enzymes all attack their corresponding disaccharides with the formation of two molecules of monosaccharide. All may be obtained from fungal and bacterial sources, but invertase and lactase are obtained commercially from yeasts. Yeast and fungal invertases both hydrolyze sucrose, but differ in the nature of their actions. Yeast invertase is a fructosidase, attacking the fructose end, whereas fungal invertase is a glucosidase, attacking the glucose end of the sucrose molecule.

Invertase is used in manufacturing artificial honey and invert sugar which is much more soluble than sucrose⁴. It is also used in the preparation of chocolate coated soft cream center candies.

Lactase may be used in preventing lactose crystallization in ice cream, which causes "grainy" or "sandy" ice cream. Lactase also prevents lactose crystallization in both whole milk and whey concentrates⁵. Maltase is important in the preparation of sweet syrups by the enzymic degradation of starch⁵.

PROTEASES

Industrially available proteolytic enzymes produced by microorganisms are usually mixtures of endopeptidases (proteinases) and exopeptidases. In a simplified form the action of the proteases may be depicted:



In addition to microbial proteases, the plant proteases bromelin, papain, and ficin, and the animal proteases, pepsin and trypsin, have extensive industrial application.

Fungal proteases have long been used for the production of soy sauce, tamari sauce, and miso. One

of the largest uses for fungal protease is in baking bread and crackers. The proper amount of protease action reduces mixing time and increases extensibility of doughs, and improves grainy texture, and loaf volume.

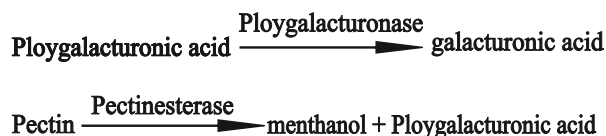
Cereal foods are also treated with proteolytic enzymes to modify their proteins, resulting in better processing, including improved product handling. To prevent development of undesirable haze in beer and ale, proteolytic enzymes are added (for "chillproofing"). Proteolytic enzymes are used for tenderizing meats, and animal casings for producing processed meats⁶.

Pharmaceutical and clinical applications for fungal proteases include their use in digestive aids. Bacterial enzymes are used throughout the dry cleaning industry. Dry cleaning solvents does not remove proteinaceous stains, such as milk, egg, and blood, from clothing. Digesters containing bacterial proteases are therefore used to solubilize such stains during the dry cleaning operation without damaging the fabric. They are also used for desizing and degumming textiles.

Other major industrial applications of bacterial proteases include bating and unhairing of hides for leather manufacture, and for recovering silver from photographic film by enzyme digestion and solubilization of the gelatin coating⁷.

PECTINASES

The pectolytic enzymes are another important group of enzymes of microbial origin. The two well recognized types of pectolytic enzymes are pectinesterase and polygalacturonase, the actions of which in overly simplified form are



Most commercial pectin enzymes are mixtures of these and probably other enzymes. Pectins are colloidal in nature, making solutions viscous and holding other materials in suspension. Pectinesterase breaks these colloids and clarify the

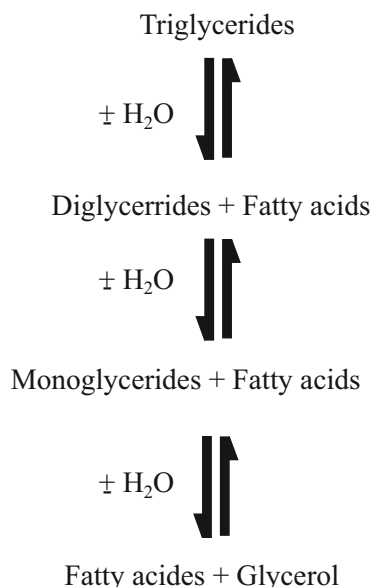
juices. At the same time, polygalacturonase degrades macromolecular pectin, causing reduction in viscosity and destroying the colloidal state so that suspended materials will settle out⁸.

Pectolytic enzymes find extensive use in fruit-juice processing industry. Addition of pectic enzymes to grapes or other fruits during crushing or grinding results in increased yields of juice on pressing. Wine from grapes so treated will usually clear faster when fermentation is complete, and have better color.

Another use for pectic enzymes is in removing the gelatinous coating from coffee beans.

LIPASES

Lipases are enzymes which have been used in oleo-chemical and dairy industries. They have the ability to hydrolyze as well as synthesize ester bonds in aqueous and micro-aqueous environments respectively. A typical example of lipase catalysis is given by their action on triacylglycerides. As shown below lipase can hydrolyze triacylglycerides under aqueous conditions. However, under microaqueous conditions they carry out the reverse reaction of synthesis.



Lipases have tremendous applications in areas such as food technology, biomedical sciences and chemical industries.

In food industry lipases have been used for the production of desirable flavors in cheese and other foods and for the interesterification of fats and oils to produce structured acylglycerols containing polyunsaturated fatty acids (PUFA). These modified acylglycerols are of special nutritional value and which are otherwise difficult to synthesize chemically⁹.

Because of their excellent capability for specific regioselective reactions lipases have emerged as important biocatalysts for biomedical applications. Lipases have been used for hydrolysis of racemic esters, for transesterification and for racemization *in situ* to yield optically pure enantiomers for the manufacture of chiral synthons⁹.

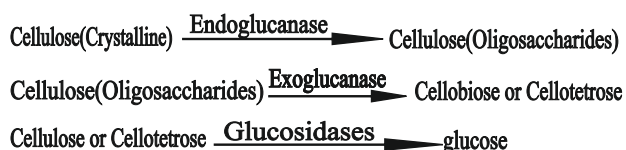
Use of lipases in biosensor manufacturing is an upcoming application. Lipase biosensors are in great demand not only in the diagnosis of clinical samples but also in new horizons such as the food and drinks industry, pollution analysis, especially pesticide contamination, and the pharmaceutical industry.

Lipases have a prominent application in detergent industry. The Novo group has developed two lipases viz. from *Streptomyces* sp. and *Humicola lanuginosa* which are useful in laundry, dish-washing detergents and industrial cleaners. Besides, lipases also find applications in leather industry, environmental management, and in cosmetic and perfume industry.

CELLULASES

Cellulases are a group of enzyme involved in cellulose degradation. The three major types of cellulose activities recognized are;

- (i) Endoglucanase/1-4-β-D-glucanohydrolase/EG- (EC 3.2.1.4);
- (ii) Exoglucanases/ 1-4-β-D-glucaglucano hydrolase/ Cellobiohydrolase/ CBH-(EC 3.2.1.74) and
- (iii) β-Glucosidases/BG/BGL/ β-glucoside glucohydrolases (EC 3.2.1.21). A simplified action of cellulases on cellulose are depicted below.



Cellulases find major use in textile industry. They are used for biostoning of denim garments for producing softness and faded look. They are used for digesting off the small fiber ends protruding from fabric resulting in a better finish. Another important application of cellulases is in laundry and detergent industry. Cellulases are commonly used in detergents for cleaning textiles¹⁰.

In food industry, cellulases are used in extraction and clarification of fruit and vegetable juices, production of fruit nectors and purees and in the extraction of olive oil¹⁰. Glucanases are added to improve the malting of barley in beer industry and in wine industry, better maceration and extraction is achieved by use of exogenous hemicellulases and glucanases. Improvement in feed digestibility and animal performance are reported with use of cellulases in feed processing.

In pulp and paper industry, cellulases and hemicellulase have been used for modification of coarse pulp and hand sheet strength and for improving drainage and runnability of paper mills. The enzyme is applied in the manufacture of soft paper and preparations containing cellulases are used to remove adhered papers.

One of the most important applications of cellulases is in the utilization of lignocellulosic wastes for the production of biofuels. The lignocellulosic residues represent the most abundant renewable resource available to human beings but their use is limited due to lack of cost effective technologies. Cellulases have the potential to convert cellulosic material into glucose and other fermentable sugars, which in turn can be used to produce single cell proteins and bioethanol¹⁰.

FUTURE OF INDUSTRIAL ENZYMES

The applications of industrial hydrolytic enzymes has been increasing gradually from the past few decades and is believed to grow to further height in coming years.

Examples of some applications under intensive investigation include enzymatic resolution of racemic mixtures of amino acids and chiral drugs, development of artificial flavors and fragrances etc. Another recent application of enzymes has been in clinical test reagents. Additional developments in this field can be expected.

At present much enzyme research is going on in various enzyme manufacturing industries and R&D Institutions. Such research is devoted to finding new and improved enzyme based applications, improving yields of industrial enzymes and enhancing enzyme specificity, stability and reusability. So it can be concluded that the new advances in enzyme technology would result in better and more efficient processes which would be green and environmentally safe.

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LEARNING-AIDS OF GEOGRAPHY

Mousumi Boral*

The National Policy on Education, 1986 have stressed the use of different types of learning aids to help any teacher to clarify concepts efficiently in accordance with the mental level of the students. Edgar Dale's (1964) 'Cone of Experience' stresses the classification of learning aids in terms of their effectiveness in communication⁴. The geography aids belonging to the base of the cone are the most effective ones, while the degree of effectiveness gradually decreases upwards.

INTRODUCTION

There is a popular saying as follows: 'I hear, I forget; I see, I remember; I do, I understand'. Desiderius Erasmus (1466-1536), a Dutch writer was the first to advocate that the children should learn through the aid of pictures or other visuals, instead of memorizing the text only. Learning aids, especially the audio-visual ones, help the teacher to clarify and interpret the concepts more efficiently, and thereby help in completing the triangular process of learning, viz. motivation-clarification-stimulation¹. The National Policy on Education (NPE, 1986) and its modifications have put stress on the use of teaching/learning aids. Usually learning aids should be simple to use in accordance with the mental level of the students². These actually motivate the learners³. However, the learning aids should be selected judiciously otherwise these may lead to a chaotic learning experience in the classroom.

Edgar Dale in his book entitled as 'Audio-visual Methods in Teaching' (1964) has propounded the idea of the 'Cone of Experience' (Fig. 1) that can be the basis of classification of the learning aids in terms of their effectiveness in communication⁴. The aids belonging to the base of the cone are the most effective ones, while those belong to at the pinnacle of the cone are the least effective, thereby the degree of effectiveness gradually decreases upwards.

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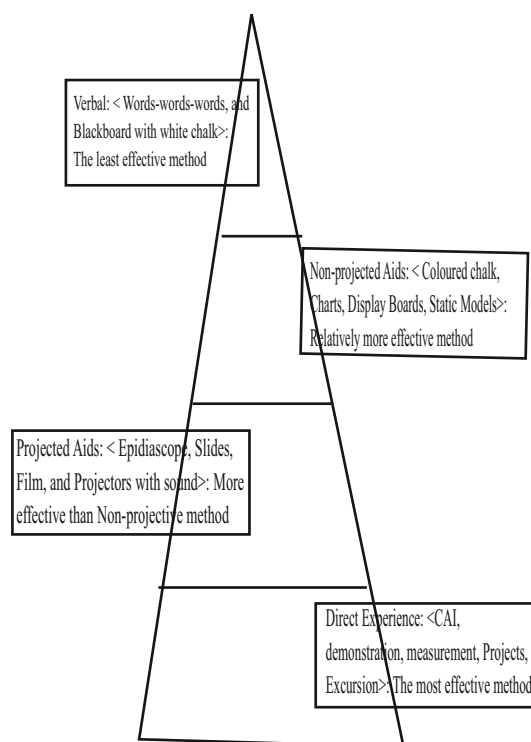


Fig. 1. The 'Cone of experience' of Edgar Dale, 1964⁴.

LEARNING-AIDS OF GEOGRAPHY

For effective geography classroom-teaching (varied teaching aids have to be handled) as situation demands. It is time to move from the conventional to new aids. Following table gives a categorized listing of the most popularly used learning aids⁶.

Projected Aids	Non-Projected Aids				
	Graphic Aids	Display Boards	3-d Aids	Audio-Visual Aids	Activity Aids
1. Films and Film Projector	1. Charts	1. Black-Board	1. Diagrams	1. Radio	1. Computer
2. Photo Slides and Slides Projector	2. Diagrams	2. Bulletin Board	2. Models	2. Tape Recorder	2. Demonstrations
3. Slides and Overhead Projector	3. Graphs	3. Magnetic Board	3. Specimens	3. Television	3. Measurements
4. Epidiascope	4. Maps				4. Field Trips
5. Slides/ Films, Computer and LCD Projector	5. Posters				
	6. Pictures				
	7. Photograph				

(1) Clay and its models: Usually, children are fond of playing with clay and mud. This opportunity can be used in creative works and can be employed in making models out of clay. Usually the younger children (classes V to VII) are very keen to make items of their geographic topics through which they learn to observe things accurately and minutely. They are cheap and can be used where expensive models are unavailable. Plaster of Paris is preferred to clay models because of its versatility. It is very appropriate for visually-impaired learners.

(2) Pieces of wood: In the younger classes the teacher can teach the subject by using pieces of wood cut in required shapes and sizes as puzzles. They can be cut in such designs and shapes that they can be joined together to form a definite shape depicting the area of study. These can be placed as an item of puzzle and the criteria of obtaining quick and correct response of the students can be tested. Usually in rural schools these resources can be used very suitably.

(3) Models for demonstration: Models made of articles ranging from clay, paper, plaster, thermocol, bamboo etc. are very helpful to give an in-depth knowledge about geographical topics. These models help the students to understand difficult abstract items at ease. They are usually presented before the

students by the teacher in such a way that they themselves can show and explain the matter and get a clear concept. The teacher can develop the instincts of creativity and the power of expression. Care should be taken so that these models do not become very big or small and can be easily handled for view, by all class students. Moreover they should be inexpensive, elaborative, decorative and made in accordance to the age and study-matter of the class.

(4) Maps and atlas: Maps are the most important tool in studying any geographical location. From the very young stage the atlas should be introduced and a habit of referring it should be cultivated. This habit obviously strengthens the depth of knowledge and increases the level of confidence. The idea of imagination and concept formation comes gradually from the young stage. Even the students should be given adequate map work so that they feel interest and become actively participatory in the class. Without map-work the geography class is boredom.

(5) Pictures and photographs: These aids can make the class-lesson interesting and vivid. Usually books contain i.e. a large number of pictures and photographs. In some schools where the students have little access to modern technology, showing relevant pictures lead to greater impact in mind. Care should be taken while giving project work so

that it does not become an album. The candidate himself should do judicious selection of meaningful pictures as instructed by the teacher, who should carefully teach the rules of selection, collection and execution of pictures and photographs. Impetus should be given for drawing pictures instead of mere photocopy to enrich the power of observation.

(6) Sketches: Rapid sketches drawn by the teacher on the board give a vivid concept of the matter and help to form a mental map. Moreover, the students should also be taught to draw sketches for better concept-formation. The skill of drawing quick sketches leads to multiple-communication and greater transmission of knowledge in a short span of time. Even the students should be inspired to draw sketches so that they can explain explicitly and retrieve the information as required. Usually the average students are much benefited by this process as it ensures better scoring.

(7) Globe: In geography, the globe is the only one common learning-aid which every school possesses. It is a very low-cost teaching aid and should be used from the very primary classes. It enables the beginners to form an idea about the actual earth and the locations of a point. The knowledge gained through globe is more realistic and accurate. The globe should be made available to the learners so that, they themselves can handle and have proper idea of the hemispheres.

(8) Blackboard/ white board/green board/ chalkboard/ magnetic board: Though boards, the traditional means of teaching, are the hearts of any classroom. Nowadays, these visual aids are still regarded as the most convenient and economical means of catering information, to the greatest number of students. Smart Technologies has developed the interactive-whiteboard. It helps the students to learn faster and retain the updated-information efficiently. It has transformed classroom teaching into a vibrant stimulating experience where lessons come alive and contribute to sharpen and stimulate the psychological faculties of a student's sensory system. It is touch-sensitive display that connects to a computer and digital projector to show

a computer image. One can then control computer applications directly from the display, write notes in digital ink and save academic work to be shared later. It increases student interest, enables teachers to spend more time differentiating instruction and create more rich and flexible learning environments to meet the needs of today's students.

