



VIVUS

BUSY IN EXPRESSION | READY FOR TRANSLATION!



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Crosswords, Art and much more!



Editor's note

Dear readers,

We hope this magazine finds you at your best, both physically and mentally. While a lot has happened all around us, here's our humble attempt in this brand-new edition of VIVUS to document the events, lectures and yearly celebrations that have taken place in MSLS in the months of January to March 2021. You will have noticed that we have included a tagline for this edition of magazine. As budding scientists, we are all continuously busy in expression, be it via words in an article or verbal exasperations at machines that are *definitely out to get us*, and often everything gets lost in translation. However, we believe that in the past year, we have done plenty of expression/introspection and are now fired up for our moment of translation! Hence the tagline "Busy in expression, ready for translation".

In this issue of VIVUS, you will find stunning art and photography, thought provoking articles and a super challenging cross word (p. 38). You have been warned!. We begin with an inspiring and humble description on how to be a "Manish" by the world's youngest professor, Prof. Soborno Isaac (p. 18). If lock down has had you cooped up in your rooms plenty, feel free to explore the town with some excellent pointers from the locals (p. 20). Did you have a "eureka" idea just now? Fancy yourself an entrepreneur? Unsure how to get started? Head on to a brief description of the Manipal-Government of Karnataka bioincubator by the founder Dr. Manesh thomas (p. 25) and a testimonial by the alumni Mr. Rudra Nath Gosh, Co-founder and CEO of ReGenco Innovation Pvt. Ltd. (p. 27).

Staying topical, make sure to acquaint yourself of the vaccines currently available in India (p. 28) and alleviate the blues with a fun lock down themed poem (p.32) and perhaps some beautiful Kerala mural paintings (p. 33). In the meantime, you may be considering international conferences or even internships at reputable institutions around the world. Want a sneak peek of the experience? We have got you covered with an article from our own who has completed a joint-PhD program from India (MSLS, MAHE) and Australia (Queensland University of Technology)(p. 30). As all of us acquaint ourselves with the new normal, don't forget to up-skill/educate the right way (p. 35) and keep dreaming and living (p. 36). While you're at it, why not try your hand at a

different lifestyle, of veganism? (p. 37). It is after all, the year of experimentation!

*"Little drops of water,
Little grains of sand,
Make the mighty ocean
And the pleasant land"*
- Julia Carney

We happily present to you Issue 7.2 of VIVUS. This would not have been possible without the contributions, suggestions, time, and efforts of many. We primarily thank our dear Director sir, **Dr. K. Satyamoorthy** for all his enthusiastic ideas and suggestions on the content and design of the magazine. Thank you for your suggestions, sir! We are greatly indebted to our faculty advisors, **Dr T.G. Vasudevan, Dr Vidhu Sankar Babu** and **Dr Saadi Abdul Vahab** for all their helpful suggestions and advice throughout the entire process of bringing this magazine to life. Thank you for your support and time.

We heartfully thank the entire editorial team, especially, **Ms. Anjali Warriar, Ms. Sowmya Prabhu, Mr. Ankit Singh Tanwar, Mr. Pradyumna Jayaram, Mr. Sathvik Upadhy**a and friends, **Mrs. Debyani Samantray, Ms. Harsha Chandrashekhar** and **Ms. Sushmitha Srinivasan**, for all their support in collation, organization and editing of written content for "Events" and "Worldwide Science" sections. We are immensely grateful for your time and diligence. **Huge shoutout to all the authors, artists, designers, and photographers** for their valuable contributions that forms the "Vivus" of the magazine. Thank you for your creativity and effort! We also extend our thanks to all the faculty, research scholars, students, and everyone for their words of encouragement and motivation "*Is it ready yet?*" x100 :D

Thank you all, we sincerely hope you like what you see.

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MAHE, Manipal

VIVUS

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EVENTS

A lot has happened!

SERIES ON ADVANCED COMPUTER-AIDED DRUG/BIOLOGICS DESIGN

04.01.2021 - 08.01.2021

Manipal School of Life Sciences and Schrödinger co-organized a short virtual online series on “Advanced Computer-Aided Drug/Biologics Design.” Computer-Aided Drug Design (CADD) is a vital component of modern drug discovery programs that utilize computational approaches to identify, develop and optimize bioactive compounds for the development of drugs. This webinar series on CADD was conceived with the intention of engaging researchers harboring the desire to understand the use of computational molecular modeling in the context of rational and robust drug design. The participants were taught the background and the applications of molecular simulations through Schrodinger’s state-of-the-art Small Molecular Drug Discovery (SMDD) Suite. The training course was split into five different sessions and each session comprised of a 60-minute detailed presentation followed by a demonstration of model design, simulation, analysis, and prediction. All modules ended with a Q&A session with Schrodinger’s scientists. Participants who completed the course were eligible for further hands-on workshops.

WEBINAR ON "PLANT- ENVIRONMENT INTERACTIONS AND SUSTAINABLE PRODUCTION"

10.01.2021

The Department of Plant Sciences, MSLS, MAHE, Manipal conducted a webinar titled “Plant-environmental interactions and sustainable productions” to shed light on the intricate network of communication between plants and their abiotic factors and the development of sustainable productivity.

The webinar contained nine fascinating lectures and presentations by distinguished speakers. Dr. K Satyamoorthy (Director & Professor, Department of Cell and Molecular Biology, Manipal School of Life Sciences, MAHE) set the ball rolling with his preamble address. The first talk was delivered by Dr. Sindhuja Sankaran (Associate Professor, Department of Biological Systems Engineering, Washington State University, Pullman, USA) on the topic “Phenomics using advanced sensing techniques in support of crop breeding programs”. She emphasized the integration of phenomics in crop improvement and sustainable agriculture and shared details about the ongoing projects in remote crop monitoring sensors, drone imaging, and post-harvest assessment and data analytics. Next in the stellar line-up was Dr. Ramesh Bhat (Professor and Head, Department of Biotechnology, College of Agriculture, University of Agricultural Sciences, Dharwad), who spoke on “Genomics-assisted breeding for foliar disease resistance and high oleic acid content on groundnut”. He elucidated the utilization of genetic backcrossing to induce high oleate biosynthesis and disease resistance in groundnut. He enumerated the advantages of the genomic selection approach of groundnut breeding over conventional breeding.

Dr. Vinita Gowda (Assistant Professor, Department of Biological Sciences, Indian Institute of Science Education and Research, Bhopal) spoke on “Building a sustainable ecosystem by understanding the role of plants, pollinators, and the climate”. She elaborated on the intricate

temporal pattern in flowering phenotypes and plant pollinators in Khaas plateau, North Western Ghats, Maharashtra. She presented a detailed account of phenology sampling methods and the census of her study. The next talk was by Dr. Subhadeep Chatterjee (Scientist VI, Centre for DNA Fingerprinting and Diagnostics, Hyderabad) on “Coordination of social behavior in bacteria: How social are bacteria?”. He emphasized the importance of communication among all living organisms and the evolution of such languages. He presented his study on the system of communication in *Xanthomonas* bacteria and the utility of genetically modified bacteria in plant protection. Dr. Rakhi Chaturvedi (Professor, Department of Biosciences and Bioengineering, Indian Institute of Guwahati) presented her work on “In vitro plant tissue culture techniques and bioresource conservation”.

She elaborated the method of plant tissue culture and its advantages, including but not limited to quantitative, qualitative improvement, secondary metabolite production, and conservation of rare plants. Dr. P. Venkatachalam (Professor and Head, Department of Biotechnology, Periyar University, Salem) spoke on the topic “Expression analysis of Pi responsive genes in Gulf ryegrass (*Lolium multiflorum* L.) and common bean (*Phaseolus vulgaris* L.)”. He presented a comprehensive talk on molecular cloning and characterization of phosphate (Pi) responsive genes Common beans and Gulf ryegrass.

The next speaker was Dr. Anna-Maria Botha Oberholster (Professor, Department of Genetics, University of Stellenbosch, Stellenbosch, South Africa). Presenting the topic “Differential expression analysis of *Withania somnifera* in response to salinity stress”, she highlighted salt stress-induced gene expression through RNA sequencing and delineated two different pathways involved in the biosynthesis of withanolides. The penultimate talk on “Cape medicinal flora: genomics-to-metabolomics signatures” was presented by Dr. Nox P. Makunga (Associate Professor, Department of Botany and Zoology, University of Stellenbosch, South Africa). She educated the audience about South African biodiversity and elaborated on using different omics tools to build a new information-linked genomic-to-metabolomics control of plant response using species unique to the Cape floral region.

The final presentation was delivered by Dr. Prakash Kumar (Professor, Department of Biological Science, National University of Singapore, Singapore) on the topic “Can salinity tolerance mechanism of mangrove trees be transferred to crop plants?”. He highlighted the adaptation of mangroves to the saline environment through processes such as ultrafiltration and water reabsorption. He chronicled the characterization of genetic biomarkers for salinity stress and the utilization of expression analysis markers to imbue rice with salt stress resistance. The webinar ended with concluding remarks from Dr. A. Muthusamy, Dr. Vidhu Sankar Babu, and Mr. Bhaskar Ballal, and a vote of thanks proposed by Ms. Aswathi Nair (Ph.D. Scholar, Department of Ageing Research, MSLS, MAHE.)



PHOTOGRAPHY BY
APOORVA JNANA

12.01.2021

NATIONAL YOUTH DAY

In commemoration of National Youth Day, on January 12, 2021, Manipal School of Life Sciences, MAHE, Manipal, invited Dr. Nandan Prabhu, (Associate Professor, Manipal Institute of Management, MAHE, Manipal) to deliver a virtual talk titled "Synthesis and Equilibrium: The Essence of Swami Vivekananda". The talk was attended by all faculty members, research scholars, and students of MSLS.

Dr. Prabhu espoused the ideologies of Swami Vivekananda and the incorporation of Vedic philosophies in science. During his lecture, he briefly summarized Swami Vivekananda's outlook on Science and Spirituality, outlined the importance of Ayurveda, and emphasized the application of Vedanta philosophy to alleviate human suffering. The session ended with an invitation to deliver more such erudite lectures to Dr Prabhu by Prof. K Satyamoorthy (Director, MSLS). Mr. Jackson Rodrigues, (Ph.D. Scholar, Department of Biophysics, MSLS) moderated the session and proposed the vote of thanks.

19.02.2021

WEBINAR ON HPTLC : TECHNIQUES AND APPLICATIONS



The webinar held on January 19, 2021 was led by Ms. Sneha Singh, Application Specialist, Anchrom Enterprises (I) Pvt. Ltd. She gave a succinct overview of chromatography, its types, and applications and dived right into the main topic – High-performance Thin Layer Chromatography. After acquainting the audience with the theoretical aspects of HPTLC, she performed a live demonstration of the technique. The webinar ended with a spirited question-and-answer session.