(9) The magnetic board: It is simply a framed iron sheet having porcelain coating in black or green colour. Appropriate instruments are used for writing and used for display the required information. It works both as chalkboard and as a flannel board. The important points can be written along with the visual display. It provides the flexibility of movement of visual display. Even the three-dimensional objects can be used with a board using magnetic holders.

(10) Bulletin board: It is also a learning material of different sizes to display a geographic topic. They depict specified topics through news, recent information, pictures, creative writings and important announcements which help to draw attention of the class and have community awareness and apprise themselves of the current and relevant environmental events and facts.

The flannel board is sometimes referred to as flannel graph or board. It is also one of the most effective means of teaching geography and displays cut-outs, pictures, drawings and other relevant information pertaining to the lesson backed with rough surfaces like sand paper strips, flannel strips etc.

(9) Charts: These are the supplements following the lesson taught. Different types of write-ups, diagrams and statistical representations are drawn on the charts to enhance the understanding of the lesson. The students with the guidance of the teachers should prepare charts by abiding the conventional rules of chart making.

(10) Radio and television: This mass media has been very helpful in the teaching of geography especially in an inclusive classroom. If planned properly they can serve to be an additional benefit to the lesson. Moreover, these talks or discussions give the students an exposure to the world. For special

programmes the classes are to be arranged to relate the lesson to these talks. The television cast a programme called *Gyan Darshan* by UGC and the frequent talks on global contemporary issues really refreshes the minds of the learners. Moreover, after the programme the teacher can clarify the specific points, can discuss and clear the doubts as needed to make it effective.

(11) Gramophone lectures and tape recording: Recordings of speech, short talk and discussion of eminent personalities really can motivate the young minds. Sometimes they are so important they have to be used for several purposes so that a particular lesson can be developed especially in an inclusive set-up. Nowadays, the use of such technology has become quite rare.

(12) Magic lanterns: It is a simple device used to project pictures from a glass slide on a screen or a wall. The teacher can use this aid while showing pictures or small figures for the whole class. As it is a low-cost instrument and as the slides are easily obtainable from the market many schools purchase this instrument. This instrument can be prepared on demand and the cost of such a slide is quite reasonable. The advantage of this aid is that the teacher has great flexibility while he carries on with the lesson and can be shown for several times. The use of magic lantern has now become redundant.

(13) Epidiascope: Comparatively this is a more costly instrument but it can project both transparent and opaque objects. It is a more powerful and effective aid but needs special training to show maps, diagrams, photographs or small objects. The name epidiascope is given to this machine because it works as an episcopes when it is used to throw the image of an opaque object and when it is used to project a slide then it serves as a diascope. The facility of this aid is that as the lesson progresses in steps the teacher can utilize as needed but demands prior training. The importance of epidiascopes are also waning due to the prevailing use of LCD projection system.

(14) Film, micro, filmstrip (projector): These instruments have brought about revolution in catering information to the maximum in a very

(interesting and lucid manner. Moreover, these processes of audio-video shows enable the students to become more aware of the current topics and act to it. Studies from the book accompanied with shows results in a meaningful learning, which ultimately, nourishes the information processing system of the learners. After the shows questions comments and feedback must be ensured so that the shows aim at success. At present the conventional system of film projection has been overtaken by digital systems.

(15) Computer applications and the use of Educational Technology: Technology has revolutionized social life and education. The advent of computers have led to the replacement of several instruments of drawing and measurements. The computer-aided designs are broadening the horizon of knowledge and it is not only being utilized by the younger generation but also by the geo-teachers to keep them abreast of the immense information.

CAI has been used in geography of both school and higher education. These are used as sources of data and information, as analytical tools, as laboratories for investigating the world, and as instructors. It has positive impacts on achievement, attitudes and class room environment. To develop students' involvement and enthusiasm for the packages an interactive problem-oriented approach to learning is emphasized. The user-friendly courseware combines elements of text, graphics, images, animations and simulations; and includes formative assessment exercises.

The system of virtual laboratory provide geography students simulated laboratory experiences. Appropriate software provides real-life laboratory situation and offer opportunities for experimentation almost like in real labs.

However, this does not necessarily mean to do away with the traditional ones. It is often opined that if a teacher uses the latest aids he is the trademark of modernity, but in institutions of remote areas local aids have to be employed to make learning lucid and joyful. The innovative, creative and motivated learning strategies should be inculcated in the students by effective use of low-cost aids. In fact,

learning has more impact with the self-made aids than by costly artificial aids. It is the choice and efficiency of a good teacher to judge which one is the best for him/her.

(16) Field Trips: It is one of the most important methods of teaching geographical elements. The individuals under the guidance of the teacher should acquire pre-hand proper knowledge of the spot to be visited. This method fosters fellow feeling, concern for cooperation and the art of social living. Its success depends on the willingness and scientific attitudes of the teacher.⁵ The teacher should put critical issues for specific instances forward so that the students develop the capacity to think convergent and divergent ways and deduct new avenues. Careful observation of the geographical elements through the senses would lead to inculcation of concerns about the geographical environment among the children. Moreover, it evades the scope of bookish knowledge, memorization and rote learning.

CONCLUSION

By resorting to this constructivist approach of meaningful learning, the learners imbibe the concepts of 'learning by doing' and 'learning to live together' and thereby act for a sustainable community⁷.

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APPLICATION OF DNA BARCODING IN TAXONOMY

Raghavan Kuppu*, Shobana Manoharan and
Ramesh Uthandakalaipandian

Classical taxonomy deals with meristic and morphometric characterisation of animal or fish or insect species by its visual observation. DNA barcodes are molecular markers that are based on conserved gene sequences of an organisms genetic material, DNA or mitochondrial DNA. These techniques have been widely successful in evolutionary and palaeontology studies.

INTRODUCTION

Taxonomy deals with the identification of organisms from an environment. It may have studied using classical approach or by molecular methods. In Classical taxonomy, morphological characters are taken as key aspects for identification of animal or fish or insect species. The morphological characters premeditated are standard length, total length, body width, snout length, eye orbital length, eye diameter etc., meristic parameters are countable measurements like dorsal fin, pelvic fin, pectoral fin, anal fin and caudal fin ray counts. On the contrary, the classical identifications become a little ambiguous in differentiation between closely related species, but molecular based taxonomy helps in deciphering the differences between concomitant species¹.

WHAT ARE DNA BARCODES?

Mitochondria are ubiquitously found in all animal cells and they are maternally inherited. Animal mitochondrial DNA (mtDNA) has a comparatively fast mutation rate, resulting in the generation of diversity within populations over relatively short evolutionary timescales (thousands of generations). Typically, in animals a 658-bp region (the Folmerregion) of the mitochondrial cytochrome c oxidase subunit I (COI) gene was proposed as a potential 'barcode'DNA¹.

HOW IS A DNA BARCODE GENERATED?

The total DNA from the animal or fish or insect sample is extracted, amplification of CO I region is done using universal primers in a Polymerase Chain Reaction (Thermal cycler). The amplified product is then sequenced, analysed and then submitted to databases (Figure 1).

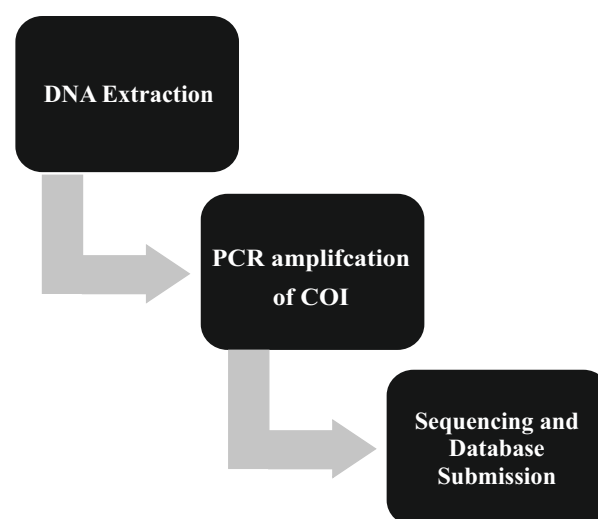


Fig.1. Procedure involved in generation of DNA Barcodes

Some of the DNA Barcode databases and their role are mentioned below,

FISH - BOL

The Fish Barcode of Life (FISH-BOL), is a global effort to make authoritative taxonomic identifications. FISH-BOL(<http://www.fishbol.org>)

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is the initial site to gather the taxonomic information of vouchered specimens across the world. It functions as a portal to BOLD (Barcode of Life Data Systems), and as an information resource for the scientific community^{2,3,4}.

BOLD

It is a web-based workbench and database (<http://www.boldsystems.org/>). It supports data acquisition, storage, analysis, and publication of DNA barcode records. It is freely available. It aids in assembly of records to gain BARCODE designation in the global sequence databases⁵.

NBFGR DATABASE (INDIA)

The National Bureau of Fish Genetic Resources (NBFGR) was established in December 1983. They have a specialized online database for fish resources in India which can be accessed through the link <http://www.nbfgr.res.in/>.

APPLICATIONS OF DNA BARCODES

The benefits of barcoding include expediting the identification of species from previously unrecognized species; and perhaps most importantly,

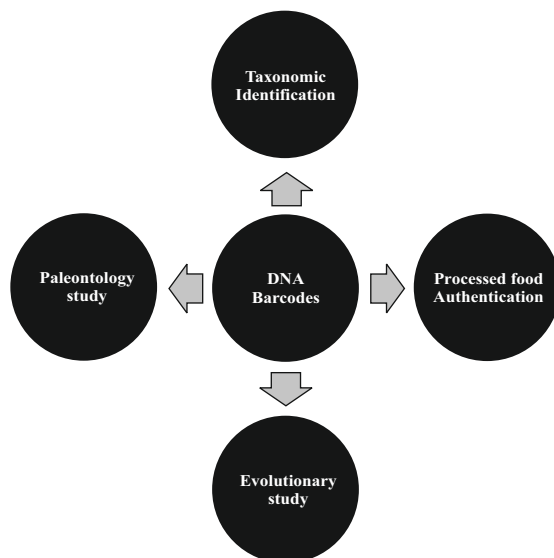


Fig. 2. Applications of DNA Barcodes.

enabling identifications where traditional methods are not applicable like in processed sea foods authentication, rare paleontological specimens or in cases where only tissue samples are available, morphometry is impossible⁵(Figure 2).

LIMITATIONS

CO I rarely fail to distinguish some interspecies variation where other molecular marker genes such as Cytochrome oxidase b, Recombination Activation Gene 1, etc. are used.

CONCLUSION

Thus, DNA barcoding has wide range of applications in authentication of animal or fish or insect species in hand with classical morphometrical analysis. The wide range of applications with high precision has made DNA barcode analysis in taxonomy, evolutionary study, phylogeographic analysis, processed food identification and species complex identification.

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ROLE OF PROBIOTICS FOR COMBATING ANTIBIOTIC RESISTANCE: A SUSTAINABLE STRATEGY AND NON-CONVENTIONAL APPROACH

Anil Kumar Bhagel and Barkha Singhal*

A global threat of developing antibiotic resistance has been progressing that leads to the serious safety concerns for the utilization of antibiotics. Though antibiotics are miraculous molecules but the overwhelming utility renders the microbial populations highly resistant towards antibiotics and creating havoc among society. The role of probiotics in the prevention of antibiotic resistance has been shown to imply considerable reduction in the use of antibiotics as well as treatment cost. Fecal microbiota transplantation (FMT) is a recently employed approach promoting the growth of beneficial microbes to outnumber the pathogenic antibiotic resistant bacteria.

INTRODUCTION

The paradigmatic shift in the treatment of bacterial as well as malignant infections by the discovery of antibiotics leads to the historic breakthrough in the field of medical science. The landmark contribution manifested by the discovery of antibiotics proved to be the boon for the global health-care system but the sudden outspread/emergence of antimicrobial resistance disrupted the successes story of these wonderful molecules. Infact, the overutilization of antibiotics irrevocably changed the ecological niche of both beneficial and harmful bacteria as well as continued selective pressure imparted by different drugs has led to additional kind of resistance mechanisms called as multidrug resistance (MDR). Currently, the scientific community have encountered some of complicated antibiotic resistant organisms across the global scale that includes vancomycin-resistant enterococci (VRE), methicillin-resistant *Staphylococcus aureus* (MRSA), extensively drug-resistant (XDR) *Mycobacterium tuberculosis*, extended-spectrum β -lactamases (ESBL) possessing strains *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Escherichia coli*, as well as *E. Coli* and

Klebisella pneumonia (KPC, *Klebsiella pneumonia carbapenamase*) possessing New Delhi metallo- β -lactamase 1 (NDM-1) enzyme¹. The complexity of this situation forced to enter the entire world into "pre-antibiotic" era as the development of novel antimicrobial formulations could not be able to cope up with the speedy outbreak of antibiotic resistance as well as imparting costly process. Despite the stupendous strides have been seen in development of novel antimicrobials but the major pitfall has been visualized in terms of distinct expression profile of various proteins, lipids, carbohydrates involved in the resistance process for every antibiotic. Therefore, there is pressing need to rely on other sustainable and non-conventional approaches for combating this menace that is by stabilization of the intestinal microbiota through the interventions of probiotics. The rising popularity towards the healthy benefits of probiotics are not only limited to the digestive tract but their wider impact has been recognized in the reduction of antibiotic resistance. It is known from the longer time that the co-administration of probiotics with most of the antibiotics can reduce the side effects of antibiotics as well as improve the treatment efficacy that consequently leads to the suppression of the risk of developing resistant bacterial strains. Besides that, fecal microbiota

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transplantation (FMT), an upcoming strategy could be used for reducing the burden of overutilization of antibiotics in futuristic scenario. This paper summarizes the brief insight of the possible role played by probiotics for combating the antibiotic resistance.

FACTORS GOVERNING THE ANTIBIOTIC RESISTANCE

The antibiotic resistance primarily occurs as a consequence of continuous selective pressure imposed by the use of variety of drugs on susceptible microbes but other social and administrative factors are also contributed for the development of antibiotic resistance. The over prescription of antibiotics in both developed as well developing countries and lack of regulatory policies concerning the use of antimicrobials in humans, agriculture and veterinary practices contribute to the emergence of resistance. The easy availability of antibiotics as well as the general behavior of patient of adopting self-medication practices and non-compliance with recommended treatments also play important role in promoting the antibiotic resistance. Furthermore, the hospitals are also serving fertile grounds for the development of resistant organisms due to the longer stay of patients with intensive and prolonged antimicrobial therapy.

TYPES OF ANTIBIOTIC RESISTANCE

The bacterial response to the antibiotic "attack" is the prime example of bacterial adaptation. Therefore, the detailed understanding of genetic and biochemical process of resistance is of dire need in order to curtail the emergence and spread of resistance. Antibiotic resistance can be either plasmid mediated or maintained on the bacterial chromosome. Till date, three types of resistance have been known that is natural (intrinsic or innate), acquired and mutational. The antibiotic attack on the specific molecular targets of the microbial cell if the targets may be modified or absent in bacteria from the natural evolutionary process then the resistance is termed as intrinsic which is the most common phenomenon in most or all of the intra-specific strains². On the other hand, mutational resistance is

highly diverse and complex in which the certain subpopulations of bacterial cells derived from a susceptible pool develop mutations in genes that affect the activity of the drug, resulting in preserved cell survival in the presence of the antibiotic. However, the resistance developed by the acquired means through horizontal gene transfer (HGT) by transformation, transduction and conjugation is the important contributing factor for the resistance development. Recently, site-specific recombination systems represented by integrons has been recognized as most efficient systems for the accumulation of antibiotic resistance genes.