NATIONAL SCIENCE DAY

28.02.2021

February 28 is celebrated as National Science Day throughout India with the sole purpose of advocating the importance of science and its application in all aspects of human life. For the past 20 years, Manipal Academy of Higher Education (MAHE), Manipal, has meticulously organized National Science Day to enthrall and nurture young minds. In the months preceding National Science Day, various activities such as model building, drawing, and elocution competitions in the defined thematic areas are conducted for high school and primary school children in the region. In addition, MAHE also organizes residential hands-on training at the Manipal School of Life Sciences (MSLS) for bright, interested students.

MAHE hosted the Science Day celebrations on February 28, 2021 at Manipal School of Life Sciences, MAHE, Manipal, and ensured COVID appropriate guidelines were put in place. Dr. Narayana Sabhahit (Registrar of MAHE) welcomed the gathering. In his introductory message to the participating students, Chief Guest Lt Gen (Dr) MD Venkatesh, Vice-Chancellor of MAHE, chronicled the contributions of Sir CV Raman to the advancement of the scientific landscape in India and urged the students to follow the path forged by him. The presidential address was delivered by Dr. HS Ballal, Pro-Chancellor of MAHE. He highlighted the higher education opportunities provided to schoolchildren in the internationally acclaimed MAHE campus. He emphasized the importance of emulating role models who strived for the welfare of society. Dr. HS Ballal, Lt Gen (Dr) MD Venkatesh; Dr. Narayana Sabhahit, and Dr. K. Satyamoorthy, Director, MSLS, awarded winners of various competitions. Dr. KP Guruprasad, (Associate Director-Research, MSLS), proposed the vote of thanks.



PROF. J. V. BHAT MEMORIAL ORATION

03.03.2021



Dr. Kishore M Paknikar (former Director, Agharkar Research Institute, Pune) delivered the 15th Annual MAHE-Prof. JV Bhat Memorial Oration at Manipal on March 3, 2021 in the presence of Dr MS Valiathan (National Research Professor and former Vice-Chancellor, MAHE, Manipal) and Dr K Satyamoorthy (Director, Manipal School of Life Sciences (MSLS), MAHE). The annual event is held to commemorate the birthday of eminent microbiologist and researcher, Prof. JV Bhat, by selecting a renowned microbiologist for the oration award. This event of MSLS was initiated by Dr PM Gopinath (former Senior Scientist, MSLS) and Dr K Satyamoorthy, supported by an endowment and the university.

Delivering his oration to a captive live and virtual audience, Dr Paknikar gave a narrative of his varied research work of the three decades, involving microorganisms and a peek into their fascinating array of applications. He provided overview of metal resources on earth and mining them using microorganisms and application. He provided several examples as evidences of their remarkable versatility of specific microorganisms ranging from leaching toxic minerals such as arsenic and chromium to being potential synthesizers of nanomaterials that have applications in biomedicine, agriculture, environment etc. He explained his interest in scientific research that actually contributes to solving problems faced in real-life scenarios such as heavy metal poisoning, biomineral leaching, cancer therapy among others. His oration also highlighted the importance of multi-disciplinary scientific research to help solve societal issues. He expressed his gratitude to be a recipient of the award in the name of Prof. JV Bhat, whom he acknowledged as the father of microbiology in the country.

Dr MS Valiathan, in his presidential address, remarked on the contributions of Prof. JV Bhat and appreciated his pioneering achievements. He commented that coming close on the heels of the National Science Day celebrations, the annual oration is also a celebration of science, as much a celebration of a renowned scientist.

Dr. TS Murali (Associate Professor, MSLS) welcomed the audience and gave a brief description of the genesis of the Prof. JV Bhat Memorial Oration. Dr. KP Guruprasad (Associate Director-Research, MSLS) proposed the vote of thanks.

WORLDWIDE SCIENCE

ALUMNI ENGAGEMENT



Dr. Dayupathi Eranda Nipunika Mandawala

BSc BT 2006-2009

Dr. Mandawala, Senior Lecturer, Faculty of Science, Horizon University, Srilanka, delivered a lecture titled "**Journey after Manipal**" on **30 January 2021**. He spoke about his academic journey spanning three countries and two continents, over 12 years. He narrated his experience as an undergraduate in Manipal and as a postgraduate at Swinburne University of Technology, Australia. He worked at Aisiri-Medical laboratory as a medical laboratory technologist in 2010 and later as a scientist-in-charge in 2015. He described the work culture at Aisiri and outlined the laboratory's achievements. He concluded the talk by educating the audience about the student research programs offered at Horizon University.

Dr. Pooja Jha

MSc MBHG 2005-2008

Dr Pooja Jha, Editor-in-chief at The Lancet Regional Health Europe, Munich, Germany delivered a riveting lecture on the topic, "**Editorial and publishing with The Lancet family of journals**" on **26 February 2021**. Dr. Jha spoke about the journal's scope and reach, which boasts a systematic interaction with the global research community. She walked the audience through the editing process, from manuscript handling and peer-reviewing to the commission review. She concluded the talk by discussing the journal's mission to raise awareness and spark debate on significant public health concerns.



Dr. Aishwarya Gurumurthy

BSc BT 2006-2009 and MSc-MBT 2009-2011

Dr Gurumurthy, Postdoctoral fellow, Ryan Lab, Department of Pathology, University of Michigan, USA, delivered a lecture titled "**The Role of Enhancer RNA and Integrator in Locus Control Region (LCR) Mediated Regulation of Beta Globin Gene Expression**" on **27 March 2021**. LCR, a super-enhancer, recruits RNA polymerase II and aids in the transcription initiation of enhancer RNA. In her talk, Dr. Gurumurthy unravelled the complex nature of this interplay and delineated its role in the developmental regulation of mammalian β -type globin gene expression in erythroid cells.

Dr. Radhakrishnan Nair

Director, Open Innovation, Procter & Gamble, Japan

Dr. Nair delivered a talk titled **“What Nuclear Technology has to Do with Diapers? Open Innovation @ Procter & Gamble”** on 7 January 2021. His insightful talk touched upon how Procter & Gamble (P&G) leveraged Open Innovation with academia and external innovators to solve complex problems of developing simple products used in daily life. He also illustrated P&G’s open innovation in 2000 with their Connect and Develop (C&D) strategy. The talk gave a snapshot of Open Innovation and its significance to the current global scenario.



DAILAB - CAFE SERIES

DAILAB - CAFE (DBT-AIST International Laboratory for Advanced Biomedicine, Classroom for Advanced and Frontier Education) is held once in 6 weeks with an aim of providing a Café-like environment for study and learning. Frontier topics are selected for CAFE talks that are presented by eminent scientists and are communicated to all the overseas participating institutions via Skype/Zoom. Participating institutions include AIST (Tsukuba, Japan), MSLS (Manipal, India), IIT (Delhi, India), Hanyang University (South Korea), Peking Medical University (China) and Brawijaya University (Indonesia).

Dr. Mahesh K. Kaushik

International Institute for Integrative Sleep Medicine, University of Tsukuba, Tsukuba, Japan

Dr. Kaushik gave a lecture titled **“Role of orexins/hypocretins in sleep/wake regulation and narcolepsy”** on 14 January 2021. He delved into the requisite functional interactions of orexin neurons with hypothalamic feeding pathways and monoaminergic/cholinergic centers. He also illustrated how orexin neurons function as a critical link between peripheral energy balance and the central mechanisms that coordinate sleep/wakefulness motivated behavior such as food-seeking.



DAILAB - CAFE SERIES

28.01.2021

Dr. D. Sakthi Kumar

Professor and Deputy Director, Bio-Nano Electronics Res. Center, Tokyo University, Japan



Dr. Kumar delivered a lecture on “**Application of theranostic materials against cancer.**” He spoke about the advent of nanotechnology and its subsequent utilization in drug delivery against cancer and highlighted its virtues, such as precision and safety. He also discussed the potential of nanotechnology in Theranostics (Therapy + Diagnosis) and the development of various theranostic materials.

16.02.2021

Dr. Manish Biyani

Professor (Res.), JAIST & President, BioSeeds Corp., Japan



Dr. Biyani delivered a talk titled “**Battling pandemic by changing direction for virus test using deep but robust technologies.**”

19.02.2021

Dr. Santosh Kumar Gothwal

Postdoctoral Fellow, Department of Respiratory Medicine, Kyoto University Hospital, Kyoto University, Japan



Dr. Gothwal delivered a lecture titled “**SARS-CoV-2 and Human body: perspectives from its Genetics, Diagnostics to Therapeutics.**”

05.03.2021

Dr. Hemanth Noothalapati

Assistant Professor, Faculty of Life & Environmental Science, Shimane University, Japan



Dr. Noothalapati gave a lecture titled “**Biological and medical applications of Raman microspectroscopy.**” He described Raman microspectroscopy, a non-destructive, highly sensitive technique, and highlighted its manifold applications in studying metabolic pathways, label-free imaging, and as a cytological tool to improve histopathological diagnosis.

12.03.2021

Dr. Mahendra Kumar Pal

Associate Research Fellow, Earthquake Disaster Mitigation Research Division, National Research Institute for Earth Science and Disaster Resilience, Japan



Dr. Pal delivered a talk titled “**Understanding the seismic resilience of building and civil structures using high-performance computing.**”

26.03.2021

Dr. Shreya Thusoo

Postdoctoral Fellow, Institute of Innovative Research, Tokyo Institute of Technology, Japan



Dr. Thusoo gave a lecture on “**Earthquake-resilient precast piles in Japan**”. The talk focused on the exponential rise in steel-encased precast concrete (SC) piles to construct earthquake-resilient foundation systems for Japan and Southeast Asia buildings. She revealed that this rise could be due to the increased ductility and resistance against large bending moments and axial forces offered by steel-encased precast piles, which render them superior to other concrete piles.

GUEST LECTURES



Dr. Shivananda Bhat K

ASSOCIATE PROFESSOR AND COORDINATOR -
DEPARTMENT OF LIBRARY & INFORMATION SCIENCE,
CHIEF LIBRARIAN - KMC HEALTH SCIENCES LIBRARY,
MAHE, MANIPAL

Dr Bhat conducted [an online session on the utilization of online library resources](#) on 22 February 2021. This informative session focused on aiding students to navigate the labyrinthian open access resources. He educated the audience about the Single Window Search, a web-scale discovery tool with integrated library subscribed content, library catalogs, digital repositories, open-access resources, and a streamlined retrieval interface.



MANDALA ART BY
REKHA KN



RESEARCH HIGHLIGHTS

01/01/21

MOLECULAR LANDSCAPE OF RECURRENT CERVICAL CANCER

DIVYA ADIGA, SANGAVI ESWARAN, DEEKSHA PANDEY, KRISHNA SHARAN, SHAMA PRASADA KABEKKODU, 2021, **CRITICAL REVIEWS IN ONCOLOGY/HEMATOLOGY**

Cervical cancer (CC) is a major gynecological problem in developing and underdeveloped countries. Despite the significant advancement in early detection and treatment modalities, several patients recur. Moreover, the molecular mechanisms responsible for CC recurrence remain obscure. The patients with CC recurrence often show poor prognosis and significantly high mortality rates. The clinical management of recurrent CC depends on treatment history, site, and extent of the recurrence. Owing to poor prognosis and limited treatment options, recurrent CC often presents a challenge to the clinicians. Several in vitro, in vivo, and patient studies have led to the identification of the critical molecular changes responsible for CC recurrence. Both aberrant genetic and epigenetic modifications leading to altered cell signaling pathways have been reported to impact CC recurrence. Researchers are currently trying to dissect the molecular pathways in CC and translate these findings for better management of disease. This article attempts to review the existing knowledge of disease relapse, accompanying challenges, and associated molecular players in CC.