MECHANISM OF ANTIBIOTIC RESISTANCE

The widespread use of antibiotics leads to the emergence of new resistant strains and the spread of existing ones. Therefore, it's imperative to understand the mechanism of antibiotic resistance for developing the effective strategies for the alleviation of this global problem³. The genetic basis for the acquisition of resistance genes may vary among bacterial species but biochemically resistance is created by broadly three types of mechanisms:

- (i) Antibiotic inactivation in which the antibiotic molecule gets inactivated by the enzymatic degradation
- (ii) Target modification in which the alteration of bacterial proteins that serves as antimicrobial targets
- (iii) Alteration in the outer membrane permeability for the antibiotics through the modification of efflux pumps.

ROLE OF PROBIOTICS

The wide spread utilization of probiotics is gaining continuous momentum and their remarkable therapeutic credentials have been widely acknowledged. Probiotic is defined as 'live microorganisms that confer a health benefit on the host when administered in adequate amounts' and most frequently belong to the lactic acid bacteria [LAB] category, such as *Lactobacillus* spp. and *Bifidobacterium* spp. Furthermore, "new" species of

beneficial microbes are identified and are being investigated for their potential as probiotics; *Akkermansiamuciniphila*, *Eubacteriumhali* and *Faecalibacteriumprausnitzii*. Now-a-days the tremendous research has been focused to assess their potential role in fight against antibiotic resistance. This can be attributed by their remarkable capability of changing their genetic material to adapt to their environments similar to the pathogenic bacteria and in future it may become vital 'weapon' in the war against drug-resistant microbes. Though the exact role of probiotics for combating antibiotic resistance is in infancy stage but the most thoroughly investigated mechanism that has conceived by the scientific fraternity is the improvement of antibiotic action through the production of bacteriocins⁴. It was visualized that the use of probiotics during antibiotic treatment may reduce antibiotic associated diarrhea (AAD) and *Clostridium difficile* infection (CDI) risk through competitive exclusion, enhancement of immune functions, gut barrier reinforcement and balancing of intestinal transit. Currently, Fecal microbiota transplantation (FMT), fecal bacteriotherapy or stool transplantation is a promising approach recognized recently for effective implementation of probiotics in reduction of antibiotic resistance.

FECAL MICROBIOTA TRANSPLANTATION (FMT)

Fecal microbiota transplantation (FMT) has emerged as an effective and safe therapy with success rate of 70% that involves the transplantation of feces from a healthy donor to a recipient⁵. The process is mediated by various methods including enema, nasogastric, nasoduodenal and colonoscopic routes that aims for the total restoration of the gut commensals by infusion of the stools from healthy donor. This therapy based on the concept of improvement of dysbiosis. The successful transplantation was published in 1958 by Ben Eiseman and colleagues for the treatment of *pseudomembranous colitis*. Initially the process has been carried out for eradicating the recurrent *Clostridium difficile* infection (CDI), a major risk

factor after the antibiotic consumption but it was sooner realized that this therapy also helps for the alleviation of other highly drug-resistant bacteria along with *Clostridium difficile*. The various research studies suggested that several types of multidrug-resistant opportunistic pathogens such as carbapenemase and extended-spectrum β -lactamase (ESBL)-producing *Enterobacteriaceae*, vancomycin-resistant *Enterococci*, and methicillin-resistant *Staphylococcus aureus* were being eliminated in patients undergoing FMT for recurrent CDI⁶. Thereafter, this therapy has been successfully used directly for decolonizing non-CDI patients with resistant infections or patients at risk of infection as well also contribute for the reduction of antimicrobial-resistant genes in FMT recipients⁷. Therefore, this therapy minimizes the repeated use of antibiotic, which in turn reduces the risk of antibiotic associated resistance.

CURRENT PROGRESS AND CHALLENGES

At present, the magnificent role of probiotics in the prevention of antibiotic resistance has been visualized from an economic perspective. The prescription of antibiotic with probiotics considerably reduce the cost because of the reduction in antibiotic associated disorders that subsequently prevent the higher cost of hospitalization stay and treatment modalities. As a whole, decrease in the risk of occurrence of antibiotic resistance has been percolated from this fact⁸. The emerging approach of fecal microbiota transplantation (FMT) also enhances the protective role of probiotics for the reduction in antibiotic resistance. Despite the promising attributes conferred by the probiotics, they are not exempted from the natural processes governing antibiotic resistance in their genome. Recent research demonstrated the *in vivo* transfer of the vancomycin resistance gene, a plasmid encoded gene, between *Enterococcus faecium* strains and *Lactobacillus acidophilus* probiotic strains during digestive transit in mice⁹. The risk of probiotics being a carrier for the spread of antibiotic resistance become highlighted and poses serious threat for consumption of probiotics. Till date strict guidelines

and regulations are lacking for the screening of antibiotic resistance genes in probiotics strains therefore seems a serious challenge in front of scientific community. Therefore, being the nonpharmacologic approach, FMT seems to be quite promising and sustainable approach until the comprehensive safety assessments regimes of probiotics has been developed.

CONCLUSION

The battle against resistant microbes is just beginning. To conclude, we feel that balancing the intestinal microbiota through the probiotics has become more practical and better approach than to find the novel molecules from the beginning. The successful elimination of antibiotic resistant organisms through the fecal microbiota transplantation further proves the efficacy of probiotics and leads to the sustainable strategy having no side effects. Although more research into these is must for the completes evaluation of the transfer of antibiotic resistance genes from probiotics to the other gut microbes. By implying this, the rational use of antibiotics will take place according to the principles of “antimicrobial stewardship” (means, prescribing them only when they are needed) that certainly helps in reducing the global burden of antibiotic resistance.

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104TH INDIAN SCIENCE CONGRESS, TIRUPATI : A BRIEF REPORT

The 104th Indian Science Congress was inaugurated in the morning of January 3, 2017 at Tarakarama Stadium in Sri Venkateswara University, Tirupati by Shri. Narendra Modi, Hon'ble Prime Minister of India, in the presence of Shri. E.S.L.Narasimhan, Hon'ble Governor of Andhra Pradesh and Telangana, Dr. Harsh Vardhan, Union Minister of Science and Technology & Earth Sciences, Shri Y.S.Chowdhary, Union Minister of State (Science and Technology), Government of India, Shri. N.Chandrababu Naidu, Hon'ble Chief Minister of Andhra Pradesh, Prof. A.Damodaram, Hon'ble Vice Chancellor, Sri Venkateswara University and Dr. D. Narayana Rao, General President, The Indian Science Congress Association.

Dr. D. Narayana Rao, General President, The Indian Science Congress Association welcomed the dignitaries and delivered his Presidential Address, on the focal theme "Science and Technology for National Development". Dr. Harsha Vardhan, Union Minister of Science and Technology, Government of India gave his speech. Shri N.Chandrababu Naidu, Hon'ble Chief Minister of Andhra Pradesh delivered his address.

The Hon'ble Prime Minister of India Shri. Narendra Modi released the 104th ISC Plenary Proceedings and presented ISCA awards to Scientists. He also felicitated and gave mementoes to six Nobel Laureates across the globe. He also presented Gold Medals to eminent persons working in various fields of Science and Technology. In his inaugural address, he referred to the constraints involved in securing and completing research projects and stressed the need to ensure 'ease of doing science' as an empowering factor for scientific delivery.

The inaugural session was attended by a large number of foreign scientists, distinguished scientists from various agencies of Government of India, academicians, Vice Chancellors of various

Universities, Members of Parliament, Senior functionaries from the Government of Andhra Pradesh, representatives from Industry, students and scholars from different parts of India and abroad.

CHILDREN SCIENCE CONGRESS

Hon'ble Chief Minister of Andhra Pradesh, Shri Chandrababu Naidu inaugurated Children Science Congress in Padmavathi Mahila Vishva Vidyalaya, Tirupati on 4th January 2017 in presence of Shri Y.S. Chowdhary, Hon'ble Minister of State for Science & Technology and Earth Sciences and Dr. Takaki Kajita, Nobel Laureate from Japan, Prof. A. Damodaram, Vice Chancellor, Prof. P.P. Mathur, General Secretary (Scientific Activities), Prof. Gangadhar, General Secretary (Membership Affairs), and Prof. D. Narayana Rao, General President ISCA.

Infosys Travel Awards were presented to school students. Prof. P. P. Mathur General Secretary (Scientific Activities), Prof. Gangadhar, General Secretary (Membership Affairs) and Prof. A. K. Saxena, Immediate Past General President were also present.

In his inaugural speech, Shri Chandrababu Naidu delivered an inspirational message for young children who want to take up Research & Development and addressed them as the "Future of India". He also mentioned that education for girl child is a must for the development of India on all fronts. He encouraged the children to have Scientists as their role model and strive for achieving their set goals. To encourage the young minds, Shri Chandrababu Naidu announced an award of Rs. 100 crore to the Scientist who wins a Nobel Prize from Andhra Pradesh.

He then invited Dr. Takaki Kajita, the Nobel Laureate, to give some tips to the students so that they can also dream of being scientists. Dr. Kajita told the students that hard work with aim is the only way to become successful in life.

The Children Science Congress, an important event of the Indian Science Congress, is organized to provide a unique opportunity to children of the age group of 10-17 years to use their scientific temperament and knowledge and to quench their thirst for creativity by conducting scientific experiments. The three days' event encouraged children to stimulate their scientific temperament by giving the school children a unique platform to showcase their innovation and creativity in scientific projects.

About 7-8 lakhs school children in the age group of 10-17 yrs participated at various levels from the districts, states & union territories. Around 2 to 3 best projects from each state participated in Indian Science Congress is then identified for the award based on the originality.

WOMEN'S SCIENCE CONGRESS

The 6th Women Science Congress was inaugurated by Hon'ble Chief Minister Chandrababu Naidu in presence of Shri Y. S. Chowdary, Union Minister of State for Science & Technology & Earth Sciences & Prof. D. Narayana Rao, General President, ISCA, on 4th January 2017 in Srinivasa Auditorium at SV University, Tirupati.

This programme is intended to showcase the contribution of women in Science and Technology. Renowned women scientists participated and delivered lectures in this session with aim to empower the women and to inculcate scientific interest and temper among them.

Prof. Neeta Singh, Professor, Department of Biochemistry, NDMC Medical College & Hindu Rao Hospital, started the session and spoke about her cancer research. She explained about Human Papilloma virus and cervical cancer to the audience in layman's language. Her speech includes the treatment and diagnosis of cervical cancer. The treatment of cervical cancer includes LEEP, Laser, Cryotherapy, cone biopsy and she explained in brief about these. She also spoke about the importance of education in girls.

Prof. H.S. Savithri, Department of Biochemistry, IISc, Bangalore, advised the young students for the

development of women in the society.

Other eminent women scientists like Dr. B. Vengamma, Director, Sri Venkateswara Institute of Medical Sciences (SVIMS) & Prof. D Usha Rani were also encouraged the young women and advised to step out of their home and achieve something.

SCIENCE COMMUNICATORS' MEET

The 10th Science communicators' meet was inaugurated on 5th Jan 2017 at 10.30 AM in the Botany Seminar Hall of Sri Venkateswara University, Tirupati. Inaugural address was given by Prof. Hemanth Joshi, Indian Institute of Mass Communication, New Delhi. Prof. P. P. Mathur, General Secretary, Scientific Activities, ISCA welcomed the guests. The key note address was given by Prof. A. Damodaram, Vice-Chancellor, Sri Venkateswara University, Tirupati. He also released the Souvenir. Prof. D. Narayana Rao, General President, ISCA presided over the function. The vote of thanks was given by Prof. Gangadhar, General Secretary, Membership Affairs, ISCA.

The technical session started with panel discussion on "Challenges in Science communication. A State of Art Perspective." The session was chaired by Dr. R.Gopi Ramachandran, Director, Vigyan Prasar, New Delhi. The other speakers were Dr. Dineesh. C. Sharma, News and Media specialist, Dr. Gita Bamzai, IIMC, New Delhi, Dr. T.V. Venkateswaran, Vigyan Prasar and Dr. Sarita Ahlwat, IIT, New Delhi.

Oral Presentations followed this technical session. The first presentation was by Abhay SD Rajput on "The other side of Science: Towards Better Science Communication Skills", Present and Future Prospect of Ultrafast Laser by Susanta Kumar Das, and "Sustainable Development for India's Pursuit of Happiness" by Bharathi Ravikrishnan. This session was chaired by Prof. S. Ramakrishna, Dept of Zoology, Bangalore University, Bangalore.

The next technical session of oral presentations was started by Abheek Chaudhuri on Emergence of Bioinformatics and its Applications. This session was chaired by Prof. C. Muthamizhchelvan, Director, Faculty of Engineering and Technology, SRM Univ,

Kattankulathur, Chennai. Other oral presentations followed.

The technical session on 6th Jan 2017 started with poster session followed by panel discussion represented by the Heads of the National Council for Science Museums of the Ministry of Culture, CSIR NISCAIR and DST's Vigyan Prasar (Dr Anil Manekar, Dr Manoj Patairiya and Dr R Gopichandran respectively). They presented an overview of the activities carried out as part of the governmental framework and proposed pathways for value added outputs as part of the way ahead. This was followed by oral presentation and the session was chaired by Dr.T.V.Venkateswaran, Vigyan Prasar, New Delhi and later by Prof.P.Neeraja, Prof of Zoology, S.V.University, Tirupati and Convener of Science comunicators' meet. The last technical session was chaired by Prof.S.Krupanidhi, Vignan University, Guntur.

Valedictory function was conducted at 4.30 PM on 6th Jan'17. The guests were welcomed by the Convener Science Comunicators' Meet, Prof. P. Neeraja. Prof. P. P. Mathur General Secretary, Scientific Activities, ISCA presided and valedictory address was given by Prof.Gangadhar, General Secretary, Membership Affairs, ISCA. Finally Vote of Thanks was given by Dr. Amit Krishna De, Executive Secretary, ISCA.

SCIENCE EXHIBITION: PRIDE OF INDIA EXPO-104TH ISC

Chief Minister N. Chandrababu Naidu inaugurated the Pride of India (Pol) Expo, hosted as part of the 104th Indian Science Congress (ISC), at Sri Venkateswara University (SVU) campus here on Tuesday, the 3rd January, 2017. Mr. Naidu, flanked by Union Minister of State for Science and Technology Y.S. Chowdary, State Ministers Ganta Srinivasa Rao (HRD), Bojjala Gopalakrishna Reddy (Environment and Forests) and others, initiated the proceedings by lighting the 'Vigyan Jyot'. He later visited the stalls set up by various departments and institutions of Andhra Pradesh, followed by those set up by R&D organizations, academic institutions and many more, evincing keen interest in the exhibits.

The mega science expo was organized to describe and display the latest innovations and applications of Science and Technology to the general masses including students who visited the Expo. Department of Science & Technology (DST) participated in Pride of India - Science Expo - 2017 held from 3-7 January, 2017. This stall of DST received the 'Most interactive pavilion award'.

DRDO pavilion has been a major attraction at the Pride of India Expo amongst visitors and student, 40 DRDO laboratories are participating at the expo to showcase state-of-art military systems and technologies at the DRDO Pavilion which narrate the sage of Self-reliance & National Pride with the "Make in India" spirit. Star attractions of the outdoor exhibits include the long Range Surface-to-Surface Ballistic Missile Agni-5, Akash Weapon System, Shaurya Missile, the model of the Brahmos missile, Remotely Operated Vehicle Daksh Robot etc.

The other organizations like DAE, CSIR, Ministry of Earth Sciences and other S&T Department and Agencies also had their exhibits along with some stalls from the state governments and other private industry. All of them were based on the themes implied by the Government of India like Swachh Bharat, Make in India, Digital India etc, which inspired people to innovate and further improve science and technology for the betterment of mankind.

VALEDICTORY SESSION

The valedictory marking the end of the event of Indian Science Congress was held at Srinivasa Auditorium, Sri Venkateswara University, Tirupati on 7th January, 2017 at 4:30 P.M. The dignitaries for the valedictory function were Dr. Ch. Vidyasagar Rao, Hon'ble Governor of Maharastra:, Shri. Y.S. Chowdhary, Union Minister of State for Science & Technology and Earth Sciences, Government of India, Prof. A. Damodaram, Hon'ble Vice Chancellor of Sri Venkateswara University, Prof .D. Narayana Rao, General President, ISCA, three Ministers from Government of Andhra Pradesh, Dr. A. K. Saxena, immediate Past General President, ISCA. The Vigyan Jyoth was handed over by Prof D Narayan

Rao, General President to Dr Achyuta Samanta , General President Elect. On this occasion Young Scientist Awards and Best Poster Awards were also presented. Prof. S. Vijaya Bhaskara Rao, proposed the vote of thanks.

INAUGURAL ADDRESS OF SRI NARENDRA MODI, HON'BLE PRIME MINISTER OF INDIA AT THE INAUGURATION OF THE 104TH SESSION OF THE INDIAN SCIENCE CONGRESS, TIRUPATI

Governor of Andhra Pradesh, Shri E. S. L. Narasimhan

Chief Minister of Andhra Pradesh, Shri N. Chandrababu Naidu

Union Minister for Science & Technology, and Earth Sciences, Dr. Harsh Vardhan

Union Minister of State for Science & Technology, and Earth Sciences, Shri Y. S. Chowdary

General President of the Indian Science Congress Association, Professor D. Narayana Rao

Vice Chancellor of Sri Venkateswara University, Professor A. Damodaram

Distinguished Delegates

Ladies and Gentlemen.

I am delighted to begin the New Year with distinguished scientists from home and abroad in the holy city of Tirupati.

I am happy to inaugurate this 104th session of The Indian Science Congress in the panoramic campus of Sri Venkateswara University.

And I appreciate the Indian Science Congress Association for choosing an appropriate theme "Science & Technology for National Development" for this year's session.

Distinguished Delegates,

The nation will always be grateful to the scientists who have worked tirelessly to empower our society by their vision, labour, and leadership.

In November 2016, the country lost one such eminent scientist and institution builder, Dr. M.G.K.

Menon. I join you in paying tribute to him. Distinguished Delegates,

The speed and scale of changes we encounter today are unprecedented.

How are we going to respond to these challenges that we do not even know could arise? It is a deep-rooted curiosity-driven scientific tradition which allows quick adaptation to new realities.

Tomorrow's experts will come from investments we make today in our people and infrastructure. My government is committed to supporting different streams of scientific knowledge; ranging from fundamental science to applied science with emphasis on innovations.

Distinguished Delegates.

In the last two sessions of the science congress, I presented before you several key challenges and opportunities for the nation.

Some of these important challenges are in the key sectors of clean water & energy, food, environment, climate, security, and healthcare.

We equally need to keep an eye on the rise of disruptive technologies and be prepared to leverage them for growth. We need to clearly assess the challenges and opportunities for our technology readiness and competitiveness.

I have been told that the Technology Vision 2035 document released in last year's Science Congress, is now developing into a detailed roadmap for twelve key technology sectors. Further, NITI Aayog is evolving a holistic science and technology vision for the country.

One important area that needs to be addressed is the rapid global rise of Cyber-Physical Systems. This has the potential to pose unprecedented challenges and stresses to our demographic dividend. But we can turn it into a huge opportunity by research, training and skilling in robotics, artificial intelligence, digital manufacturing, big data analysis, deep learning, quantum communication and Internet-of-Things.

There is a need to develop and exploit these technologies in services and manufacturing sectors;

in agriculture, water, energy & traffic management; health, environment, infrastructure and Geo Information Systems; security; financial systems and in combating crime.

We need to develop an Inter-Ministerial National Mission in the Cyber-Physical Systems to secure our future by creation of basic R&D infrastructure, manpower and skills.

Distinguished Delegates,

The oceans that surround the Indian peninsula have over thirteen hundred of our islands. They also give us a seven and a half thousand kilometre coastline and 2.4 million square kilometres of Exclusive Economic Zone.

They contain enormous opportunities in energy, food, medicine and a host of other natural resources. The ocean economy should be a significant dimension of our sustainable future.

I am told, that the Ministry of Earth Sciences is working to launch a Deep Ocean Mission to explore, understand and harness this resource in a responsible way. This could be a transformative step for the prosperity and security of the nation.

Distinguished Delegates,

Our best science and technology institutions should further strengthen their basic research in line with leading global standards. Translating this basic knowledge into innovations, start-ups and industry will help us achieve inclusive and sustainable growth.

SCOPUS database indicates that India now ranks sixth in the world with respect to scientific publications, growing at a rate of about fourteen percent as against the world average growth rate of about four percent. I am sure that our scientists will further meet the challenges of enhanced quality of basic research, its technology translation and its societal connect.

By 2030 India will be among the top three countries in science and technology and will be among the most attractive destinations for the best talent in the world. The wheels we set in motion today will achieve this goal.

Distinguished Delegates,

Science must meet the rising aspirations of our people. India fully appreciates the strong role science and technology plays in meeting the societal needs. We must address the problems of urban-rural divide and work for inclusive development, economic growth and employment generation. To enable this, there is a need for a new overarching structure that will coordinate with all the relevant stakeholders.

Our ability to mount and execute large, transformational national missions requires effective partnerships that integrate with a large stakeholder base. The effectiveness of these missions can be ensured only by getting out of our deep rooted silos, and adopting a collaborative approach, which is essential to address our multifarious development challenges rapidly and effectively. Our ministries, our scientists, R&D institutions, industries, start-ups, universities and IITs, all should work together seamlessly. In particular, our infrastructure and socio-economic ministries must make appropriate use of science and technology.

Our Institutions could consider inviting outstanding scientists from abroad including NRIs for long term research associations. We should involve foreign and NRI PhD students in post-doctoral research in our projects.

Another empowering factor for scientific delivery is the Ease of Doing Science. If we want science to deliver, we must not constrain it.

Building a strong Science and Technology infrastructure that is accessible to academia, start-ups, industry and R&D labs is a priority of the government. We need to address the problems of ease of access, maintenance, redundancy and duplication of expensive equipments in our Scientific Institutions. The desirability of establishing professionally managed, large regional centers in PPP mode housing high value scientific equipment should be examined.

On the lines of Corporate Social Responsibility, the concept of Scientific Social Responsibility needs to be inculcated to connect our leading institutions to all stakeholders, including schools and colleges.

We must create an environment for sharing of ideas and resources.

The brightest and best in every corner of India should have the opportunity to excel in science. This will ensure that our youth get high-end training exposure to the best of science and technology to make them job-ready in a competitive world.

To this end, I would exhort the National Laboratories to connect with schools and colleges to develop appropriate training programs. This will also help with the effective use and maintenance of our vast scientific and technological infrastructure.

Laboratories, Research Institutions and Universities in each major city region, should be interlinked to function on a hub and spoke model. The hubs will share major infrastructure, drive our national science missions and be the engines that link discovery to application.

College teachers with background in research can be connected to the neighbouring universities and R&D institutions. Outreach activities from the institutions of eminence to schools, colleges and polytechnics will activate the latent Science and Technology manpower from the educational institutions in your neighbourhoods.

Distinguished delegates,

Seeding the power of ideas and innovation in schoolchildren will broaden the base of our innovation pyramid and secure the future of our nation. As a step in this direction, Ministry of Science & Technology is initiating a programme focused on students of classes 6 to 10.

The programme will scout, mentor, reward and showcase ten lakh top innovative ideas focused on local needs from 5 lakh schools.

We must provide equal opportunities to the girl child to enroll and excel in the under-represented disciplines of science and engineering and ensure continued participation of trained women scientists in nation building.

Distinguished Delegates,

For a large and diverse country like India, technology needs to span a wide range; from

advanced space, nuclear and defence technologies to rural development needs in providing clean water, sanitation, renewable energy, community health, etc.

While we excel globally, we also need to develop local solutions that fit our unique context.

There is a need to develop appropriate Micro-Industry models for the rural areas that use local resources and skills to meet the local needs and generate local enterprise and employment.

For example, we should develop a host of technologies based on efficient co-generation for clusters of villages and semi-urban areas. These technologies should aim to convert agri and bio-waste to satisfy multiple needs of electricity, clean water, crop-processing and cold storage.

Distinguished Delegates,

The role of science in planning, decision making, and governance has never been more important.

We need to develop and deploy Geo-information Systems to meet the development goals of our citizens, Gram Panchayats, Districts and States. A coordinated effort by the Survey of India, ISRO and the Ministry of Electronics and Information Technology can be transformative.

For sustainable development, we must take strong measures to focus on Waste to Wealth Management in the critical areas of electronic waste, biomedical and plastic wastes, and solid waste and waste water solutions.

We are scaling up R&D on clean carbon technologies, technologies for enhancement of energy efficiency and increased and efficient use of renewable energy.

Focus on environment and climate remains our priority to ensure sustainable development. Our strong scientific community can also effectively address our unique challenges. For example, can we find farmer-centric solutions to the problem of crop burning? Can we redesign our brick kilns for reduced emissions and greater energy efficiency?

Science and technology is a key factor in the Startup India Programme launched in January 2016. Two other strong initiatives are Atal Innovation

Mission and NIDHI – the National Initiative for Development and Harnessing Innovations. These programmes focus on building an innovation driven enterprise ecosystem. Further, Public-Private partnerships with CII, FICCI and high technology private companies are being pursued to strengthen the innovation ecosystem.

Distinguished Delegates,

Our Scientists have contributed strongly to the strategic vision of the nation.

The Indian space programme has put India among the top space faring nations. We have achieved a high degree of self-sufficiency in space technology, including launch vehicle development, payload and satellite building, applications for development and the building of core competence and capacity.

The Defence Research & Development Organisation has played the role of a force multiplier for the Armed Forces with its systems and technologies.

We are leveraging strategic international partnerships and collaborations based on the principles of mutuality, parity and reciprocity, to make Indian Science globally competitive. We are also placing special emphasis on building strong relationships with our neighbouring countries and multilateral fora such as BRICS. The best of global science is helping us unravel creation's mysteries and develop cutting-edge technologies. Last year, we activated the 3.6 meter optical telescope in Devasthal in Uttarakhand made with Indo-Belgian collaboration. Recently, we approved the LIGO project with USA to construct a state-of-the-art detector system in India.

Distinguished Delegates,

In conclusion, I wish to reiterate that the Government remains committed to provide the best support to our Scientists and Scientific Institutions.

I am sure that our scientists will scale up their efforts ranging from the quality of basic sciences to technology development to innovation.

Let Science and Technology become a strong tool of inclusive development and betterment of the

weakest and poorest segments of our society.

Together, we will prevail to make a just, equitable and prosperous nation.

Jai Hind.

RECOMMENDATIONS FROM SECTIONS :

AGRICULTURE AND FORESTRY SCIENCES:

1. Research on climate change in relation to adaptation and mitigation for a climate-smart agriculture should be strengthened in an interdisciplinary manner.
2. Assessment of natural resources with modern tools and techniques (e.g., geoinformatics, remote-sensing, drone, simulation modelling, etc) at farm level and their integration with socio-economic scenario for sustainable land use planning and management.
3. Promotion of diversified agriculture and popularization of non-timber forest products (NFTP) through adoption of agro-forestry and short duration energy plantations to ensure livelihood security and women empowerment in tribal areas need to be encouraged.
4. Enhancing nutrient and water use efficiency in agro-ecosystems through the use of existing traditional and modern techniques like nano-formulation, fertigation, etc. in irrigated and rain-fed farming systems.
5. Research on conservation agriculture in relation to soil processes involving nutrient fluxes and flows, organic recycling in relation to organic matter formation and its stability, nutrient availability and soil quality for enhanced productivity and environmental security should be emphasized.
6. Newer formulations of mixed bio-fertilizers exploiting soil metagenomics and devising effective delivery systems to farmers' fields is needed.
7. Research on rapid waste recycling and use of organic manures such as FYM, compost, vermicompost, etc. needs to be promoted. Standardization of organic manures, their preparation methods and quality criteria needs to be established.

8. National networking arrangement to coordinate the studies on fertilizer use and soil health in different agro-ecological regions for efficient inputs use, soil health and environment needs to be developed.
9. Strengthening public-private partnership and farmers' linkages with research institutes should be expedited for enhancing agro-technology delivery.

ANIMAL VETERINARY AND FISHERY SCIENCES

1. Basic Biology should be made integral part of undergraduate and Post-graduate studies in Biotechnology, Microbiology, Bioinformatics and modern disciplines..
2. The assemblage of species with we share the planet represents a vast untapped genetic library, with undiscovered pharmaceutical and beneficial substances. So programme needed to be initiated for the exploration of other less known potential varieties of life forms with a view to ensure rural livelihood, food health and financial security.
3. Documentation of traditional technical knowledge (TTK) and indigenous technology, its revival and strengthening for sustainable development in the area of bioresources and adaptation to climate change should be made.
4. Bioresources are the wonderful gift of nature to the mankind whose sustainability can be effectively linked to rural livelihood and economic development, so science education should aim at attracting students for proper management and sustainable utilization of bioresources.
5. Programme needs to be initiated for exploration of other less known varieties of life forms with the view to ensure livelihood and food security.
6. Application of molecular tools for wildlife conservation, especially of endangered species may be given greater importance.
7. Multivoltine race of silkworm (*Bombyx mori*) should be tested under different agro-climatic zones of India for proper evaluation of their improvement efficiency.
8. Bio-economic modeling of different ponds and reservoir management with view to increase fish production should be carried out.
9. Promotion of public awareness on biodiversity conservation role of individuals for minimizing ecological footprint and maintaining health and hygiene in the vicinity should be made.
10. Public-private partnership (PPP) should be encouraged to solve the environmental problems and conservation and proper exploitation of all such life forms, which ensure food, health and livelihood.
11. Public participation in decision-making should be ensured and integration of environmental, economic and social sustainability with food, health and livelihood security of the people.
12. Various disease problems (in aquaculture and animal's husbandry etc.) and their management can be worked out in details.
13. Launching of massive training programmes to link economically important bioresources such as silkworm, honey bee, aquaculture, vermiculture, pearl culture livestock, etc. with a view to promote/accelerate more rural livelihood should be intensively initiated.
14. Since biotechnology is now playing an important tool for food, health and livelihood security, shortterm training should be initiated in rural area for better production of eatables which will contribute in increasing National GDP from this sector.
15. Students with M. Sc. Degree in Zoology (with specialization in Fish & Fisheries) are neglected and denied appointment in fisheries and other related departments which is a great injustice to them. UGC should take strong step to protect the interest of such students.

ANTHROPOLOGICAL AND BEHAVIOURAL SCIENCES (INCLUDING ARCHAEOLOGY, PSYCHOLOGY, EDUCATION AND MILITARY SCIENCES)

More research works should be carried out in the field of reproductive health of women living in rural and tribal areas of India. Because reproductive health is an important component of general health and is a prerequisite for social, economic and human development. The highest attainable level of health is not only a fundamental human right for all, it is also a social and economic imperative because human energy and creativity are the driving forces of development.

1. Population Aging' indeed has become a great challenge for the humanity in the 21st century. It is a demographic imperative which has socioeconomic and political consequences across the globe. There should be a collective approach in dealing with this phenomenon to secure our lives and also of our future generation in later years.
2. Scientists from behavioral sciences discussed about the authentication of the MNREGA implementation through rapid field survey.
3. There should be more research in the field of Developmental Psychology since this will enhance the skill of people in problem solving, moral understanding, conceptual understanding, language acquisition, social, personality emotional development, self concept and identity formation. It can be considered as an alternative approach to a single focus on economic growth, and focused more on social justice, as a way of understanding progress.
4. Scholars also found it imperative to research in studying ethnic variability (both biological and cultural) and its reasons. This is will help in bringing national harmony, social justice and peace

EARTH SYSTEM SCIENCES

1. Oceanic resource need to be strengthened . Smart cities employs .

2. Natural hazards need to be concentrated.
3. Earth System academics .
4. Geo ethics need to be taken care.
5. More & more power need to established (Nuclear Power). Nuclear waste should be taken care.
6. Space technology needs to be taken care in geo spatial maps.
7. Linkage with societal needs.
8. Mineral resource need to be studied –Topping the benefits.
9. Natural hazards need to be investigated : sustainable development.
10. Dedicated section on Remote Sensing Application.