01/01/21

SMALL NUCLEOLAR RNA AND ITS POTENTIAL ROLE IN BREAST CANCER - A COMPREHENSIVE REVIEW

VENZIL LAVIE DSOUZA, DIVYA ADIGA, S SRIHARIKRISHNAA, PADMANABAN S SURESH, ANIRUDDHA CHATTERJEE, SHAMA PRASADA KABEKKODU, 2021, **BIOCHIMICA ET BIOPHYSICA ACTA (BBA) - REVIEWS ON CANCER**

Small Nucleolar RNAs (snoRNAs) are known for their canonical functions, including ribosome biogenesis and RNA modification. snoRNAs act as endogenous sponges that regulate miRNA expression. Thus, precise snoRNA expression is critical for fine-tuning miRNA expression. snoRNAs processed into miRNA-like sequences play a crucial role in regulating the expression of protein-coding genes similar to that of miRNAs. Recent studies have linked snoRNA deregulation to breast cancer (BC). Inappropriate snoRNA expression contributes to BC pathology by facilitating breast cells to acquire cancer hallmarks. Since snoRNAs show significant differential expression in normal and cancer conditions, measuring snoRNA levels could be useful for BC prognosis and diagnosis. The present article provides a comprehensive overview of the role of snoRNAs in breast cancer pathology. More specifically, we have discussed the regulation, biological function, signaling pathways, and clinical utility of abnormally expressed snoRNAs in BC. Besides, we have also discussed the role of snoRNA host genes in breast tumorigenesis and emerging and future research directions in the field of snoRNA and cancer.

03/01/21

MANGIFERIN, A NATURALLY OCCURRING POLYPHENOL, MITIGATES OXIDATIVE STRESS INDUCED PREMATURE SENEESCENCE IN HUMAN DERMAL FIBROBLAST CELLS

RASHI KANOI, POOJA LOACHAN, SHUBHANKAR DAS & BOLA SADASHIVA SATISH RAO, 2021, **MOLECULAR BIOLOGY REPORTS**

Chronic oxidative stress has been associated with several human ailments including the condition of aging. Extensive studies have shown the causal relationship between oxidative stress, aging, and cellular senescence. In this regard, forestalling or preventing senescence could delay the aging process as well as act as an intervention against premature aging. Hence, in the present study, we investigated the anti-senescence potential of Mangiferin (MGN) against Hydrogen peroxide (H₂O₂) induced premature senescence using human dermal fibroblast cells. Early passage human dermal fibroblasts cells were exposed to H₂O₂ (10 μM) for 15 days. In order to assess the anti-senescence property of MGN, cells were preconditioned with MGN (10 μM / 50 μM; 2 h) followed by addition of H₂O₂ (10 μM). H₂O₂ mediated induction of premature senescence was accompanied by elevated ROS, lowering of mitochondrial mass and membrane potential, changes in ATP content along with G₀/G₁ arrest and SA-β-gal expression. While, conditioning the cells with MGN lowered oxidative burden, stabilized mitochondrial membrane potential / mass and protected the cells against cell cycle arrest, ultimately rendering protection against premature senescence. The present findings showed that MGN might act as a potential cytoprotective nutraceutical that can prolong the onset of chronic oxidative stress mediated premature senescence.

RESEARCH HIGHLIGHTS

10/01/21

BIOMIMETIC NANOARCHITECTURING: A DISGUISED ATTACK ON CANCER CELLS

ADRIJA JHA, AJINKYA NITIN NIKAM, SANJAY KULKARNI, SADHANA P MUTALIK, ABHIJEET PANDEY, MANASA HEGDE, BOLA SADASHIVA SATISH RAO, SRINIVAS MUTALIK, 2021, **THE JOURNAL OF CONTROLLED RELEASE**

With the changing face of healthcare, there is a demand for drug delivery systems that have increased efficacy and biocompatibility. Nanotechnology derived drug carrier systems were found to be ideal candidates to meet these demands. Among the vast number of nanosized delivery systems, biomimetic nanoparticles have been researched at length. These nanoparticles mimic cellular functions and are highly biocompatible. They are also able to avoid clearance by the reticuloendothelial system which increases the time spent by them in the systemic circulation. Additionally, their low immunogenicity and targeting ability increase their significance as drug carriers. Based on their core material we have summarized them as biomimetic inorganic nanoparticles, biomimetic polymeric nanoparticles, and biomimetic lipid nanoparticles. The core then may be coated using membranes derived from erythrocytes, cancer cells, leukocytes, stem cells, and other membranes to endow them with biomimetic properties. They can be used for personalized therapy and diagnosis of a large number of diseases, primarily cancer. This review summarizes the various therapeutic approaches using biomimetic nanoparticles along with their applications in the field of cancer imaging, nucleic acid therapy and theranostic properties. A brief overview about toxicity concerns related to these nanoconstructs has been added to provide knowledge about biocompatibility of such nanoparticles.

25/01/21

ELUCIDATING METHODS FOR ISOLATION AND QUANTIFICATION OF EXOSOMES: A REVIEW

TALITHA KEREN KURIAN, SOUMYABRATA BANIK, DHARSHINI GOPAL, SHWETA CHAKRABARTI & NIRMAL MAZUMDER, 2021, **MOLECULAR BIOTECHNOLOGY**

Exosomes are the smallest extracellular vesicles present in most of the biological fluids. They are found to play an important role in cell signaling, immune response, tumor metastasis, etc. Studies have shown that these vesicles also have diagnostic and therapeutic roles for which their accurate detection and quantification is essential. Due to the complexity in size and structure of exosomes, even the gold standard methods face challenges. This comprehensive review discusses the various standard methods such as ultracentrifugation, ultrafiltration, size-exclusion chromatography, precipitation, immunoaffinity, and microfluidic technologies for the isolation of exosomes. The principle of isolation of each method is described, as well as their specific advantages and disadvantages. Quantification of exosomes by nanoparticle tracking analysis, flow cytometry, tunable resistive pulse sensing, electron microscopy, dynamic light scattering, and microfluidic devices are also described, along with the applications of exosomes in various biomedical domains.

27/01/21

CONCEPTUALIZATION OF FUNCTIONAL SINGLE NUCLEOTIDE POLYMORPHISMS OF POLYCYSTIC OVARIAN SYNDROME GENES: AN IN SILICO APPROACH

B. N. PRABHU, S. H. KANCHAMREDDY, A. R. SHARMA, S. K. BHAT, P. V. BHAT, S. P. KABEKKODU, K SATYAMOORTHY & P. S. RAI, 2021, **JOURNAL OF ENDOCRINOLOGICAL INVESTIGATION**

Purpose: Polycystic ovarian syndrome (PCOS) is a multi-faceted endocrinopathy frequently observed in reproductive-aged females, causing infertility. Cumulative evidence revealed that genetic and epigenetic variations, along with environmental factors, were linked with PCOS. Deciphering the molecular pathways of PCOS is quite complicated due to the availability of limited molecular information. Hence, to explore the influence of genetic variations in PCOS, we mapped the GWAS genes and performed a computational analysis to identify the SNPs and their impact on the coding and non-coding sequences.

Methods: The causative genes of PCOS were searched using the GWAS catalog, and pathway analysis was performed using ClueGO. SNPs were extracted using an Ensembl genome browser, and missense variants were shortlisted. Further, the native and mutant forms of the deleterious SNPs were modeled using I-TASSER, Swiss-PdbViewer, and PyMOL. MirSNP, PolymiRTS, miRNASNP3, and SNP2TFBS, SNPInspector databases were used to find SNPs in the miRNA binding site and transcription factor binding site (TFBS), respectively. EnhancerDB and HaploReg were used to characterize enhancer SNPs. Linkage Disequilibrium (LD) analysis was performed using LDlink.

Results: 25 PCOS genes showed interaction with 18 pathways. 7 SNPs were predicted to be deleterious using different pathogenicity predictions. 4 SNPs were found in the miRNA target site, TFBS, and enhancer sites and were in LD with reported PCOS GWAS SNPs.

RESEARCH HIGHLIGHTS

10/02/21

ZNF471 MODULATES EMT AND FUNCTIONS AS METHYLATION REGULATED TUMOR SUPPRESSOR WITH DIAGNOSTIC AND PROGNOSTIC SIGNIFICANCE IN CERVICAL CANCER

SAMATHA BHAT, SHAMA PRASADA KABEKKODU, DIVYA ADIGA, RAYZEL FERNANDES, VAIBHAV SHUKLA, POONAM BHANDARI, DEEKSHA PANDEY, KRISHNA SHARAN & KAPAETTU SATYAMOORTHY, 2021, CELL BIOLOGY AND TOXICOLOGY

Cervical cancer (CC) is a leading cause of cancer-related death among women in developing countries. However, the underlying mechanisms and molecular targets for therapy remain to be fully understood. We investigated the epigenetic regulation, biological functions, and clinical utility of zinc-finger protein 471 (ZNF471) in CC. Analysis of cervical tissues and five independent public datasets of CC showed significant hypermethylation of the ZNF471 gene promoter. In CC cell lines, promoter DNA methylation was inversely correlated with ZNF471 expression. The sensitivity and specificity of the ZNF471 hypermethylation for squamous intraepithelial lesion (SIL) vs tumor and normal vs tumor was above 85% with AUC of 0.937. High methylation and low ZNF471 expression predicted poor overall and recurrence-free survival. We identified -686 to +114 bp as ZNF471 promoter, regulated by methylation using transient transfection and luciferase assays. The promoter CpG site methylation of ZNF471 was significantly different among cancer types and tumor grades. Gal4-based heterologous luciferase reporter gene assays revealed that ZNF471 acts as a transcriptional repressor. The retroviral mediated overexpression of ZNF471 in SiHa and CaSki cells inhibited growth, proliferation, cell migration, invasion; delayed cell cycle progression in vitro by increasing cell doubling time; and reduced tumor growth in vivo in nude mice. ZNF471 overexpression inhibited key members of epithelial-mesenchymal transition (EMT), Wnt, and PI3K-AKT signaling pathways. ZNF471 inhibited EMT by directly targeting vimentin as analyzed by bioinformatic analysis, ChIP-PCR, and western blotting. Thus, ZNF471 CpG specific promoter methylation may determine the prognosis of CC and could function as a potential tumor suppressor by targeting EMT signaling.