ENGINEERING SCIENCES

1. Fresh graduate engineers/scientists should be motivated for R&D work as well as for teaching faculty.
2. There should be good interactive mechanism between the academia and the industry to minimize unemployment for the passing out students.
3. Good number of faculties along with infrastructural facilities should be provided to the engineering colleges and universities in order to upgrade the standard of education.
4. Discipline-wise engineering curriculum should be updated periodically to meet the future challenges.
5. Training courses for the engineers should be improved /upgraded, so that they can adapt themselves to emerging technologies.
6. Faculty members should have good industrial exposure in order to improve the quality of education as well as to create job opportunities for the fresh engineers/scientists.
7. Engineers and scientists should work in a harmony, so that innovation by the scientists can be fruitfully assimilated and utilized by the engineers to make it useful to the society at large.

8. Microzoning of Metropolitan cities should be taken up with priority. Engineers and scientists should come forward to sort out critical issues in mitigating the disaster due to earthquake.
9. Govt. of India stressed on infrastructure development. We must take up the critical issues, safety and security.

ENVIRONMENTAL SCIENCES

1. National Survey on Biodiversity of Himalayan Region and Western Ghats (including-microphysics. BGA) with special emphasis on indigenous knowledge based natural resources should be undertaken to decipher the unknown and un-recorded natural resources.
2. An all India co-ordinated program should be undertaken to assess and monitor environmental pollution (inorganic and organic) to mitigate the pollution and also to provide a better livelihood.

INFORMATION AND COMMUNICATION SCIENCE & TECHNOLOGY (INCLUDING COMPUTER SCIENCES)

- 1 Proliferation of different technologies, combined with ever-increasing complexity of software and more advanced business, economic, financial models has led to a wider complex and networked issues. Scientific discoveries and innovations produce new knowledge bases for development of new products, solutions and services for transforming lives of masses and new ways of living using new technologies. These should continue unabated.
- 2 In order to have true digital society, suitable for the country like ours, creation, integration and adoption of new culture base is to be formed.
- 3 Computer and IT education including its history and ramifications, must form a part of course curricula in universities, colleges and other courses offered from time to time. Exhaustive databases including events, personalia etc. must be prepared. Professional Societies like ISCA, Computer Society of India(CSI), NassCOM, IETE etc. along with major institutions,

universities etc. also NIELIT, at all levels must be involved in this process to be supported by governments as part of nationwide project..

- 4 The need for further data acquisition in some specified areas like medicine – both diagnosis, disease control and cure, also healthcare, should be well funded, and subsequently disseminated and analysed for the betterment of the society. Rigorous analysis and critical attention need to be given to medical electronics taking into account its affordability to a large segment of consumers.
- 5 Cognitive Computing, Artificial intelligence, archival , searching, Predictive Analytics and Prescriptive Analytics in ever-involving Big data and Internet of Things need to be studied and exercised with well funded projects on a continuing basis.
- 6 Smart villages, like smart cities, are the order of the day. Special and appropriate infrastructural design and application long with skilled manpower must be identified throughout the country at different levels, particularly among the next generations.
- 7 IT should act as a facilitator and a catalyst, as well to provide 'Education for ALL' in the coming decade. Future Citizen driven education need to be introduced for the transformation from the present Academy driven education.
- 8 Decision-making with the use of computers, mobiles, televisions considering all networks with popular social networking sites should be encouraged and acted upon. Legislation and security mechanisms to this effect, particularly in connectivity, must be strengthened.

MATERIALS SCIENCE

1. Development of advanced polymeric/ elastomeric/ polymer matrix composite materials for Defence/Aeronautical applications.
2. Nano materials and devices for green and clean energy applications.
3. Polymeric Hydrogel materials for Biomedical applications.

4. Sensor materials for detection of toxic chemicals.
5. Chalcogenide and chalcopyrites for optoelectronic applications.

MATHEMATICAL SCIENCES (INCLUDING STATISTICS)

Mathematics curriculum should be reengineered at all levels including School and College level, keeping in mind the unfolding Science and Technology revolution across the globe.

A very well defined methodology, to be in place to impart basic mathematics education to every citizen of the country.

Sufficient researches in mathematics and related areas in Indian Universities and Research Institutes to be undertaken. This should be in addition to promotional research avenues addressing applications of Mathematics in various disciplines such as Defense Studies, Biological Studies, Environmental Studies and Social Sciences Studies.

MEDICAL SCIENCES (INCLUDING PHYSIOLOGY)

1. Physiological Survey of India needs to be set up to promote the subject of Physiology.
2. More work needs to be done to fast different natural pro.

NEW BIOLOGY (INCLUDING BIO-CHEMISTRY, BIOPHYSICS & MOLECULAR BIOLOGY AND BIOTECHNOLOGY)

1. The new Biology domain knowledge is rapidly increasing. The students for both Undergraduate and Post Graduate courses in the related area must be exposed to a dynamic curriculum. More stress should be given to Practical exposure and training for the students. The DST/DBT/CSIR supported funds must reach to the remote area colleges and Universities which will help to build up the Human resources in this area.
2. The research focus should be given to both basic and applied research.
3. New approaches to be implemented for border less education and collaborative research.

4. The basic training should nurture more inquisitive minds and Innovation should be encouraged more.
5. Research in the area of Chemical Biology, Chemical genetics to be encouraged to facilitate Drug discovery.
6. Research related to health and food production should be emphasized to help the nation come out of malnutrition, poverty and challenges to keep the biodiversity undisturbed.

PHYSICAL SCIENCES

1. Immediate and serious emphasis should be given to Physics Education/ Teaching at Undergraduate and Postgraduate levels in Universities particularly State Universities situated in remote areas.
2. Intensive research is required for developing materials for electro-optic applications.
3. Development of nanomaterials suitable for display, imaging and lightening applications.
4. Graphene quantum dot conducting polymer for opto-electronic and photovoltaic applications.
5. Applications of electrochemical and photocatalytic technology should be expanded for mineralisation of various environmental organic polymers.
6. The need of hour is the quality and speedy research in various disciplines of Physics. Proper attention must be given to multidisciplinary research.
7. In view of the importance of liquid crystals both in technological developments and also in chemical/ biological/ medical sciences; proper attention be paid to this gray area.

PLANT SCIENCES

1. New alternative sources of phytomedicines from preferable so far untouched plants, especially the weeds and lower plants (Algae, Bryophytes and Pteridophytes) should be explored and multiplied.
2. Bioprospecting of the medicinal compounds or compounds of commercial importance (pharma-ceutical, nutraceutical, industrial

enzymes, dyes etc.) should be carefully carried out from screened potential sources or through use of synthetic biology.

3. Development of biofertilizers and biocontrol agents for improvement of crops.
4. Screening of plants and phytoplanktons for C-sequestration, biofuel development and reducing carbon credits.
5. Phytoremediation of heavy metal pollution through phytomining / phytoextraction / phytostabilization / volatilization and their suitable disposal or bacterial degradation.
6. Development and popularization of bioplastics.
7. All the new compounds, plants and technology should be entered in the digital database of CSIR to protect our traditional, cultivated or bioprospected herbal wealth.

KNOW THY INSTITUTIONS**ICAR - NATIONAL INSTITUTE OF ANIMAL NUTRITION AND PHYSIOLOGY
BENGALURU**

Genesis of ICAR-National Institute of Animal Nutrition and Physiology (ICAR-NIANP) dated back to 1976, when the National Commission on Agriculture recommended creation of this institute to work on fundamental and basic principles involved in optimum nutrient utilization. Realizing the imperative national need for improvement of feed resources and their utilization by unraveling basic physiological and nutritional principles to improve animal productivity, the proposal for establishment of the institute was approved by the planning commission in the VIII five year plan. In October 1992, ICAR constituted a committee of experts under the chairmanship of Dr BK Soni to suggest the location, structure, function and other related issues for translating the proposal of the establishment of ICAR-NIANP. The institute was subsequently established on 24th November, 1995 as per the recommendations of the stripe review committee. The Institute began its journey with five scientists, five technical and ten supporting staff from the campus of SRS ICAR-NDRI, Bangalore. Approximately 50 acres of farm land of the SRS

ICAR-NDRI was transferred to ICAR-NIANP for setting up its new campus. The new campus of the institute was soon developed at Adugodi, Bangalore and the Institute started functioning from this magnificent new campus in the year 2003. Over the last 16 years, the Institute has developed its repute through significant contribution in the animal nutrition and physiological research. Today, it is recognized as one of the best research Institutes in the area of Animal Sciences under of the National Agricultural Research System of India and was conferred Sardar Patel Outstanding ICAR Institution Award in 2012. The Institute also has ISO 9001:2015 certification.

Vision

Productivity enhancement for profitable and sustainable livestock production

Mission

Improving production and reproductive efficiency in livestock through basic physiological and nutritional approaches

Mandate

Basic and strategic research on physiology and nutrition for efficient livestock production

Capacity development in Animal Nutrition and Physiology

Objectives

To carry out quantitative and qualitative assessment of feed resources and to develop district-wise information system

To enhance availability of nutrients through various approaches viz., strategic supplementation, biotechnological interventions and feed processing technologies

To enhance reproductive efficiency of livestock through physiological and nutritional interventions

To address the issues of feed quality and safety

Focus of the Institute

Deconstruction of Ligno-Cellulosic Biomass for Improving Feed Utilization

Biogeography of Gut Microbes in Animals

Novel Approaches for Assessing and Improving Nutrient Bioavailability, Animal Reproduction and Productivity

Feed Informatics, Feed Quality and Safety and Value Addition

Climate Change Impact on Livestock

Technology Translation to Connect Discovery with Application

Developing quality Human Resources in the Area of Animal Nutrition and Physiology

Awards/Accolades

The institute scientists have bagged three times ICAR Team Research Awards (2000,2007 and 2013), Hari Om Ashram Trust Award (2004), Jawaharlal Nehru award for Outstanding Post Graduate Agricultural Research (2006) and Lal Bahadur Shastri Young Scientist Award (2012).

Infrastructure**Research Laboratories**

The Institute has eighteen state of the art laboratories equipped with advanced analytical

facilities to conduct research in the area of macro- and micro-nutrient, feed quality and safety, feed additives and nutraceuticals, toxicology, energy metabolism, fermentation technology, rumen microbiology, reproductive physiology and biotechnology, molecular biology and proteomics, radioisotope and endocrinology, and climate change and stress physiology.

ARIS Cell and ASRB-ICAR Online Examination Centre

Agricultural Research Information Systems (ARIS) Cell looks after the maintenance of the computer, network infrastructures and website of the Institute. An online examination centre for Karnataka has been established at the Institute for ICAR NET/ARS Prelim exams conducted by Agricultural Scientists Recruitment Board (ASRB), New Delhi. The centre is equipped with 100 test terminals, servers, UPS backup and dedicated high speed internet connectivity.

Experimental Livestock Unit (ELU)

The ELU has the facilities for housing large and small ruminants, poultry bird and mouse/rat to cater the need of various animal experimentations. The unit is also equipped with a small scale feed processing and storage facility. Recently, a laboratory animal house facility was inaugurated by DG, ICAR. The state of art facility with 15 crore outlay is being developed to take up basic and fundamental studies in animal Nutrition and Physiology.

Major achievements**District-wise National Database on livestock population and feed resources availability**

The Institute has developed district and state level database on animal and feeds and fodder resources availability in the country. The databases are updated and refined for predicting the requirements of feeds and fodder in different parts of the country. Prediction equations are developed to project future production and demand for the feeds. Remote sensing technology is being used for assessment, which would help in devising necessary

strategies to address the shortages of feed resources for improving productivity of livestock

District wise database on enteric methane emissions from livestock based on the feeding systems has been developed for Karnataka region to work out strategies for reducing livestock generated methane in the environment.

The district wise database on enteric methane emission has been developed based on methane production potential of feed and latest livestock census. The livestock of Karnataka emits approximately 0.364 Tg; out of which north Karnataka contributes 63% and rest 37% arises from livestock of southern districts of Karnataka.

Area specific mineral mixture was developed for Karnataka region

Deficiency and or imbalance of micro- nutrients are one of the most important factors responsible for low productivity. As these are required in small quantities, it can be supplemented more easily without affecting the existing feeding practices. Area-specific mineral mixture was developed based on the micro-nutrient content in water, soil, feed and fodder and biological materials of animals. This is a more practical and cost effective method of supplementation and avoids antagonistic effects of excess levels of other minerals thereby improving the bioavailability of micronutrients. Mineral mapping for different agro-climatic zones has been carried out. This technology has been commercialized and has a great potential in improving the reproductive efficiency and immunity in dairy animals.

Technologies for utilization of Areca sheath and Pineapple waste as livestock feed

Over the years, the availability of paddy straw has been reduced in some coastal regions and cultivation of areca as a commercial crop has increased. The areca sheath, a by-product of areca tree, is found to contain less lignin and silica and nutritionally superior to paddy straw. However, its use has been limited due to the physical structure. Technology has been developed to process areca sheath in total mixed rations which reduces the cost

of feeding dry fodder by 50% with increase in milk yield and mitigate shortage of dry fodder.

Specific mineral mixture for Small Ruminants to overcome the suboptimal production and reproductive failure

The deficiency and or imbalance of micro- and macro-nutrients are one of the most important factors responsible for low productivity in small ruminants i.e. sheep and goat. As such, there are no specific mineral mixtures available for small ruminants. The requirement of minerals for small ruminants varies considerably as compared to large ruminants due to their physiological needs. Specific mineral mixtures for small ruminants have been developed and are found to be useful in improving productive and reproductive efficiency, immunity of small ruminants.

A simplified low cost azolla production method was developed and popularized

Azolla can be used as a valuable green feed supplement, particularly under low input livestock production system. Fresh Azolla can be mixed with commercial feed in 1:1 ratio and fed to livestock and is known to save 20-25% of cost towards the purchase of commercial feeds. Low cost production method of azolla cultivation has been developed and popularized in rain-fed regions and found to improve milk yield.

Poultry layer house illumination with higher wave length of light (red-675 nm) using LED source to improves egg production and reduce electricity expenditure

Egg production is dependent on the relative activation of two pathways. The inhibitory pathway is activated by stimulating retinal photoreceptors by the incandescent band of the spectrum, and the stimulatory pathway is activated by direct action of the red band on photoreceptors in the brain. Use of near red (675 nm) of the spectrum using red bulbs increased egg production during 72 week period from 77.89 to 85.21%. This technology will help in augmenting the existing management procedures in commercial poultry farms for enhancing egg production without additional cost.

Technology developed for Production of pre-biotics (Xylooligosaccharides) from agricultural crop residues/agricultural waste materials.

The cost of prevention is less than the cost of treatment of diseases. Nutraceuticals are the substances isolated from food ingredients, which have beneficial effect on the digestive process through manipulation of health promoting bacteria and improvement of general health and immunity. The process for prebiotic (xylooligosaccharides) production have been developed from agriculture wastes like finger millet straw, corn cobs and husks, sugarcane bagasse, pigeon pea stalks, green coconut husks, cotton stalks, and natural grass. The xylooligosaccharides were found to stimulate growth and multiplication of beneficial microflora followed by reduction in the population of pathogenic microflora in the gastrointestinal tract of animals.

Technology for reducing the enteric methane emissions from ruminants.