15/02/21

RECENT TRENDS IN SMARTPHONE-BASED DETECTION FOR BIOMEDICAL APPLICATIONS: A REVIEW

SOUMYABRATA BANIK, SINDHOORA KANIYALA MELANTHOTA, ARBAAZ, JOEL MARKUS VAZ, VISHAK MADHWARAJ KADAMBALITHAYA, IFTAK HUSSAIN, SIBASISH DUTTA & NIRMAL MAZUMDER, 2021, ANALYTICAL AND BIOANALYTICAL CHEMISTRY

Smartphone-based imaging devices (SIDs) have shown to be versatile and have a wide range of biomedical applications. With the increasing demand for high-quality medical services, technological interventions such as portable devices that can be used in remote and resource-less conditions and have an impact on quantity and quality of care. Additionally, smartphone-based devices have shown their application in the field of teleimaging, food technology, education, etc. Depending on the application and imaging capability required, the optical arrangement of the SID varies which enables them to be used in multiple setups like bright-field, fluorescence, dark-field, and multiple arrays with certain changes in their optics and illumination. This comprehensive review discusses the numerous applications and development of SIDs towards histopathological examination, detection of bacteria and viruses, food technology, and routine diagnosis. Smartphone-based devices are complemented with deep learning methods to further increase the efficiency of the devices.

18/02/21

COMPREHENSIVE ANALYSIS OF REGULATION OF DNA METHYLTRANSFERASE ISOFORMS IN HUMAN BREAST TUMORS

MANGALA HEGDE & MANJUNATH B. JOSHI, 2021, JOURNAL OF CANCER RESEARCH AND CLINICAL ONCOLOGY

Significant reprogramming of epigenome is widely described during pathogenesis of breast cancer. Transformation of normal cell to hyperplastic cell and to neoplastic phenotype is associated with aberrant DNA (de)methylation, which, through promoter and enhancer methylation changes, activates oncogenes and silences tumor suppressor genes in variety of tumors including breast. DNA methylation, one of the major epigenetic mechanisms is catalyzed by evolutionarily conserved isoforms namely, DNMT1, DNMT3A and DNMT3B in humans. Over the years, studies have demonstrated intricate and complex regulation of DNMT isoforms at transcriptional, translational and post-translational levels. The recent findings of allosteric regulation of DNMT isoforms and regulation by other interacting chromatin modifying proteins emphasizes functional integrity and their contribution for the development of breast cancer and progression. DNMT isoforms are regulated by several intrinsic and extrinsic parameters. In the present review, we have extensively performed bioinformatics analysis of expression of DNMT isoforms along with their transcriptional and post-transcriptional regulators such as transcription factors, interacting proteins, hormones, cytokines and dietary elements along with their significance during pathogenesis of breast tumors. Our review manuscript provides a comprehensive understanding of key factors regulating DNMT isoforms in breast tumor pathology and documents unsolved issues.

RESEARCH HIGHLIGHTS

25/02/21

COMORBIDITIES AND INFLAMMATION ASSOCIATED WITH OVARIAN CANCER AND ITS INFLUENCE ON SARS-COV-2 INFECTION

SIMA CHAUDHARI, SATYAJIT DEY PEREIRA, MESHACH ASARE-WAREHENE, RITAM NAHA, SHAMA PRASADA KABEKKODU, BENJAMIN K. TSANG & KAPAETTU SATYAMOORTHY, 2021, **JOURNAL OF OVARIAN RESEARCH**

Abstract

Coronavirus disease 2019 (COVID-19) caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) worldwide is a major public health concern. Cancer patients are considered a vulnerable population to SARS-CoV-2 infection and may develop several COVID-19 symptoms. The heightened immunocompromised state, prolonged chronic pro-inflammatory milieu coupled with comorbid conditions are shared in both disease conditions and may influence patient outcome. Although ovarian cancer (OC) and COVID-19 are diseases of entirely different primary organs, both diseases share similar molecular and cellular characteristics in their microenvironment suggesting a potential cooperativity leading to poor outcome. In COVID-19 related cases, hospitalizations and deaths worldwide are lower in women than in males; however, comorbidities associated with OC may increase the COVID-19 risk in women. The women at the age of 50-60 years are at greater risk of developing OC as well as SARS-CoV-2 infection. Increased levels of gonadotropin and androgen, dysregulated renin-angiotensin-aldosterone system (RAAS), hyper-coagulation and chronic inflammation are common conditions observed among OC and severe cases of COVID-19. The upregulation of common inflammatory cytokines and chemokines such as tumor necrosis factor α (TNF- α), interleukin (IL)-1 β , IL-2, IL-6, IL-10, interferon- γ -inducible protein 10 (IP-10), granulocyte colony-stimulating factor (G-CSF), monocyte chemoattractant protein-1 (MCP-1), macrophage colony-stimulating factor (M-CSF), among others in the sera of COVID-19 and OC subjects suggests potentially similar mechanism(s) involved in the hyper-inflammatory condition observed in both disease states. Thus, it is conceivable that the pathogenesis of OC may significantly contribute to the potential infection by SARS-CoV-2. Our understanding of the influence and mechanisms of SARS-CoV-2 infection on OC is at an early stage and in this article, we review the underlying pathogenesis presented by various comorbidities of OC and correlate their influence on SARS-CoV-2 infection.

01/03/21

INTEGRATED BIOINFORMATIC ANALYSIS OF MIR-15A/16-1 CLUSTER NETWORK IN CERVICAL CANCER

S SRIHARIKRISHNA VAIBHAV SHUKLA G NADEEM KHAN SANGAVI ESWARAN DIVYA ADIGA SHAMA PRASADA KABEKKODU, 2021, **REPRODUCTIVE BIOLOGY**

The miR-15a/16-1 cluster is abnormally expressed in cervical cancer (CC) tissues and plays a vital role in cervical carcinogenesis. We aimed to evaluate the miR-15a/16-1 expression in healthy and cancerous cervical tissues, identify the associated networks, and to test its prognostic significance. miR-15a/16-1-MC expressions were analyzed in TCGA-CESC datasets by UALCAN, GEPIA2, and Datasetviewer. miR-15a/16-1 validated targets were extracted from mirTarBase and in silico functional analysis of the target genes were performed using WebGestalt. The interaction networks were constructed by the miRNet, STRING, and NetworkAnalyst tools. The prognostic significance and metastatic potential of the target genes were predicted using UALCAN and HCMDDB. The FDA approved drugs to target miR-15a/16-1 and target gene network in CC were performed using DGIdb, STITCH and PanDrugs. TCGA-CESC and GEO data analysis suggested significant overexpression of miR-15a/16-1 in CC samples. The Kaplan-Meier survival analysis showed that miR-15a and its four target genes (BCL2, CCNE1, NUP50, and RBPJ) influence the overall survival of CC patients. Among the 66 differentially expressed target genes, 12 of them are linked to head, neck, or lung metastasis. Functional enrichment analysis predicted the association of this cluster with p53 signaling, human papillomavirus infection, PI3-AKT signaling pathway, and pathways in cancer. Drug-gene interaction analysis showed 52 potential FDA approved drugs to interact with the miR-15a/16-1 target genes. Nine of the 52 drugs are currently used as a chemotherapeutic agent for the treatment of CC patients. The present study shows that miR-15a/16-1 expression can be used as a clinical marker and target for therapy in CC.

RESEARCH HIGHLIGHTS

01/03/21

RED LASER-MEDIATED ALTERATIONS IN SEED GERMINATION, GROWTH, PIGMENTS AND WITHANOLIDE CONTENT OF ASHWAGANDHA [WITHANIA SOMNIFERA (L.) DUNAL]

SACHIN ASHOK THORAT POORNIMA POOJARI ARYA KANIYASSERY KODSARA RAMACHANDRA KIRANA KAPAETTU SATYAMOORTHY KRISHNA KISHORE MAHATO ANNAMALAI MUTHUSAMYA, 2021, **JOURNAL OF PHOTOCHEMISTRY AND PHOTOBIOLOGY B: BIOLOGY**

Withania somnifera (L.) Dunal, generally well-known as Ashwagandha, is part of Indian traditional medicinal systems like Ayurveda, Siddha, and Unani for over 3000 years for treating an array of disorders. The chief bioactive component of this plant is the withanolides, a group of C28-steroidal lactone triterpenoids. These compounds are present in very low concentrations and hence cell culture methods have been used to enhance their production. Low-level laser irradiation has been reported to have elicited the seed germination, agronomical characters, biosynthesis of bioactive compounds in some plants. Therefore, the objective of the study was to investigate the effect of red (He-Ne) laser irradiation on seed germination, growth characters, pigment contents and withanolide content in *W. somnifera*. The seeds were inoculated onto two different combinations of Murashige and Skoog (MS) media and incubated for germination. The highest germination percentage was observed in ½ MS with pH 6.5 and GA3 presoaking followed by ½ MS with different pH. Four different doses of Helium-Neon (He-Ne) laser (10, 15, 20 and 25 J/cm²) were used to irradiate the seeds at 632.8 nm and germinated in vitro on ½ MS with pH 6.5. The maximum germination percentage, 63.88% was noted from seeds irradiated with 25 J/cm² (P = 0.04). The highest total length of 13.33 cm was observed in the seedlings irradiated with 25 J/cm² groups (P = 0.008). The highest total chlorophyll content of 329.5 µg/g fresh weight (FW) was observed for seedlings irradiated with 15 J/cm² (P = 0.02) and the highest carotenoid content of 49.6 µg/g FW was observed for 25 J/cm² treated seedlings. Further, primary root length was measured and found to be highest (11.14 cm) in seedlings irradiated with 10 J/cm² and the highest number of lateral roots were observed for 15 and 25 J/cm² groups. The significant amount of Withanolide A (WA) 0.52 µg/g dry weight (DW) and 0.60 µg/g DW was noted in 15 (P = 0.01) and 20 J/cm² (P = 0.002) groups, respectively than control. The present investigation thus reveals the positive impact of red laser on the germination of seeds, growth characters and withanolide contents under in vitro environment.

01/03/21

PHOTODYNAMIC THERAPY TO CONTROL MICROBIAL BIOFILMS

ANJALI WARRIER, NIRMAL MAZUMDER, SUDHARSHAN PRABHU, KAPAETTU SATYAMOORTHY, THOKUR SREEPATHY MURALI, 2020, **PHOTODIAGNOSIS AND PHOTODYNAMIC THERAPY**

Microorganisms thrive in well-organized biofilm ecosystems. Biofilm-associated cells typically show increased resistance to antibiotics and contribute significantly to treatment failure. This has prompted investigations aimed at developing advanced and novel antimicrobial approaches that could effectively overcome the shortcomings associated with conventional antibiotic therapy. Studies are ongoing to develop effective curative strategies ranging from the use of peptides, small molecules, nanoparticles to bacteriophages, sonic waves, and light energy targeting various structural and physiological aspects of biofilms. In photodynamic therapy, a light source of a specific wavelength is used to irradiate non-toxic photosensitizers such as tetrapyrroles, synthetic dyes or, naturally occurring compounds to generate reactive oxygen species that can exert a lethal effect on the microbe especially by disrupting the biofilm. The photosensitizer preferentially binds to and accumulates in the microbial cells without causing any damage to the host tissue. Currently, photodynamic therapy is increasingly being used for the treatment of oral caries and dental plaque, chronic wound infections, infected diabetic foot ulcers, cystic fibrosis, chronic sinusitis, implant device-associated infections, etc. This approach is recognized as safe, as it is non-toxic and minimally invasive, making it a reliable, realistic, and promising therapeutic strategy for reducing the microbial burden and biofilm formation in chronic infections. In this review article, we discuss the current and future potential strategies of utilizing photodynamic therapy to extend our ability to impede and eliminate biofilms in various medical conditions.

05/03/21

A COMPREHENSIVE REVIEW ON THE CARCINOGENIC POTENTIAL OF BISPHENOL A: CLUES AND EVIDENCE

NADEEM GHANI KHAN, JACINTA CORREIA, DIVYA ADIGA, PADMALATHA SATWADI RAI, HERMAN SUNIL DSOUZA, SANJIBAN CHAKRABARTY & SHAMA PRASADA KABEKKODU, 2021, **ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH**

Bisphenol A [BPA; (CH₃)₂C(C₆H₄OH)₂] is a synthetic chemical used as a precursor material for the manufacturing of plastics and resins. It gained attention due to its high chances of human exposure and predisposing individuals at extremely low doses to diseases, including cancer. It enters the human body via oral, inhaled, and dermal routes as leach-out products. BPA may be anticipated as a probable human carcinogen. Studies using in vitro cell lines, rodent models, and epidemiological analysis have convincingly shown the increasing susceptibility to cancer at doses below the oral reference dose set by the Environmental Protection Agency for BPA. Furthermore, BPA exerts its toxicological effects at the genetic and epigenetic levels, influencing various cell signaling pathways. The present review summarizes the available data on BPA and its potential impact on cancer and its clinical outcome.

RESEARCH HIGHLIGHTS

12/03/21

GLOBAL OPEN HEALTH DATA COOPERATIVES CLOUD IN AN ERA OF COVID-19 AND PLANETARY HEALTH

ANKIT SINGH TANWAR, NIKOLAOS EVANGELATOS, JULIEN VENNE, LESLEY ANN OGILVIE, KAPAETTU SATYAMOORTHY, AND ANGELA BRAND, 2021, **OMICS: A JOURNAL OF INTEGRATIVE BIOLOGY**

Big data in both the public domain and the health care industry are growing rapidly, for example, with broad availability of next-generation sequencing and large-scale phenomics datasets on patient-reported outcomes. In parallel, we are witnessing new research approaches that demand sharing of data for the benefit of planetary society. Health data cooperatives (HDCs) is one such approach, where health data are owned and governed collectively by citizens who take part in the HDCs. Data stored in HDCs should remain readily available for translation to public health practice but at the same time, governed in a critically informed manner to ensure data integrity, veracity, and privacy, to name a few pressing concerns. As a solution, we suggest that data generated from high-throughput omics research and phenomics can be stored in an open cloud platform so that researchers around the globe can share health data and work collaboratively. We describe here the Global Open Health Data Cooperatives Cloud (GOHDCC) as a proposed cloud platform-based model for the sharing of health data between different HDCCs around the globe. GOHDCC's main objective is to share health data on a global scale for robust and responsible global science, research, and development. GOHDCC is a citizen-oriented model cooperatively governed by citizens. The model essentially represents a global sharing platform that could benefit all stakeholders along the health care value chain.

16/03/21

MODULATION OF NEUTROPHIL (DYS)FUNCTION BY AYURVEDIC HERBS AND ITS POTENTIAL INFLUENCE ON SARS-COV-2 INFECTION

MANJUNATH B JOSHI, ARCHANA KAMATH, ASWATHY S .NAIR, POOJA YEDEHALI THIMMAPPA, SITARAM J, SRIRANJINI, G.G.GANGADHARAN, KAPAETTU SATYAMOORTHY, 2021, **JOURNAL OF AYURVEDA AND INTEGRATIVE MEDICINE**

For centuries, traditional medicines of Ayurveda have been in use to manage infectious and non-infectious diseases. The key embodiment of traditional medicines is the holistic system of approach in the management of human diseases. SARS-CoV-2 (COVID-19) infection is an ongoing pandemic, which has emerged as the major health threat worldwide and is causing significant stress, morbidity and mortality. Studies from the individuals with SARS-CoV-2 infection have shown significant immune dysregulation and cytokine overproduction. Neutrophilia and neutrophil to lymphocyte ratio has been correlated to poor outcome due to the disease. Neutrophils, component of innate immune system, upon stimulation expel DNA along with histones and granular proteins to form extracellular traps (NETs). Although, these DNA lattices possess beneficial activity in trapping and eliminating pathogens, NETs may also cause adverse effects by inducing immunothrombosis and tissue damage in diseases including Type 2 Diabetes and atherosclerosis. Tissues of SARS-CoV-2 infected subjects showed microthrombi with neutrophil-platelet infiltration and serum showed elevated NETs components, suggesting large involvement and uncontrolled activation of neutrophils leading to pathogenesis and associated organ damage. Hence, traditional Ayurvedic herbs exhibiting anti-inflammatory and antioxidant properties may act in a manner that might prove beneficial in targeting over-functioning of neutrophils and there by promoting normal immune homeostasis. In the present manuscript, we have reviewed and discussed pathological importance of NETs formation in SARS-CoV-2 infections and discuss how various Ayurvedic herbs can be explored to modulate neutrophil function and inhibit NETs formation in the context of a) anti-microbial activity to enhance neutrophil function, b) immunomodulatory effects to maintain neutrophil mediated immune homeostasis and c) to inhibit NETs mediated thrombosis.

19/03/21

CHIA SEED OIL AMELIORATES DOXORUBICIN-INDUCED CARDIOTOXICITY IN FEMALE WISTAR RATS: AN ELECTROCARDIOGRAPHIC, BIOCHEMICAL AND HISTOPATHOLOGICAL APPROACH

AKHERUZ ZAMAN AHMED, KAMALESH D. MUMBREKAR, SHAKTA MANI SATYAM, PRAKASHCHANDRA SHETTY, MELANIE ROSE D'SOUZA & VARUN KUMAR SINGH, 2021, **CARDIOVASCULAR TOXICOLOGY**

Doxorubicin (DOX) is a potent anti-cancer antibiotic that was widely used for treatment of various cancers. It produces free radicals which result in extreme dose-limiting cardiotoxicity. This study investigated the cardioprotective potential of chia seed oil, an active polyphenolic nutraceutical against doxorubicin-induced cardiotoxicity in Wistar rats. Twenty-four female Wistar rats were divided into four groups (n=6) which consist of normal control, DOX control, test-A and test-B group. Animals were prophylactically treated with two different doses of test drug, i.e. chia seed oil 2.5 ml/kg/day and 5 ml/kg/day in test-A and test-B groups orally for 7 days. Doxorubicin (25 mg/kg; single dose) was administered intraperitoneally to DOX control, Test-A and Test-B animals on the seventh day to induce cardiotoxicity. ECG analysis was done before and after treatment. Besides ECG, CK, CK-MB, LDH, AST, MDA and GSH were analyzed. DOX had significantly altered ECG, CK, CK-MB, LDH, AST, MDA and GSH. Pre-treatment with chia seed oil significantly alleviated DOX-induced ECG changes and also guarded against DOX-induced rise of serum CK, CK-MB and AST levels. Chia seed oil alleviated histopathological alteration in DOX-treated rats. It also significantly inhibited DOX-induced GSH depletion and elevation of MDA. The present study revealed that chia seed oil exerts cardioprotection against doxorubicin-induced cardiotoxicity in female Wistar rats. Our study opens the perspective to clinical studies to precisely consider chia seed oil as a potential chemoprotectant nutraceutical in the combination chemotherapy with doxorubicin to limit its cardiotoxicity.

RESEARCH HIGHLIGHTS

19/03/21

CERVICAL CYTOLOGY AND ASSOCIATED FACTORS AMONG TRIBAL WOMEN OF KARNATAKA, INDIA

SUPRITI GHOSH, SANJAY M PATTANSHETTY, SNEHA D MALLYA, DEEKSHA PANDEY, VASUDEVA GUDDATTU, VEENA G KAMATH, SHAMA PRASADA KABEKKODU, KAPAETTU SATYAMOORTHY, RANJITHA S SHETTY, 2021, PLOS ONE

Background: Reproductive well-being is a crucial element of women's health. Due to the asymptomatic nature of gynaecological morbidities, women rarely seek medical advice in the initial period leading to delayed diagnosis and poor prognosis of subsequent disease. The present study aimed to explore the cervical cytology and its associated risk factors among women from tribal communities of the southern part of coastal Karnataka, India. Methods: Papanicolaou (Pap) smear test was performed among 1140 women from three tribal populations, to detect cervical lesions, infections and reactive changes. A semi-structured questionnaire was administered to collect data on socio-demographic and reproductive characteristics of the study population. Results: The most predominant gynaecological complaint among the participants was severe lower back ache (77.6%), followed by white discharge per vagina (29.0%) and menstrual irregularities (25.9%). Of the 1140 women screened, 12.4% showed cervical microbial infections, 23.6% were reported to have reactive changes, and 0.2% had epithelial cell abnormalities in the cervix. Cervical microbial infections were found to be associated with younger age group, low socio-economic status and younger age at sexual debut. Conclusion: Most of the symptoms suggestive of gynaecological morbidities reported in this study are preventable or treatable. Strengthening ongoing cervical cancer screening programme and implementation of health education programmes among tribal population would be the right policy approach to prevent, detect and treat these symptoms at an early stage and to achieve acceptable health outcomes among tribal women.

24/03/21

METASTATIC SUPPRESSION BY DOC2B IS MEDIATED BY INHIBITION OF EPITHELIAL-MESENCHYMAL TRANSITION AND INDUCTION OF SENESCENCE

SAMATHA BHAT, DIVYA ADIGA, VAIBHAV SHUKLA, KANIVE PARASHIVA GURUPRASAD, SHAMA PRASADA KABEKKODU & KAPAETTU SATYAMOORTHY, 2021, CELL BIOLOGY AND TOXICOLOGY

Senescence induction and epithelial-mesenchymal transition (EMT) events are the opposite sides of the spectrum of cancer phenotypes. The key molecules involved in these processes may get influenced or altered by genetic and epigenetic changes during tumor progression. Double C2-like domain beta (DOC2B), an intracellular vesicle trafficking protein of the double C2 protein family, plays a critical role in exocytosis, neurotransmitter release, and intracellular vesicle trafficking. DOC2B is repressed by DNA promoter hypermethylation and functions as a tumor growth regulator in cervical cancer. To date, the molecular mechanisms of DOC2B in cervical cancer progression and metastasis is elusive. Herein, the biological functions and molecular mechanisms regulated by DOC2B and its impact on senescence and EMT are described. DOC2B inhibition promotes proliferation, growth, and migration by relieving G0/G1-S arrest, actin remodeling, and anoikis resistance in Cal27 cells. It enhanced tumor growth and liver metastasis in nude mice with the concomitant increase in metastasis-associated CD55 and CD61 expression. Inhibition of EMT and promotion of senescence by DOC2B is a calcium-dependent process and accompanied by calcium-mediated interaction between DOC2B and CDH1. In addition, we have identified several EMT and senescence regulators as targets of DOC2B. We show that DOC2B may act as a metastatic suppressor by inhibiting EMT through induction of senescence via the DOC2B-calcium-EMT-senescence axis.