Methane accounts for 2-12 % loss of dietary gross energy in ruminants and is a potent greenhouse gas with a global warming potential 25 times higher than that of carbon dioxide. Therefore reducing ruminal methane not only improves the efficiency of nutrient utilization, but also helps to protect the environment from warming. Plant secondary metabolites such as tannins as rumen modifiers are potential compounds since they are natural products which are environmental friendly and therefore have a better acceptance with regard to food safety issues. Studies carried out at NIANP has shown that tropical tree leaves containing-tannins such as *Autocarpus integrifolis*, *Jatropha curcus* and *Sesbania grandiflora* suppress methanogenesis by 25-30%. Therefore tannins contained in these plants could be of interest in the development of new additives in ruminant nutrition.

Combination test (HOST-Giemsa) to screen and eliminate subfertile bulls from AI chain.

Conception rates following artificial insemination are poor especially in buffaloes (~30%). One of the reasons for this is the inability to

identify sub-fertile bulls and thus the quality of the semen used in the AI programs. Routine tests of sperm concentration and mass activity that are used by the semen collection centers are not able to detect semen of subfertile quality. To address this problem, a highly reliable advanced combination test that can detect semen of sub-fertile bulls has been developed, which involves assessing acrosomal and functional membrane integrities of the sperm. Semen with sperms having both of these attributes has been shown to be strongly positively correlated with fertilization ability in vitro. These tests can be adopted by semen collection centers to detect and discard the semen from sub-fertile bulls to overcome the low conception rate associated with poor quality semen.

Feed Assist

Imbalanced feeding and under nutrition are the major factors affecting production and reproduction. There is a great need for an intuitive knowledge based system, which can suggest balanced ration for the dairy animals. The Feed Assist software offers correct least cost ration under field conditions useful for sustainable livestock production.

NIANP method of fodder sprouts production

To overcome the problems of hydroponic fodder production like high cost, handling of very high moisture feed and risk of mould growth, ICAR-NIANP, Bangalore developed a cost-effective method of producing mold-free sprouted fodder. Pre-soaked seeds are treated with vinegar and the sprouting seeds are grown on low cost bedding material like straw of paddy/wheat/finger millet/sorghum placed on gunny mat with minimum usage of water (2 to 3 sprays of water per day). They are grown for about 7 days and the entire straw mat with fodder sprouts is rolled, taken out from the racks and used for feeding the livestock. It is an easy and low cost contingency measure to tide over periods of green fodder deficit without the usage of power. About 8 liters of water is needed to obtain about four kg. of nutritive mold-free fodder sprouts from one kg. of maize seed in places with moderate climate.

Collaboration and linkages

ACIAR, Australia
FAO, Rome
Global Research Alliance, New Zealand
George-August University of Goettingen and
University of Kassel, Germany
CIRAD, France
Hiroshima University,
Shinshu University, Nagano, Japan
National Institute of Livestock and Grassland
Science, Tsukuba, Japan
International Livestock Research Institute,
North Carolina State University, USA
Monash University, Malaysia

Future thrust areas

Precision feeding and phase feeding to tackle
problem of feed shortage
Residual feed intake as a tool for selecting animal
for better performance
Augmenting production intensity through
genomic and molecular tools
Deconstruction of lingo-cellulosic biomass
through manipulation gut microbiota

Modulating gut microbiota for better nutrient
utilization
Mining plant derived feed additives and
nutraceuticals
Nanotechnology for nutrient delivery
Reducing green house gases and environmental
pollutants from animal farming
Developing physiological and nutritional
strategies for combating stress
Understanding nutrient-gene interaction for
various physiological functions
Identifying biomarkers for selecting superior
males and gametes for better reproductive
efficiency
Identifying water efficient crop-livestock
production system to promote environmentally
sustainable animal farming

Contact :

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E-mail: directornianp@gmail.com

CONFERENCES / MEETINGS / SYMPOSIA / SEMINARS

ICUE 2018 on Green Energy for Sustainable Development, 24-26 October, 2018, Phuket, Thailand.

Topics:

Green Energy Technology

Renewable Energy (Wind, Solar, Hydro, Geothermal)
Biomass, Biofuels and Biogas
Greening the Fossil Fuels
Emerging and Advanced Green Energy Technologies
Energy efficiency and rationale use of energy

Green Power, Industrialization and Transport

Smart Grid and Green Energy Integration
Electric Power Generation, Transmission and Distribution
Power System Design, Operation and Interconnection
Power System Optimization, Planning and Analysis
Greening the Industrial Sector's Energy Use and Options
Green Energy in Transport

Green Energy Policies and Programmes

Sustainable Development Goals (SDGs) and Green Energy
Energy and Carbon Offset
Greenhouse Gas Mitigation and Climate Change
Energy and the Environment
Greening Urbanization and Urban Settlements
Rural Development through Green Energy
Energy and Health
Promoting Disruptive Innovation

Green Economy

Green Energy Trade for Economic Development
Trans-boundary Power Exchange (cross-border power issues)
Geopolitical Sustainability Issues and Strategies
Low Carbon Economy and Society

Contact :

Maria Kathrina B. Gratuito, ICUE 2018 Secretariat, Regional Energy Resources Information Center (RERIC), Energy Program, Department of Energy, Environment and Climate Change, Asian Institute of Technology, P.O. Box4, Klong Luang, Pathumthani, 12120, THAILAND, E-mail: icue2018@ait.ac.th
Website: www.icue.ait.ac.th, Tel: (66 2) 524 6216, 524 5413(Direct), Fax: (66 2) 524 5439 (Direct), Website <http://www.icue2018.ait.ac.th>

10th International Conference on Software Technology and Engineering ICSTE 2018 , October 27-29, 2018, Kuala Lumpur, Malaysia .

Topics:

Electronics and Communications Engineering

QoS Provisioning and Architectures
 Telecommunication Services and Applications
 Wireless Networking
 Optical Communications
 Multimedia Communications
 Network Performance
 Innovative Networking Technologies
 Network Security
 Network Planning and Design
 Software Technology in communication Engineering

Microwave Engineering

Antennas - Design, Modeling and Measurement
 Microwave Circuits - Systems and Applications
 Computational Electromagnetics
 Radio Propagations
 Integrated Optics

Applied Electronics

Embedded Systems
 Reconfigurable Computing
 VLSI Design
 Biomedical Electronics
 Industrial Electronics and Automations
 Robotics
 Electronic Devices in Communications
 Software Engineering in Electronics

Applications of Neural Networks
 Industrial Automation and Control

Informatic and Communication Engineering

Artificial Intelligence
 Bioinformatics
 Software Engineering
 VLSI Design and Fabrication
 Photonic Technologies
 Parallel and Distributed Computing
 Data Mining
 Cryptography
 Algorithms and Data Structures
 Graphs and Combinatorics
 E-commerce and E-learning
 Geographical Information Systems (GIS)
 Networking
 Signal Processing
 Embedded System
 Communication and Wireless Systems
 Multimedia Systems and Applications
 Emerging Technologies

Coding and Signal Processing

Channel Coding
 Space-Time Signal Processing MIMO and OFDM Systems
 Signal Detection and Estimation
 Audio/Speech Signal Processing
 Image/Video Processing and Coding
 Medical Imaging and Image Analysis

Contact :

Conference Secretary: Yoyo Zhou, +86-28-86512185, Email: icste@iap.org, Website: www.icste.org/index.html

International Conference on The Humanities and The Social Sciences ICHSS 2018, Faculty of Arts, University Of Peradeniya, 22-23 November, 2018, Sri Lanka.

Theme : "Development, Diversity, and Harmony through Knowledge and Innovation"

Topics:

Signal Processing

Arabic and Islamic Studies
Archeology, History, and Heritage Studies
Art, Theater, and Media
Buddhist and Pali Studies
Economic Research
Education and Pedagogy
Geography and Environmental Studies
Greek and Roman Studies

Languages and Literary Studies
Library and Information Studies.
Philosophy: East and West
Political Science and Public Administration
Psychology and Counselling
Religious and Cultural Studies
Sociology and Social Anthropology
Tamilology

Contact :

ICSSH Conference Secretariat ,Room 56, Faculty of Arts, University of Peradeniya, Peradeniya 20400, SRI LANKA, Website : <http://arts.pdn.ac.lk/ichss/index.html>, 0094 81 238 6173, 0094 77 577 7033 (mobile)
Email : ichss2018.pdn@gmail.com

World Congress on Infectious Diseases and Antibiotics-2018, 28-29 November, 2018, Bangalore, Karnataka.

Topics:

Infectious Diseases

Infectious Diseases
Veterinary Infectious Diseases
Pediatric Infectious Diseases
Respiratory and Pulmonary Infectious Diseases
Infection and Immune System
HIV/Zika/Ebola and other Viruses
Infectious Diseases Epidemiology

Antibiotics

Discovery of Antibiotics
Antibiotic Therapy
Production in Antibiotics
Antibiotic Resistance and Prevention
Antimicrobial Resistance
Drug Discovery Technologies in Antibiotics
Pharmacology of Antibiotics

Infectious Diseases

Diseases of Reproductive Organs and Sexually Transmitted Diseases

Molecular Bacteriology Infection

Infectious/ Plant Disease Modeling

Problems in Infectious Disease Practice

Diagnosis, Management and Treatment of Infectious Diseases

Vaccines/Preventive Vaccine for Infectious Diseases

Infection Prevention and Control Guidelines

Preventing and Controlling Viral Hepatitis

Neurological Infectious Disease

Blood Infectious Diseases

Acute Rheumatic Fever /Rheumatic Heart Disease

Antibiotics

Antimicrobial Peptides

Medical Use of Antibiotics

Antibiotics for Emerging and Re-Emerging Diseases

Antibiotics of Veterinary Importance

Interaction and Side-Effects of Antibiotics

The Next Generation Approach Of Antibiotics

Mechanisms of Antibacterial Resistance

Genetics of Antimicrobial Resistance

Alternatives to Antibiotics

Antibiotics: Countries

Antibiotics for Throat Infection

Contact :

Biogenesis Health Cluster, H.No. 362, 2nd Floor, 11th Cross, 4th Main, 2nd Block, Behind B.D.A. Shopping Complex, R.T. Nagar, Bengaluru -560032, Tel:+91 80 2333 0019, Fax:080 2333 0058, Website : <http://infectiousdiseasescongress.com>

S & T ACROSS THE WORLD

COMPOUNDS IN COCOA MAY HELP DELAY ONSET OF TYPE 2 DIABETES

Researchers have discovered certain compounds found in cocoa can actually help your body release more insulin and respond to increased blood glucose better. Insulin is the hormone that manages glucose, the blood sugar that reaches unhealthy levels in diabetes. Of course, there's a catch. "You probably have to eat a lot of cocoa, and you probably don't want it to have a lot of sugar in it," said study author Jeffery Tessem, assistant professor of nutrition, dietetics and food science at BYU. "It's the compound in cocoa you're after." When a person has diabetes, their body either doesn't produce enough insulin or doesn't process blood sugar properly. At the root of that is the failure of beta cells, whose job it is to produce insulin. The new study, published in the *Journal of Nutritional Biochemistry*, 2017 finds beta cells work better and remain stronger with an increased presence of epicatechin monomers, compounds found naturally in cocoa.

To discover this, collaborators at Virginia Tech first fed the cocoa compound to animals on a high-fat diet. They found that by adding it to the high-fat diet, the compound would decrease the level of obesity in the animals and would increase their ability to deal with increased blood glucose levels.

The BYU team, comprised of graduate and undergraduate students in Tessem's lab and the labs of Ben Bikman and Jason Hansen (BYU professors of physiology and developmental biology), then dove in and dissected what was happening on the cellular level -- specifically, the beta cell level. That's when they learned cocoa compounds named epicatechin monomers enhanced beta cells' ability to secrete insulin.

"What happens is it's protecting the cells, it's increasing their ability to deal with oxidative stress," Tessem said. "The epicatechin monomers are making the mitochondria in the beta cells stronger, which

produces more ATP (a cell's energy source), which then results in more insulin being released."

While there has been a lot of research on similar compounds over the past decade, no one has been able to pinpoint which ones are the most beneficial or how exactly they bring about any benefit -- until now. This research shows the epicatechin monomers, the smallest of the compounds, are the most effective.

"These results will help us get closer to using these compounds more effectively in foods or supplements to maintain normal blood glucose control and potentially even delay or prevent the onset of type-2 diabetes," said study co-author Andrew Neilson, assistant professor of food science at Virginia Tech.

But rather than stocking up on the sugar-rich chocolate bars at the checkout line, researchers believe the starting point is to look for ways to take the compound out of cocoa, make more of it and then use it as a potential treatment for current diabetes patients.

(Source : <https://www.sciencedaily.com/releases/2017/08/170828102728.htm>)

CLIMATE CHANGE COULD INCREASE VOLCANO ERUPTIONS

A new study, led by the University of Leeds, has found that there was less volcanic activity in Iceland when glacier cover was more extensive and as the glaciers melted volcanic eruptions increased due to subsequent changes in surface pressure.

Dr Graeme Swindles, from the School of Geography at Leeds, said: "Climate change caused by humans is creating rapid ice melt in volcanically active regions. In Iceland, this has put us on a path to more frequent volcanic eruptions."

The study examined Icelandic volcanic ash preserved in peat deposits and lake sediments and identified a period of significantly reduced volcanic activity between 5,500 and 4,500 years ago. This period came after a major decrease in global temperature, which caused glacier growth in Iceland.

The findings, published in the journal *Geology*, 2017, found there was a time lag of roughly 600 years between the climate event and a noticeable decrease in the number of volcanic eruptions. The study suggests that perhaps a similar time lag can be expected following the more recent shift to warmer temperatures.

Iceland's volcanic system is in process of recovering from the 'Little Ice Age' -- a recorded period of colder climate roughly between the years 1500 to 1850. Since the end of the Little Ice Age, a combination of natural and human caused climate warming is causing Icelandic glaciers to melt again.

Dr Swindles said: "The human effect on global warming makes it difficult to predict how long the time lag will be but the trends of the past show us more eruptions in Iceland can be expected in the future.

"These long term consequences of human effect on the climate is why summits like COP are so important. It is vital to understand how actions today can impact future generations in ways that have not been fully realised, such as more ash clouds over Europe, more particles in the atmosphere and problems for aviation. "

Icelandic volcanism is controlled by complex interactions between rifts in continental plate boundaries, underground gas and magma build-up and pressure on the volcano's surface from glaciers and ice. Changes in surface pressure can alter the stress on shallow chambers where magma builds up.

Study co-author, Dr Ivan Savov, from the School of Earth & Environment at Leeds, explains: "When glaciers retreat there is less pressure on Earth's surface. This can increase the amount of mantle melt as well as affect magma flow and how much magma the crust can hold.

"Even small changes in surface pressure can alter the likelihood of eruptions at ice-covered volcanos."

(Spurce: <https://www.sciencedaily.com/releases/2017/11/171123095405.htm>)

A NEW WAY TO STORE THERMAL ENERGY

In large parts of the developing world, people have abundant heat from the sun during the day, but most cooking takes place later in the evening when the sun is down, using fuel -- such as wood, brush or dung -- that is collected with significant time and effort.

Now, a new chemical composite developed by researchers at MIT could provide an alternative. It could be used to store heat from the sun or any other source during the day in a kind of thermal battery, and it could release the heat when needed, for example for cooking or heating after dark.

A common approach to thermal storage is to use what is known as a phase change material (PCM), where input heat melts the material and its phase change -- from solid to liquid -- stores energy. When the PCM is cooled back down below its melting point, it turns back into a solid, at which point the stored energy is released as heat. There are many examples of these materials, including waxes or fatty acids used for low-temperature applications, and molten salts used at high temperatures. But all current PCMs require a great deal of insulation, and they pass through that phase change temperature uncontrollably, losing their stored heat relatively rapidly.

Instead, the new system uses molecular switches that change shape in response to light; when integrated into the PCM, the phase-change temperature of the hybrid material can be adjusted with light, allowing the thermal energy of the phase change to be maintained even well below the melting point of the original material.

The new findings, by MIT postdocs Grace Han and Huashan Li and Professor Jeffrey Grossman, are reported this week in the journal *Nature Communications* 8, (1), 2017.

"The trouble with thermal energy is, it's hard to hold onto it," Grossman explains. So his team developed what are essentially add-ons for traditional phase change materials, or, "little molecules that undergo a structural change when

light shines on them." The trick was to find a way to integrate these molecules with conventional PCM materials to release the stored energy as heat, on demand. "There are so many applications where it would be useful to store thermal energy in a way lets you trigger it when needed," he says.

The researchers accomplished this by combining the fatty acids with an organic compound that responds to a pulse of light. With this arrangement, the light-sensitive component alters the thermal properties of the other component, which stores and releases its energy. The hybrid material melts when heated, and after being exposed to ultraviolet light, it stays melted even when cooled back down. Next, when triggered by another pulse of light, the material resolidifies and gives back the thermal phase-change energy.

"By integrating a light-activated molecule into the traditional picture of latent heat, we add a new kind of control knob for properties such as melting, solidification, and supercooling," says Grossman, who is the Morton and Claire Goulder and Family Professor in Environmental Systems as well as professor of materials science and engineering.

The system could make use of any source of heat, not just solar, Han says. "The availability of waste heat is widespread, from industrial processes, to solar heat, and even the heat coming out of vehicles, and it's usually just wasted." Harnessing some of that waste could provide a way of recycling that heat for useful applications.

"What we are doing technically," Han explains, "is installing a new energy barrier, so the stored heat cannot be released immediately." In its chemically stored form, the energy can remain for long periods until the optical trigger is activated. In their initial small-scale lab versions, they showed the stored heat can remain stable for at least 10 hours, whereas a device of similar size storing heat directly would dissipate it within a few minutes. And "there's no fundamental reason why it can't be tuned to go higher," Han says.

In the initial proof-of-concept system "the temperature change or supercooling that we achieve

for this thermal storage material can be up to 10 degrees C (18 F), and we hope we can go higher," Grossman says.

Already, in this version, "the energy density is quite significant, even though we're using a conventional phase-change material," Han says. The material can store about 200 joules per gram, which she says is "very good for any organic phase-change material." And already, "people have shown interest in using this for cooking in rural India," she says. Such systems could also be used for drying agricultural crops or for space heating.

"Our interest in this work was to show a proof of concept," Grossman says, "but we believe there is a lot of potential for using light-activated materials to hijack the thermal storage properties of phase change materials."

(Source:<https://www.sciencedaily.com/releases/2017/11/171116185959.html>)

SOLAR PANELS: NANOTECHNOLOGY GIVES GREEN ENERGY A GREEN COLOR

Solar panels have tremendous potential to provide affordable renewable energy, but many people see traditional black and blue panels as an eyesore. Architects, homeowners and city planners may be more open to the technology if they could install green panels that melt into the landscape, red panels on rooftops and white ones camouflaged as walls.

A new study published this week in *Applied Physics Letters*, 2017; 111 (7);, from AIP Publishing, brings us one step closer to a future of colorful, efficient solar panels. Researchers have developed a method for imprinting existing solar panels with silicon nanopatterns that scatter green light back toward an observer. The panels have a green appearance from most angles yet only show about a 10 percent power reduction due to the loss of absorbed green light.

"Some people say 'why would you make solar cells less efficient?' But we can make solar cells beautiful without losing too much efficiency," said Verena Neder, a researcher at AMOLF and lead

author of the paper. "The new method to change the color of the panels is not only easy to apply but also attractive as an architectural design element and has the potential to widen their use."

Most research on solar cells has focused on increasing efficiency and reducing cost. Currently, the solar panels sold to consumers can ideally turn up to 22 percent of the sun's light into usable energy. Colored solar panels are already on the market, but the dyes and reflective coatings that give them their color greatly reduce efficiency.

Neder and colleagues created their efficient, green solar panels through soft-imprint lithography, which works somewhat like an optical rubber stamp to imprint a dense array of silicon nanocylinders onto the cell surfaces. Each nanocylinder is about 100 nanometers wide and exhibits an electromagnetic resonance that scatters a particular wavelength of light. The geometry of the nanocylinder determines which wavelength it scatters and can be fine-tuned to change the color of the solar cell. The imprint reduces the solar panel's efficiency by about 2 percent.

"In principle, this technique is easily scalable for fabrication technology," said Albert Polman, a scientific group leader at AMOLF and senior author on the paper. "You can use a rubber stamp the size of a solar panel that in one step, can print the whole panel full of these little, exactly defined nanoparticles."

Unlike existing colored solar panels, the nanopatterns give a consistent appearance from different angles. "The structure we made is not very sensitive to the angle of observation, so even if you look at it from a wide angle, it still appears green," Neder said.

The nanopatterns also could be useful in making tandem solar cells, which stack several layers, each designed to absorb certain parts of the spectrum, to achieve efficiencies of greater than 30 percent.

Next, the researchers are designing imprints to create red and blue solar cells. Once they master these three colors, the primary colors of light, they can create any color, potentially even white. "You have to combine different nanoparticles, and if they

get very close to each other they can interact and that will affect the color," Polman said. "Going to white is a really big step."

(Source: <https://www.sciencedaily.com/releases/2017/08/170815120504.htm>)

ELECTROTUNABLE LIQUID MIRROR-WINDOW ON THE WALL

The scientists from the Indian Institute of Technology, Guhawati in India and Imperial College, London in the United Kingdom have synthesised a nanoparticles-based liquid mirror that can be electrically tuned to transmit or reflect light making it potentially useful for fabricating a switchable window-mirror device. The nanoparticles in this case are metamaterials – artificially structured materials used to control and manipulate light and sound. They can make things invisible and may even catch minute details of objects that no other sophisticated optical microscope can. Although advances have been made, tuning and modulating the optical properties of metamaterials in real time remain a challenge. The researchers have developed a system containing modified gold nanoparticles and two immiscible layers of electrolytes. They then electrically tuned the assembly and disassembly of the nanoparticles by altering the applied potential. At negative potential values, the nanoparticles assembled towards the electrolyte layers, forming a dense layer; at positive potential values, the nanoparticles disassembled. Like a mirror, the dense layer reflected light, while disassembled nanoparticles transmitted light the way a window does. Exploiting these optical properties, the researchers made a prototype electrically switchable liquid window-mirror device. A coin was placed to face the liquid mirror and a currency note was placed at the back of the mirror. At positive potential values, the nanoparticles disassembled and transmitted light, showing the presence of the currency note. At negative potential values, the nanoparticles assembled and formed a dense layer that reflected light, making the coin visible.

(Source: *Nature India Alert*, 25th October 2017)

OLDEST FOSSIL OF 'MISSING LINK' DINOSAUR DISCOVERED IN GERMANY

Germany's Bavaria region is known today for its green hills and valleys, studded with whimsical castles and breweries. During the Jurassic period, most of this landscape was under a shallow sea, located much closer to the equator, with coral reefs and a chain of subtropical islands populated by dinosaurs. Scientists in Bavaria have identified a new fossil from this long-gone era: what may be the oldest known specimen of *Archaeopteryx*—once thought to be the feathery link between dinosaurs and modern birds.

The discovery of the 150-million-year-old fossil highlights the diversity of known *Archaeopteryx* specimens, which may have belonged to several species, like "a Jurassic analog of Darwin's finches," said study leader and paleontologist Oliver Rauhut, of the Bavarian State Collections for Paleontology and Geology in Munich. The sites in southern Germany where *Archaeopteryx* fossils have been found were once islands in a chain known as the Jurassic Solnhofen archipelago.

When the first *Archaeopteryx* fossils were discovered in the 19th century, paleontologists recognized the finds' mix of avian and reptilian features — such as feathers and a full set of teeth — and declared these raven-size creatures the earliest known birds. That title was undermined after fossils discovered more recently in Asia suggested that *Archaeopteryx* was just one of many bird-like dinosaurs to roam the planet.

In 2010, a private collector found an *Archaeopteryx* specimen at Gerstner Quarry, where tourists can dig for fossils, just outside of the Bavarian village of Schamhaupten, north of Munich.

The collector alerted Rauhut, who then analyzed the fossil. Scientists sometimes use fossils of extinct mollusks called ammonites as guides to gauge which geologic period a nearby specimen comes from. Based on the ammonites found near the Schamhaupten *Archaeopteryx*, the researchers think this specimen dates to the boundary between the Kimmeridgian age and the Tithonian age, around 152 million years ago, during the Jurassic period, the scientists said. That might make it the oldest of the 12 fossils that have been classified as *Archaeopteryx*.

Based on fossils of extinct mollusks called ammonites found in the same slab that held the *Archaeopteryx* fossil, scientists dated the dinosaur to about 152 million years ago. "Specimens of *Archaeopteryx* are now known from three distinct rock units, which together cover a period of approximately 1 million years," Rauhut, who is also a professor at Ludwig-Maximilian University in Munich, said in a statement. Rauhut added that the specimens also show a great deal of diversity in their physical characteristics, which suggests that the fossils could represent more than one species. "The high degree of variation in the teeth is particularly striking," Rauhut said in the statement, and the arrangement of teeth is different in every specimen, "which could reflect differences in diet." He said the situation was "very reminiscent" of the finches Charles Darwin studied on the Galapagos Islands, which showed diversity in their beak shapes and famously helped inspire his theory of evolution by natural selection. Rauhut added that *Archaeopteryx* could have diversified into several species on the islands of the So Inhofener archipelago.

(Source: The findings were described online Jan. 26, 2018 in the journal *PeerJ*.)



THE INDIAN SCIENCE CONGRESS ASSOCIATION

14, DR. BIRESH GUHA STREET, KOLKATA- 700 017

ANNOUNCEMENT FOR AWARDS: 2018-2019

Nominations / Application in prescribed forms are invited from Indian Scientists for following Awards:

- | | |
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| Asutosh Mookerjee Memorial Award | Dr. B. C. Deb Memorial Award for Popularisation of Science |
| C. V. Raman Birth Centenary Award | Professor R. C. Mehrotra Commemoration Lecture- Chemical Sciences |
| Srinivasa Ramanujan Birth Centenary Award | Prof.(Mrs.) Anima Sen Memorial Lecture- Psychology & Educational Sciences |
| Jawaharlal Nehru Birth Centenary Awards | Dr. (Mrs.) Gouri Ganguly Memorial Award for Young Scientist- Animal, Veterinary and Fishery Sciences |
| S. N. Bose Birth Centenary Award | Prof. G. K. Manna Memorial Award- Animal, Veterinary and Fishery Sciences |
| S. K. Mitra Birth Centenary Award | Prof. Sushil Kumar Mukherjee Commemoration Lecture-Agriculture and Forestry Sciences |
| Birbal Sahani Birth Centenary Award | Prof. S. S. Katiyar Endowment Lecture - New Biology/ Chemical Sciences |
| S. S. Bhatnagar Memorial Award | Prof. R. C. Shah Memorial Lecture- Chemical Sciences |
| M. K. Singal Memorial Award | Prof. Archana Sharma Memorial Award- Plant Sciences |
| Vikram Sarabhai Memorial Award | Dr. V. Puri Memorial Award- Plant Sciences |
| D. S. Kothari Memorial Award | Prof. W. D. West Memorial Award- Earth System Sciences |
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| Millennium Plaques of Honour | ISCA Fellowship |
| Excellence in Science and Technology Award | *Asutosh Mookerjee Fellowship |
| R. C. Mehrotra Memorial Life Time Achievement Award | |
| B. C. Guha Memorial Lecture | |
| G. P. Chatterjee Memorial Award | |
| Professor Hira Lal Chakravarty Award- Plant Sciences | |
| Pran Vohra Award -Agriculture and Forestry Sciences | |
| Professor Umakant Sinha Memorial Award- New Biology | |
| Dr. B. C. Deb Memorial Award for Soil/Physical Chemistry | |

*Last date 15th July, 2018; **Last date 15th November, 2018

Receiving of Nominations / Application for different ISCA Awards and Lectures of 2018-2019 is **July 31, 2018**. For proforma of application forms and necessary information, please write to the General Secretary (Membership Affairs). The Indian Science Congress Association, 14, Dr. Biresw Guha Street, Kolkata- 700 017, E-mail: iscacal@vsnl.net. The form also can downloaded from-<http://www.sciencecongress.nic.in>



भारतीय विज्ञान कांग्रेस संस्था

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सदस्यता की शर्तें और सदस्यों की विशेषाधिकार/Terms of Membership and Privileges of Members :

संस्था की सदस्यता उन सभी लोगों के लिए खुली है, जो स्नातक या उसके समान स्तर पर शैक्षणिक योग्यता अर्जन कर चुके हैं, और जिन्हें भारत में विज्ञान की तरक्की में रुचि है।

Membership of the Association is open to person with Graduate or equivalent Academic Qualifications and interested in the advancement of Science in India.

1. **वार्षिक सदस्य** : जो व्यक्ति नये रूप से वार्षिक सदस्यता ग्रहण करना चाहता है उसे वार्षिक सदस्यता शुल्क ₹ 200/- के साथ भर्ती शुल्क ₹ 50/-* (विदेशियों के लिए** U.S. \$ 70) मात्र देने पड़ेंगे। वार्षिक सदस्यता शुल्क प्रत्येक वर्ष के 01 अप्रैल को देय हो जाएगा। जो भी 15 जुलाई के भीतर अपनी सदस्यता शुल्क नहीं अदा कर पाएगा वह उस साल के लिए अपनी वोट देने की क्षमता से वंचित हो जाएगा और/या वह उस वर्ष के लिए संस्था के कार्यालय को भी नियंत्रण नहीं कर पाएगा। वार्षिक सदस्य अपनी सदस्यता दोबारा अगले साल 15 जुलाई के भीतर बिना शुल्क दिए पुनः अपनी सदस्यता प्राप्त कर सकता है।

सदस्यगण अपना पेपर कांग्रेस सत्र के समय पेश कर सकते हैं। उन्हें वार्षिक विज्ञान कांग्रेस सत्र की कार्यविवरण की एक प्रति बिना मूल्य में प्राप्त हो सकती है। इसके साथ वे संस्था के रोजनामचा "एवरीमैन्स साइंस" की प्रति भी बिना मूल्य उस साल के लिए प्राप्त कर सकते हैं। सदस्यता के नवीकरण के लिए कृपया ISCA वेबसाइट से फार्म डाउनलोड करें।

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सत्र की कार्यविवरण की एक पूर्ण प्रति बिना मूल्य में प्राप्त हो सकती है। इसके साथ वे संस्था के रोज़नामचा "एवरीमैन्स साइंस" की प्रति भी बिना मूल्य प्राप्त कर सकते हैं।

5. **Institutional Member** : An Institution paying a subscription of ₹ 5,000/- (for foreign** U.S.\$ 2,500) only, can become an Institutional Member of the Association for that financial year. It shall be eligible to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional Member shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress Session as also a copy each of the Associations journal Everymans Science.
6. दाता : कोई भी व्यक्ति जो एक साथ ₹ 10,000/- (विदेशियों के लिए U.S. \$ 5,000) मात्र दें, वह संस्था के दाता बन सकते हैं। एक व्यक्तिगत दाता को वह सारे अधिकार और विशेषाधिकार मिलेंगे जो एक सदस्य को उसके पूर्ण जीवन काल में प्राप्त होते हैं।

एक संस्थान जो एक साथ ₹ 50,000/- (विदेशियों के लिए U.S. \$ 25,000) मात्र दें, सदा के लिए इस संस्था के संस्थान दाता बन सकते हैं, जिसे वह एक व्यक्ति को नामांकित करके उसे अपने संस्थान के प्रतिनिधि के रूप में विज्ञान कांग्रेस के वार्षिक सत्र में भेज सकते हैं। एक संस्थान/व्यक्तिगत दाता वार्षिक विज्ञान कांग्रेस के कार्यविवरण और संस्था के रोज़नामचा "एवरीमैन्स साइंस" की प्रति भी बिना मूल्य प्राप्त कर सकते हैं।

6. **Donor** : Any person paying a lump sum of ₹ 10,000/- (for foreign ** U.S.\$ 5,000) only, can become an Individual Donor of the Association. An **INDIVIDUAL DONOR** shall have all the rights and privileges of a member during his/her lifetime.