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Critical Reviews in Oncology / Hemat

ORIGINAL ARTICLE

Photobiomodulation invigorating collagen deposition, pro cell nuclear antigen and Ki67 expression during dermal w

Doxorubicin-Induced Cardiotoxicity
Electrocardiographic, Biochemical
Approach

Mumbrekar² · Shakta Mani Satyam³ · Prakashchandra Shet
Singh⁴

© 2021 / Published online: 19 March 2021

Kini Rao^{5,6} · Keerth

Identification of Open Health Data Cooperatives Clc
Phenethyl Es
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and Physiolo
Animal Mode
Ankit Singh Tanwar,^{1,2} Nikolaos Evangelatos,²⁻⁴ Julien Venne,^{2,5}
Lesley Ann Ogilvie,⁶ Kapaettu Satyamoorthy,⁷ and Angela Brand^{1,2,8,9}

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ZEN PEN



MANISH

AN ARTICLE BY SOBORNO ISAAC BARI
WORLD'S YOUNGEST PROFESSOR

Soborno Isaac Bari is a 9-year-old Bangladeshi-American child prodigy who is the youngest professor globally. The little professor teaches computer science and physics at the Massachusetts Institute of Technology. At such a young age, he also writes programs and codes for NASA's space station robots. Soborno Isaac aspires to take admission to Harvard by 10 by clearing the Scholastic Assessment Test and compile multiple doctorate degrees at an early age. He has the aim to spread peace and happiness, following which he has written a book entitled 'The love' in 2019 whose second chapter 'Love for mankind' was released in April 2020. He was honored with the Global Child Prodigy award in the year 2020.

(I)

Every birthday, my father would give me an assignment to measure how much progress I make in becoming a manish starting from my second birthday.

It was April 8th, 2014. The eve of my second birthday.

I wanted my second birthday to be more meaningful than my first. Candles and cake were too boring to me. I asked my father if tomorrow, maybe I could actually have a challenge, something I could learn from and something I would like. But there was no response. My father just pointed at the bed, and I slept. I have a vivid memory of what happened next. I woke up to my father calling me from outside, and my father took me to Room Zero at our home. He gave me a book and said:

"Find the name of the book's writer and the name of the book. You have one hour. Start."

I checked the cover, to no avail. I flipped through the pages, looking for a name. The thing was, he had put black paint over where the author's name and the book's name was. I suddenly found something pivotal; a picture. This picture showed me the basics of gravity. First a cannonball is shot from point V to A, then, with slightly larger velocity, it lands on B, and then, with escape velocity, it goes around, its orbit increasing distance, until eventually it orbited around the planet and never came back. This is the perfect velocity to escape, but

gravity pulls on just enough that the cannonball never leaves orbit. But it almost did seem impossible. But now I knew who the author was, because this was questioned by Newton himself. He asked: If an apple falls, does the moon fall? And he said that it does fall, just like the cannonball. So I knew the name of the author. Meanwhile, the clock kept ticking.

"20:38. 20:37. 20:36. 20:35..."
 I obviously didn't have much time, so I thought and thought of the right answer. Ah! The answer must be Cannonball! Why else would there be a picture of a cannon? "1 minute left." the robotic voice uttered in a dreadful fashion. So with 50 seconds left, I wrote on the board:

"The author of the book is Sir Isaac Newton.
 The name is cannonball."

After a few moments, the light turned off... and the door opened. However, a few months later I found out that Cannonball was the wrong answer. Nevertheless, I fell in love with math and physics on that day.

On my third birthday, I was taken to the 9/11 memorial, and was asked to find the significance of the pool and the memorial itself. I first naively thought that this was a decorative pool, like Niagara Falls, and started making a physical comparison, only to see two people crying and placing roses in the pool and then walking past me to a huge crowd. I then realized that this pool was of huge significance. I then spotted the

Freedom Tower. I finally remembered the significance. I did not know of 9/11, but I knew that a building that was tall and made of glass crashed 19 years ago. And I had almost lost my uncle to that incident. That instilled patriotism in my blood.

On my fourth birthday, my father dropped me off in the middle of a crowded mosque in the Bronx and told me to do something of significance. But what could he mean by that? Doing something was much harder than finding something. So I looked around. I rummaged in my punjabi. I started praying to Allah. But everyone was doing that! Not of significance at all. I tried listening to the Imam, who spouted out that America was the number one evil, it hated Islam, all the nonsense. When I found out there was a piece of chalk in my pocket, I started solving mathematics, but then the Imam scolded me. "Chalk is haram in the Mosque," the imam said. "Chalk is not haram," I responded. I launched a campaign named "The Love" and an eponymous book with the same name to protest the behavior of the Imam. That day, I learned how to make change.

On my fifth birthday, I was given the assignment to recite the Quran for 1 hour, and that I had 5 hours. Confusing, but okay. I read the Quran for 1 hour, but the timer said I had about 4 hours left. Excuse me? So, I looked around for other tools to no avail. All of a sudden, I decided to check my father's Amazon account to see the recently purchased book. I managed my mother to give me the password for the Amazon account



and found out that my father brought four books from Amazon on April 2nd: Bible, Torah, Tripitaka and Bhagavad Gita. I found these four books hidden in our basement bookshelves. He never said anything about the other religious books. But swearing that other people's religions are wrong and that we should kill them for that was deeply wrong. So, what I did was I read all the other ones for 4 hours. This was the message my father was trying to tell me. Religious indifference. We should love each other no matter our religion. On that day, I fell in love with all religions including Hinduism, Islam, Buddha, Judaism and Christianity.

On my sixth birthday, I woke up to a quite strange statement. "When do the lives of 15 million people matter more than 2 billion?" What did this mean? Well, it seemed that 15 million was much less than 2 billion. How could they possibly mean more to the world? But then I thought 2 billion was the population of Muslims, while 15 million was the population of Jews. So, was that the message my father was trying to show me? But then, I thought that I needed to get a look at the bigger picture, and not just jump to conclusions by using my father's perspective. So, I went to a mostly Arab-Palestinian neighborhood, Bridgeview, and a mostly Jewish neighborhood, Borough Park. I summarized their conversations and my observations of their perspectives in two sentences: I saw that almost every Palestinian child wanted to join Hamas and "free their nation", and almost every Israeli child wanted to become a scientist. I thought that this should also be what Palestinians children are dreaming.

On my 7th birthday, I was given 4 American flags, and I was asked to go to the two neighborhoods from last year and "do something of significance". So, I did what any person would do. I planted several flags on the lawn of many houses in Bay Ridge, and I planted another flag near a store. I then went to Borough Park to do the same. When I came back 2 days later, I saw all the flags I left in Bay Ridge were removed and I saw flags in Borough Park exactly how

I had left them. On my way back home, I saw what happened to one of the Bay Ridge flags. I was horrified. It was ripped apart by a tire. Why live in a country you hate?

(II)

It was January 6, 2020.

A child was giving a lecture in a packed auditorium at the University of Pune and saw a Hindu Purohit limping to him. The purohit kissed the child's forehead and said, "You are not a child. You are a g.." However, he couldn't finish his sentence, and fell on the ground. The child sat down on the stage. His eyes filled with tears and his voice choked. He gently touched the purohit's feet and said, "You are not a man. You are a Manish." The sound of an ambulance broke the silence. "From today, you're a manish," the purohit said, holding the child's hands before the ambulance carried him to the hospital.

After my meeting with the purohit, my father stopped measuring my progress towards becoming a Manish. But I believe I'm still not a Manish yet.

[Know more about the world's youngest professor \(2021\) at https://bariscienceclub.tech/](https://bariscienceclub.tech/)

Collected by:



Anjali Warriar, PhD Scholar, Department of Biotechnology

FEATURED STORY

TRAVELOGUE

EXPLORE MANIPAL

Scenic spots away from the town: A travel guide

ARTICLE & PHOTOGRAPHS BY:



SATHVIK UPADHYA
PhD Scholar
Department of Cell and
Molecular Biology



PRADYUMNA JAYARAM
PhD Scholar
Department of Cell and
Molecular Biology



ANKIT TANWAR
PhD Scholar
Department of Public Health
Genomics



APOORVA JNANA
PhD Scholar
Department of
Biotechnology

The long drawn-out lock down spent being cooped up at our homes has us craving for a breath of fresh air. While the pandemic is not over, the gradual unlock does allow a little “breather” experience. Avoid crowded hotspots and take cues from this article to explore underrated beauty in and around Manipal worth visiting with minimal calculated risk. Wear your masks, maintain social distance, and let’s go!

Additional photographers:



Nadeem Khan G | PhD Scholar | Department of Cell and Molecular biology



Sushmitha Srinivasan | PhD Scholar | Department of Biophysics



SUVARNA RIVERBANKS

This is the best place to spend a calm evening away from the hustle-bustle of Manipal. The serenity of the site overlooking the backwaters of the Suvarna is the best place to rejuvenate yourself from the hectic 24×7 grind. If you are lucky, you might even get a chance at the 20-30 min canoe ride in the river from the local fishermen for a reasonable price. The ride is mesmerizing as you enjoy the stunning scenery all around. As only a handful of people know this place, it is probably less crowded (in comparison with the rush you often find, irrespective of a pandemic, at Malpe beach) hence, is the best post-pandemic location to visit. Bonus - One can take many photos without others photobombing.

Location: <https://goo.gl/maps/8B7oCuQUWAAh5vKv8>

PADUKERE BEACH

Padukere beach is located in Udupi and is around half an hour's journey from Manipal. The beach is a bit remote making it the perfect beach to visit now since it will be far less crowded than Malpe beach (which is always packed). Padukere beach is the best place to enjoy the weekend evenings with friends, family, and loved ones. On this magical beach, you can enjoy nature's most beautiful artwork, "the sunset," peacefully, making this place heavenly. The scenery and the experience make this beach a must-visit place if you are in Manipal. Bonus: If you ride a further kilometre or two opposite to Padukere beach, you will find Mattu beach, which is just as serene and beautiful as the former.

Location: <https://goo.gl/maps/2gnCoWoQ1yHDbXDRA>

PADUKERE BEACH - PHOTOGRAPHY BY NADEEM KHAN G





ARBI FALLS

Rain is an emotion (the jury's out on whether it is a good/bad/frustrated/romantic one) in Manipal. Manipal rains are not just unpredictable as the weather usually is. No, it has a life of its own, toying playfully with unsuspecting strangers who dare to venture out without a simple umbrella. It would not be surprising if you have experienced heavy rain, bright sunlight and a teasing drizzle, all in the span of those 10 minutes that you might take to walk just under half a kilometre. Suffice to say, the monsoon in Manipal is an entirely different experience. Some magical places come into life especially in monsoon; one is Arbi falls, which is located near Dashrath Nagar at the outskirts of Manipal. Heavy rain leads the water to gush down through the rocks, lead into the forest, and create this beautiful masterpiece. Following a short hike into the woods from the base in Dashrath Nagar, you will find yourself at the foot of the thunderously roaring waterfall. Arbi falls is not your typical huge waterfall though; this one is much smaller and not as high. However, the luscious forest, fresh air, and the waterfall compensate for its height and make this an ideal place to spend your noon. Take a dip, take a selfie, immerse yourself in the beauty!

Location: <https://goo.gl/maps/2gnCoWoQ1yHDbXDRA>

HANGING BRIDGE

As the name suggests, this Thimmanna Kuduru hanging bridge is in a small village named Tonse, Kemmannu. This hanging bridge is famous among Manipal students and is worth a short trip. A twenty-minute journey from Manipal brings you to this beautiful scenic place with a backwaters mood surrounded by numerous coconut palm trees and lush greenery. This bridge connects a small island with the mainland. This place is the perfect place to relax in the evening with friends, as it is not popular among outsiders and thus less crowded. At first look, this place may scare you, as the bridge starts to swing and gives you a feeling of falling into the river, but as (& when) you get to the centre, the fear is replaced by awe of the beautiful scenery.

Location: <https://goo.gl/maps/fg1cZsMW7KvJPXHs5>

HANGING BRIDGE - PHOTOGRAPHY BY NADEEM KHAN G



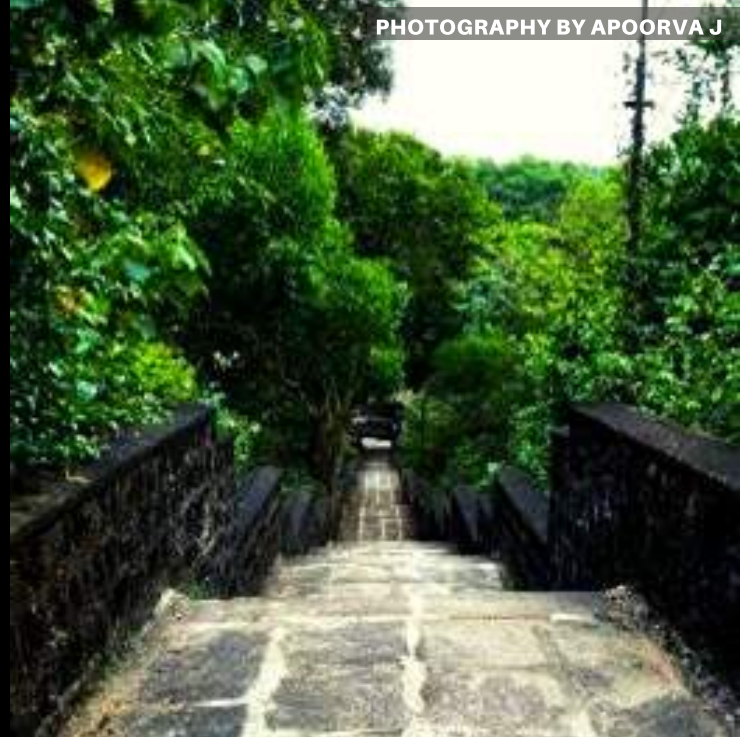


SRI INDRANI PANCHADURGA PARAMESHWARI TEMPLE

We have been to so many temples in our lifetime. It is arguably a very Indian thing to do; to go to temples, bow your head in front of the deity, fold your hands and whisper a little wish and goodwill for our loved ones. When you visit this temple though, you might want to complement this with awe of the incredible beauty that this temple is.

On arriving at the base (say from an auto at Indrali bus stop), one is greeted with steps leading upwards since it is a temple built on a hill. As you climb the stairs, if you look back, you will be greeted with a breathtaking view of Udupi and even catch a glimpse of the shoreline of Malpe beach. Once you reach the top of the stairs, you will find a small doorway that suddenly opens into an incredibly vast space with huge corridors and a calming silence that dissolves you. It could be a little disorienting at first, to have walked in through a plain set of stairs to now enter a vast area with lush greenery and an unassuming, albeit beautiful temple in the centre (Don't nobody tell me, "Arey obviously ya. It is built on a hill no" It's disorienting and fascinating, okay?). On the right, there is a set of stone stairs leading downstairs to a quaint Anjaneya temple with a huge backdrop of giant trees and a lush pond, also called as "Kalyani". The atmosphere here is very serene with an air of meditative silence that is incredibly therapeutic. Perhaps, all temples make you feel this way, but we were truly at a loss for words at the beauty of this gem. Definitely worth a visit!

Location: <https://goo.gl/maps/Hae1LckVe6AyscXU8>



KERE BASADI (VARANGA JAIN TEMPLE)

Varanga, a small village in Karkala, a few hours away from Manipal is home to a 1000 year old Jain temple known locally as Kere Basadi (Lake temple). As the name states, this temple is present at the center of a lake and is surrounded by greenery. During the monsoon, the lake fills up with water. There will be a boat to reach the temple. Among the aquatic plants and the fishes in the lake, nature exists in abundance in this peaceful location. Varanga Jain Temple has a history of over 850 years. The lake, greenery of the forest and everything is serene and resonates with bliss. This is definitely a wonderful monsoon getaway.

Location: <https://goo.gl/maps/VGS9MDSsnoez4Aqs7>

GAALI POINT

Located in a remote area away from Manipal city near the Industrial area (Ananth nagar), Gaali point offers the perfect place for a relaxed evening far from the town. 'Gaali' in Kannada means 'wind', hence the name because it is quite windy up here. It is a must-visit place come spring and rain, where one can catch fresh air, spending time with friends while enjoying the beauty of nature. Bonus: it has one of the best views of the Udupi city.

Location: <https://goo.gl/maps/gdxns8YQrxez71QN9>

While travel to far away lands might still be a long way away, we hope this list keeps your wanderlust sated. Stay safe!

**Sathvik Upadhya,
Pradyumna Jayaram,
Ankit Tanwar,
Apoorva Jnana**



GAALI POINT - PHOTOGRAPHY BY SATHVIK U



THE PILLARS OF ENTREPRENEURSHIP

A CONVERSATION WITH DR. MANESH THOMAS

TRANSCRIBED BY JACKSON RODRIGUES AND APOORVA JNANA

Currently working as Chief Executive Officer of Manipal - Government of Karnataka Bioincubator, at Manipal Academy of Higher Education, Manipal, Karnataka, with support of KITS, Government of Karnataka and Biotechnology Industry Research Assistant Council (BIRAC), Department of Biotechnology, Government of India, by administrating its activities and incubation programs to support Innovation, Technology development, and Entrepreneurship. Current focus is to promote Innovation & Entrepreneurship among the faculty and student innovators of MAHE, Manipal, especially in Bio-Medical sectors, including, Medical, Dental, Healthcare, Diagnosis, Biopharma, Biotechnology, Biomedical Devices and Social Innovations. Before joining MAHE, worked as Head Instrumentation & Project coordinator of Savli Technology & Business Incubator, under Department of Science and Technology, Government of Gujarat, with support of Biotechnology Industry Research Assistant Council (BIRAC), Department of Biotechnology, Government of India, to promote Innovation & Entrepreneurship across the Gujarat state. In addition to that also worked with DGR, (ICAR), Government of India, as Research Fellow.

Biotechnology is a vast field ripe with opportunities to contribute to the national economy. As such it needs innovative minds that have been trained to create jobs rather than merely look for one. In this regard, bioincubators provide such training which will involve the use of government, private or societal platforms to launch innovative ideas into a business opportunity.

Bioincubators are any supporting system that nurture any of the innovations (vital activities). Manipal – Government of Karnataka bioincubator is a joint venture in this aspect between Manipal Academy of Higher Education and Government of Karnataka. It was created with a mission to transform innovative ideas into technology and enterprises. Its main intention is to guide personnel with a naïve idea into a full-fledged business opportunity. The Manipal-GoK bioincubator was established in the year 2019 (January) and has over 30,000 trainees. Additionally, health technology bioincubator supported by NSTEDB (National Science & Technology Entrepreneurship Development Board) supports health, agriculture and IT related startups.

There are a variety of training programs made available by the Manipal – GoK bioincubator. Full time incubation involves extended infrastructure support of individuals wherein a laboratory space is dedicated to individuals for developing their product. Trainees will also be guided to register as independent companies. There are also membership programs designed specially for students and researchers. This involves 3-6 months training of potential entrepreneurs with genuine interest in innovation, even if they do not have an innovative idea to begin with. The training program is designed to equip the future upcoming entrepreneurs with the skills and knowledge to start their own startups.

In the past year, Manipal Universal Technology Business Incubator has supported over 30 startups. The innovative ideas range from development of a 3D printed skin for replacing animal model testing in burn cases to development of technology for mobilization of paralyzed limbs. One of trainees of the incubator team, Amarthya received the NIDHI-EIR fellowship for his idea. NIDHI-EIR

fellowship provides support to first generation innovative entrepreneurs committed to exploring their business ideas at select DST approved technology business incubators such as the Manipal – GoK bioincubator. It provides a subsistence grant of 3.6 lakh per annum to support aspiring entrepreneurs in developing their innovation. Another is Musthafa Ansari who is developing a device for reduction of lipidemia. One of startups spearheaded by Johnson Dsouza has currently reached an evaluation of crores including support from grants such as BIRAC-BIG (Biotechnology Ignition Grant BIG – BIRAC) and other BIRAC grants of 1.3 crore. Hence, several funding opportunities are available for young entrepreneurs to expand their idea and translate it into a burgeoning startup.

Dr Manesh Thomas on innovation

In science, we think that only if we have a breakthrough, we can be an entrepreneur. It is not like that. Discovery or inventions are not the pre-requisite, the key is innovation. The innovation can be in any field, like medical, business, IT, or environmental.

You must have a unique selling point. Know your customers, know who wants your product, know who will value your products.

- Dr. Manesh Thomas



One can find common problems in daily life with people and innovate with those daily life problems. Such innovations do not necessarily need deep scientific knowledge. Don't stick on to the comfort zone, find the problems in the society. Compared to foreign companies we Indians are failing to identify the seemingly mundane but detrimental problems around us. Such innovations have commercial value. The best candle maker in the world can never think of electricity. Change your way of thinking and innovation will follow. And once you have the beginnings of an innovative idea and the commitment to pursue your dream, you can go ahead, and we will support you.

On the leap from research into entrepreneurship

How does one translate the knowledge learnt in schools and colleges into business? After your MSc and BSc, you will get an opportunity for research. This is the academic research. When we get a chance to do research, we have to do applied research. In the process of research, you will sometimes be knowingly or unknowingly generating an intellectual property. It is important to protect this intellectual property if your research involves an innovative product, idea, technology or even an innovative process, make sure to file patent before publishing the research in a journal. Do not disclose anything without disclosure agreements. On the business side of research, one must know the current and future needs of the products.