An Institution paying a lump of ₹ 50,000/- (for foreign ** U.S.\$ 25,000) only, can become an **INSTITUTIONAL DONOR** of the Association forever, which shall have the right to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional/ Individual Donor shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress Session as also the Associations journal Everymans Science.

* भर्ती शुल्क ₹ 50/- सिर्फ एक नये वार्षिक सदस्य के लिए ज़रूरी है। यह सत्र सदस्य/आजीवन सदस्य/ संस्थान सदस्य/छात्र सदस्य/दाता के लिए ज़रूरी नहीं है।

* Admission fee of ₹ 50/- is needed only for becoming a new Annual Member and not for Sessional Member/Life Member/Institutional Member/Student Member/Donor.

** (एक विदेशी सदस्य का अर्थ है, जो भारतवर्ष के बाहर का नागरिक हों।)

** (A Foreign Member means one who is normally Resident outside India).

(अ) **पेपर पेश करना** : एक पूर्ण पेपर की प्रति उसके साथ तीन सारांश की प्रति जो 100 शब्दों से ज्यादा न हों और जिसमें कोई आरेख या फार्मूला न हों, वह प्रत्येक वर्ष 15 सितम्बर के अंदर अनुभागीय अध्यक्ष तक पहुँच जाना चाहिए।

(A) **Presentation of Papers** : A copy of complete paper accompanied by an abstract in triplicate not exceeding one hundred words and not containing any diagram or formula, must reach the Sectional President latest by September 15, each year.

(ब) सभी वर्गों के सदस्य जो विज्ञान कांग्रेस सत्र में भाग लेने के पश्चात लौटते समय के टिकट में रियायत प्राप्त कर सकता है, बशर्ते कि उनकी यात्रा के खर्च का थोड़ा भी भाग सरकार (केन्द्रीय या राज्य),

कोई कानूनी सत्ता या कोई विश्वविद्यालय या कोई नगरपालिका न उठाएँ और उनकी कुल कमाई या परिलब्धियां ₹ 5,000/- (प्रति माह पाँच हजार रुपए) से अधिक नहीं हैं। कृपया ISCA वेबसाइट से रेलवे रियायत फार्म डाउनलोड करें।

- (B) Members of all categories are entitled to **Railway Concession** of return ticket by the same route with such conditions as may be laid down by the Railway Board for travel to attend the Science Congress Session provided that their travelling expenses are not borne, even partly, by the Government (Central or State), Statutory Authority or an University or a City Corporation and their total earning of or emoluments drawn do not exceed ₹ 5,000/- (Rupees Five Thousand per month). Please download the Railway Concession form from ISCA Website.
- (स) संस्था के पुस्तकालय में सभी वर्गों के सदस्य को पढ़ने की सुविधा सुबह 10.00 बजे से शाम को 5.30 बजे तक सभी काम के दिनों में (शनिवार और रविवार) को छोड़कर प्राप्त होगी।
- (C) Members of all categories are entitled to reading facilities between 10.00 a.m. to 5.30 p.m. on all weekdays (except Saturdays & Sundays) in the library of the Association.
- (ड) समय समय पर संस्था द्वारा तय की गई मूल्य दरों पर विश्रामगृह, सभागार आदि सुविधाओं की प्राप्ति भी सभी वर्गों के सदस्य कर सकते हैं।
- (D) Members of all categories may avail Guest House facilities, Lecture Hall hiring at the rates fixed by the Association from time to time.
- (ई) भविष्य में भारतीय विज्ञान कांग्रेस संस्था द्वारा आयोजित परिसंवाद, सम्मेलन और वार्षिक कांग्रेस में सभी वर्गों के सदस्यों द्वारा भाग लेने के लिए अपनी-अपनी सदस्यता पत्र को लाना ज़रूरी होगा।
- (E) Members of all categories should bring the Membership Card always for attending any Seminar, Conference and Annual Congress organized by ISCA in future.

ध्यान दें : (1) सभी बैंक ड्राफ्ट The Indian Science Congress Association के नाम से ही लिखा जाएँ, और जो कोलकाता के किसी भी शाखा में देय हों। सदस्यों से यह निवेदन किया जा रहा है, कि वे अपनी सदस्यता संख्या का उल्लेख भारतीय विज्ञान कांग्रेस संस्था के कार्यालय के साथ पत्राचार के वक्त अवश्य करें।

(2) भारतीय विज्ञान कांग्रेस संस्था द्वारा मनीऑर्डर, आई. पी. ओ., ई. सी. एस. या चेक से भुगतान ग्रहण नहीं किया जाएगा। कोई भी सदस्यता निर्धारित सदस्यता फार्म (आवेदन-पत्र नई सदस्यता/सदस्यता की नवीकरण के लिए) में विधिवत बिना भरने से नहीं लिया जाएगा।

(3) नकदी केवल ISCA मुख्यालय में हाथ से लिया जाएगा। कृपया डाक द्वारा लिफाफे के भीतर नकदी नहीं भेजें।

Note : (1) All Bank Drafts should be drawn in favour of *The Indian Science Congress Association* Payable at any branch in Kolkata. Members are requested to mention their Membership No. while making any correspondence to ISCA office.

(2) No money order, I.P.O., ECS or cheque will be accepted by ISCA. No Membership will be taken without duly filled in prescribed Membership Form (Application Form for New Membership/ Application for Renewal of Membership).

(3) Cash will only be taken by hand at ISCA Hqrs. Pl. do not send the Cash by Post within the envelope.



भारतीय विज्ञान कांग्रेस संस्था

14, डॉ० बिरेश गुहा स्ट्रीट, कोलकाता - 700 017, भारत

THE INDIAN SCIENCE CONGRESS ASSOCIATION

14, Dr. Biresh Guha Street, Kolkata-700 017, INDIA

दूरभाष/Telephone : (033) 2287-4530, 2281-5323

फैक्स/Fax : 91-33-2287-2551

वेबसाइट/Website : <http://sciencecongress.nic.in>

ई-मेल/E-mail : iscacal@vsnl.net

es.sciencecongress@nic.in

सदस्यता के लिए नया आवेदन पत्र / Application Form For New Membership

सेवा में/To

महासचिव (सदस्यता कार्य)/ The General Secretary (Membership Affairs)

भारतीय विज्ञान कांग्रेस संस्था/The Indian Science Congress Association

14, डॉ० बिरेश गुहा स्ट्रीट/14, Dr. Biresh Guha Street,

कोलकाता - 700 017/Kolkata - 700 017

महोदय/Dear Sir,

स्टैम्प आकार का
फोटो /
Stamp Size
Photograph

मैं भारतीय विज्ञान कांग्रेस संस्था का आजीवन सदस्य/वार्षिक सदस्य/सत्र सदस्य/छात्र सदस्य/संस्थान सदस्य/व्यक्तिगत दाता/संस्थागत दाता अपना नाम लिखवाना चाहता/चाहती हूँ।

I like to be enrolled as a Life Member/Annual Member/Sessional Member/Student Member/Institutional Member/Individual Donor/Institutional Donor of The Indian Science Congress Association. (Pl. Tick)

मैं इसके साथ ----- सदस्यता शुल्क के रूप में नक़द ₹ -----/बैंक ड्राफ्ट संख्या ----- दिनांकित ----- प्रचालक बैंक ----- 01 अप्रैल 20--- से 31 मार्च 20--- तक भेज रहा/रही हूँ।

I am sending herewith an amount of ₹ in payment of my subscription by Cash/Bank Draft No. dated issuing bank from the year 1st April 20 to 31st March 20.

मैं निम्नलिखित विभाग में रुचि रखता/रखती हूँ (कृपया किसी एक में निशान लगाएँ)/ I am interested in the following section (Please tick any one).

विभाग/Sections

1. कृषि और वानिकी विज्ञान/Agriculture and Forestry Sciences
2. पशु, पशुचिकित्सा और मत्स्य विज्ञान/Animal, Veterinary and Fishery Sciences
3. मानवशास्त्रीय और व्यवहारपरक विज्ञान (जिसमें सम्मिलित हैं, पुरातत्व-विज्ञान, मनोविज्ञान, शैक्षिक विज्ञान और सेना विज्ञान)/Anthropological and Behavioural Sciences (including Archaeology, Psychology, Education and Military Sciences)
4. रसायन विज्ञान/Chemical Sciences

5. भू-पद्धति विज्ञान/Earth System Sciences
6. अभियन्ता विज्ञान/Engineering Sciences
7. पर्यावरण विज्ञान/Environmental Sciences
8. सूचना और संचारण विज्ञान और प्रौद्योगिकी (जिसमें कंप्यूटर विज्ञान भी सम्मिलित है)/Information and Communication Science & Technology (including Computer Sciences)
9. भौतिक विज्ञान/Materials Science
10. गणित विज्ञान (जिसमें सांख्यिकीय सम्मिलित है)/Mathematical Sciences (including Statistics)
11. चिकित्सा शास्त्र (जिसमें शरीर विज्ञान भी सम्मिलित है)/Medical Sciences (including Physiology)
12. नया जीवविज्ञान (जिसमें जीव रसायन, जीव भौतिकी और आणविक जीवविज्ञान और जीव-प्रौद्योगिकी भी सम्मिलित है)/New Biology (including Bio-Chemistry, Biophysics & Molecular Biology and Biotechnology)
13. भौतिकीय विज्ञान/Physical Sciences
14. वनस्पति विज्ञान/Plant Sciences

(कृपया टंकित करें या ब्लॉक अक्षरों में भरें/Please type or fill up in Block Letters)

नाम/Name (ब्लॉक अक्षरों में/in Block Letters) :

श्री/सुश्री/श्री/श्रीमती/डॉ॰/प्रो॰/Mr./Ms./Shri/Shrimati/Dr./Prof (कृपया टिक करें)/(Please tick)

कुलनाम/Surname

प्रथम नाम/First Name

मध्य नाम/Middle Name

शैक्षणिक योग्यता/Academic Qualifications :

(अंतिम शैक्षणिक योग्यता प्रमाण-पत्र अंक-सूची का स्वतः सत्यापित जिराक्स प्रति संलग्न करना है / Self attested xerox copy of last educational certificate/marksheet must be attached)

पदनाम/Designation

सम्पर्क का पता/Address of communication :

(राज्य, शहर/नगर और पिन कोड सहित/including state, city/town and pin code)

दूरभाष संख्या/मोबाईल संख्या और ई-मेल/Phone No./Mobile Number & E-mail :

किसी भी सरकारी अनुमोदित पहचान पत्र (अनिवार्य) / Any Govt. approved ID Card (Mandatory) :

स्थायी पता/Permanent Address :

दिनांक/Date :

भवदीय/Yours Faithfully

हस्ताक्षर/Signature

ध्यान दें : (i) सभी बैंक ड्राफ्ट The Indian Science Congress Association के नाम से ही लिखा जाएँ और जो कोलकाता के किसी भी शाखा में देय हों।

- Note :** (i) All Bank Drafts should be drawn in favour of *The Indian Science Congress Association* Payable at any branch in Kolkata.
- (ii) सभी सदस्यता और सदस्यता के नवीकरण के लिए आवेदन-पत्र आवेदकों को अपने खुद के पते उपलब्ध कराके करने चाहिए न कि देखभाल के पते प्रस्तुत करने चाहिए।
- (ii) All Application Forms for Membership and the renewal of Membership must be submitted by providing the address of the applicants themselves only and not any care of address.
- (iii) भर्ती शुल्क ₹ 50/- सिर्फ एक नये वार्षिक सदस्य के लिए ज़रूरी है। यह सदस्य/आजीवन सदस्य/संस्थान सदस्य/छात्र सदस्य/दाता के लिए ज़रूरी नहीं है।
- (iii) Admission fee of ₹ 50/- is needed only for becoming a new Annual Member and not for Sessional Member/Life Member/Institutional Member/Student Member/Donor.
- (iv) सदस्यों से यह निवेदन किया जा रहा है कि वे अपनी सदस्यता संख्या का उल्लेख भारतीय विज्ञान कांग्रेस संस्था के कार्यालय के साथ पत्राचार के समय अवश्य करें।
- (iv) Members are requested to mention their Membership No. while making any correspondence to ISCA office.
- (v) भारतीय विज्ञान कांग्रेस संस्था द्वारा मनीऑर्डर, आई. पी. ओ., ई. सी. एस. या चेक से भुगतान ग्रहण नहीं किया जाएगा।
- (v) No Money order, I.P.O., ECS or Cheque will be accepted by ISCA.
- (vi) कोई भी सदस्यता निर्धारित सदस्यता फार्म (आवेदन-पत्र नई सदस्यता/सदस्यता की नवीकरण के लिए) में विधिवत बिना भरने से नहीं लिया जाएगा।
- (vi) No Membership will be taken without duly filled in prescribed Membership Form (Application Form for New Membership/Application For Renewal of Membership)
- (vii) नकदी केवल ISCA मुख्यालय में हाथ से लिया जाएगा। कृपया डाक द्वारा लिफाफे के भीतर नकदी नहीं भेजें।
- (vii) Cash will only be taken by hand at ISCA Hqrs. Pl. do not send the cash by Post within the envelope.



The Indian Science Congress Association

14, Dr. Biresh Guha Street,
Kolkata- 700 017

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Website : <http://sciencecongress.nic.in>

Fax : 091-33-2287-2551

E-mail : iscacal@vsnl.netes.sciencecongress@nic.inDate : April 2nd, 2018.

REMINDER

TO
ALL ANNUAL MEMBERS (2017-18)**RENEWAL OF ANNUAL MEMBERSHIP SUBSCRIPTION FOR 2018-2019**

Dear Sir / Madam,

1. Kindly fill up the renewal form given on the opposite page and remit ₹ 200/- by Bank Draft on a Kolkata Bank in favour of "The Indian Science Congress Association" to renew your membership for 2018-2019. No Cheque, Postal order or Money order will be accepted by ISCA.
2. For exercising **Voting Right** the enrolment of Annual Membership is required to be made by **July 15, 2018**. Subscription received after July 15, 2018 will be treated as Sessional Member.
3. Last date of receiving **full papers along with 3 copies of Abstracts** for presentation at the **106th Session of Indian Science Congress** to be held from 3-7 January, 2019 is **September 15, 2018**.
4. As per the resolution of the **Executive Committee** in its meeting held on **October 15, 2011**, all Application forms for Membership and the renewal of membership must be submitted by providing the address of the applicants themselves only and not any 'Care of Address'.
5. While sending your subscription, **Please quote your last year (i.e. 2017-2018 only) Annual membership number.**

If your subscription is already remitted, please ignore this letter.

Yours faithfully

Prof. Gangadhar
General Secretary
(Membership Affairs)**N.B.**; Sending of membership subscription without the duly filled in renewal form will not be accepted.



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E-mail : iscacal@vsnl.net

es.sciencecongress@nic.in

Dated : _____

APPLICATION FOR RENEWAL OF ANNUAL MEMBERSHIP SUBSCRIPTION FOR 2018-2019

Annual Membership Number :

(Last Year i.e. 2017-2018 only)

Name:

Middle Name :

Surname :

Affiliation:

Present Address (only for persons changing the address)

*If there is any change in the address as given earlier in your application, please state the original address mentioned previously.

Original Address :

+Enclosed Bank draft No.-----dt.----- of ₹ 200 (two hundred only)

Date:_____

Signature of the Applicant

Contact No:_____

+in favour of "The Indian Science Congress Association" payable at any branch of Bank in Kolkata.