One must think of patent search and market review. You must think of current and future aspects of our products based on the strong literature survey. For example, if we think of product development for COVID pandemic, we must think of its future and on how long it would last. In translational research one must always look for intellectual properties by constantly checking Google patents for prior art and the process involved for developing a product, or technology, or getting it licensed. If you are interested in getting into entrepreneurship aspects of research, it is best to decide this in the early stages of research and accordingly decide on the direction your research would take.

On the key aspects of a successful product

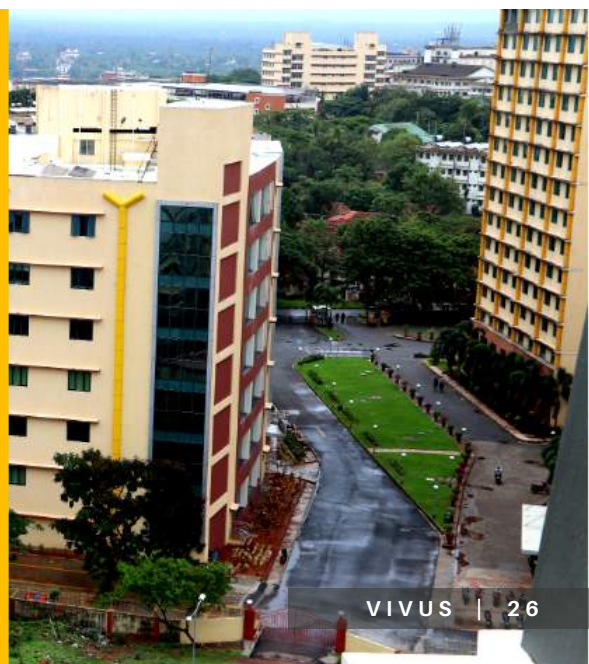
“You must have a unique selling point. Know your customers, know who wants your product, know who will value your products. Also understand your competitors and where is your market. Get familiar in your area or interest and know the products already available in the market for your ideas. A strong market research and having a unique/innovative idea are the key aspects to a successful product.”



Jackson Rodrigues, PhD Scholar, Department of Biophysics



Apoorva Jnana, PhD Scholar, Department of Biotechnology



ENTREPRENEURSHIP: BOON OR BANE?



ARTICLE BY:
**RUDRA NATH
GOSH**

My entrepreneurship journey started while pursuing part of my MSc degree at Grenoble Alpes University, France. During my tenure, I was a part of the European Scientific Institute (ESI), Archamps, where I attended intensive 10-day workshops on developing innovative commercial product ideas. I was fortunate enough to present some of our pioneering ideas to the start-up companies in the healthcare field. I was selected by Biomics (Minatec) for my ideas and was hired to work as an intern with the start-up on 3D bioprinting and tissue engineering models. My role as an intern provided me with exposure to the start-up community and motivated me to begin my entrepreneurship journey.

I came back to my alma mater, Manipal School of Life Sciences in the year 2019. With the help of my professors, I started researching biomaterials and their use in the field of tissue engineering. For any entrepreneur, proper support and guidance are key to push forward towards achieving the goal. The support from Manipal School of Life Sciences, Dr. K. Satyamoorthy (Director, MSLS, MAHE) and my fellow researchers were invaluable to my success. The mentoring support provided by Manipal - Government of Karnataka Bioincubator and Manipal Universal Technology Business Incubator (MUTBI) helped me to secure my first grant titled "NIDHI-Entrepreneur-In-Residence" of rupees 3.6 lakhs funded by The Department of Science & Technology (DST) and The National Science & Technology Entrepreneurship Development Board (NSTEDB) to kickstart my company. During the first year, there were many obstacles with

the Covid-19 pandemic playing a major role. There were several instances where I almost gave up faith in research and my start-up company. However, my friends and family always had faith in me and my goals and were always by my side. Soon, I was fortunate enough to get acquainted with Dr. Joseph Thomas, from KMC Manipal and Dr. Mathew Peter from MIT, Manipal. They made me believe that my ideas and work were worth fighting for.

In November 2020, I, Rudra Nath Ghosh, founded my company "ReGenco Innovation Pvt. Ltd." as Chief Executive Officer with Dr. Joseph Thomas by my side. ReGenco Innovation Pvt. Ltd is currently focused on developing 3D viable tissue products with the help of 3D bioprinting technology. In January 2021, we received the NIDHI-PRAYAS grant funded by Department of Science & Technology (DST) which further added to the progress of the company. My journey as an entrepreneur was full of obstacles in the beginning. There were several rejections and setbacks. However, I learned from the negatives and took home the positives with me. I truly believe that if one relentlessly believe in their ideas and works hard to execute them, success is surely assured.

Rudra Nath Gosh
Co-founder and CEO
Regenco Innovation Private Limited

CANVA.COM



VACCINES IN INDIA: A BRIEF PRIMER

ARTICLE BY:



SWATHI M



KESHAV PRASAD

The COVID-19 pandemic has without doubt challenged the public healthcare systems, upended education systems and forced citizens to re-think what constitutes “normal”. A major factor in overcoming the pandemic and preventing a much feared “third wave” is to ensure maximum vaccination. The vaccines currently available in the market are Covishield, Covaxin and Sputnik V. The current article will be restricted to comparing the two most popular vaccines, Covishield and Covaxin.

COVISHIELD™ is a monovalent vaccine composed of a single recombinant, replication-deficient chimpanzee adenovirus (ChAdOx1) vector encoding the S glycoprotein of SARS-CoV-2. Following administration, the S glycoprotein of SARS-CoV-2 is expressed locally, stimulating neutralizing antibody and cellular immune responses. COVAXIN®, is India's indigenous, inactivated COVID-19 vaccine developed using Whole-Virion Inactivated Vero Cell derived platform technology. Since inactivated vaccines do not multiply, they are unlikely to reverse and produce adverse reactions. They include dead viruses that are unable to infect

humans but can nevertheless train the immune system to create a defensive response in the face of an infection. Covishield uses a viral vector, a technology also used in Ebola vaccine. The coronavirus spike protein gene is introduced to a modified variant of a chimp adenovirus ChAdOx1. It penetrates through cells but does not multiply due to genetic modification. The adenoviruses interact with cells and latch onto proteins on cell surfaces after being injected into a person's arm. The virus is engulfed by the human cells by phagocytosis. The adenovirus injects its DNA into the cell's nucleus. Since adenovirus has been genetically modified, it cannot replicate itself; but the gene for the coronavirus spike protein can be read by the cell and transcribed to mRNA. This will be translated into spike protein. These spike proteins are transported to the cell's surface. The immune system recognises these cell surface spike proteins and raise alarm. B cells encounter coronavirus spike protein on human cell surfaces or free-floating spike protein fragments. Helper T cells activate these B cells, begin to proliferate and produce antibodies against the spike protein.

Features	Covishield	Covaxin
About	Non - replicating viral vector	Inactivated Coronavirus
Scientific name	ChAdOx1-S/nCoV-19 [recombinant] vaccine	BBV152
Developed by	Serum Institute of India	Bharath Biotech
Price	Rs: 700 – 900/-	Rs 1,250-1,500/-
Components of vaccine	Inactivated adenovirus with segments of Coronavirus, Aluminium Hydroxide Gel, L-Histidine, L-Histidine hydrochloride monohydrate, Magnesium chloride hexahydrate, Polysorbate 80, Ethanol, Sucrose, Sodium chloride, and Disodium edetate dihydrate (EDTA).	Inactivated Coronavirus, Aluminium Hydroxide Gel, TLR 7/8 agonist, 2-Phenoxyethanol and Phosphate Buffered Saline [NKA1]
Storage condition	2-8°C	2-8°C
Dosage Schedule	12 – 16 weeks	4 – 6 weeks
Efficacy	81.3% when two doses are given within 12 weeks of each other.	81%
Adverse effects from immunization (AEFIs)	Arthralgia, chills, fatigue, headache, injection site pain, injection site tenderness, myalgia, malaise, nausea and pyrexia, infrequent events of demyelinating disorders (causal relationship not tested)	Abdominal pain, body ache, cold, cough, dizziness-giddiness, fatigue, fever, headache, injection site pain, injection site swelling, nausea, sweating, tremor and vomiting

Covaxin works by instructing the immune system to produce antibodies against the coronavirus SARS-CoV-2. Large batches of viruses are treated with beta-propiolactone (BPL). On interaction with purine residues, BPL changes the structure of nucleic acids causing nicks in DNA, as well as cross-linking between DNA and proteins, and between the DNA strands of the double helix. Thus, inactivated virus could no longer multiply. However, their proteins, including spike, remain unaltered. Inactivated viruses are mixed with a trace amount of an aluminium-based chemical as adjuvant. Adjuvants stimulate the immune system to increase the immune system's reaction to a vaccine. Within the body, some of the inactivated viruses are engulfed by an antigen-presenting cell. The antigen-presenting cell digests the virus and presents fragments on its surface. This triggers helper T cells to activate immune response.

Each vaccine has its own set of advantages and disadvantages. However, irrespective of which one you fancy, please make sure to get yourself and all your loved ones vaccinated as soon as possible.

Swathi M

Research Assistant, Department of Ageing Research

Keshav Prasad

PhD Scholar, Department of Cell and Molecular Biology



**MANDALA ART BY
REKHA KN**



MY JOINT-PhD EXPERIENCE: THE BEST OF BOTH WORLDS!



ARTICLE AND
PHOTOGRAPHY BY
MELISA J ANDRADE

Being passionate about cell biology since my undergraduate studies, I was thrilled with the prospect of working on skin tissue engineering during my PhD in two different labs, in India and Australia. This dream was made possible by my wonderful supervisors at MSLS, MAHE and Queensland University of Technology (QUT), through a Joint PhD program. I am sure you must be wondering... what exactly is a Joint PhD? Well, when the doctoral research is jointly conducted between two different universities on a shared topic of interest, under the supervision of experts in the field affiliated to these universities, spending half of the tenure at each of these institutes and upon fulfilling the PhD requirements of both the universities, after a final PhD defense consisting of a combined set of panel members, a joint-degree is issued.

In this Joint-PhD program, the integration of the different PhD systems of both the universities came with lots of learning experiences, double the milestones, tight deadlines, opportunity to work in interdisciplinary research labs with cutting-edge facilities, stimulating interactions with culturally diverse dynamic team members and exposure to several prestigious conferences. My PhD research primarily focused on establishing 2-dimensional (2D) co-cultures and 3-dimensional (3D) human skin reconstructs and investigating the signaling mechanisms through which growth factors like insulin-like growth factor-I (IGF-I) rescue skin cells from ultraviolet radiation damage. The first time I was able to grow skin in a cell culture dish was one of the most exciting moments at the beginning of my PhD, something I will never forget. Using these physiologically relevant models, the signaling mediators involved in photoprotection were modulated in order to elucidate the specific pathways. These findings will have implications in the development of therapeutics for sunburns or photodamage.

Working back and forth between two different labs with their own established protocols or way of functioning taught me to be more adaptable and equipped me to work under any circumstances such as with kits / without kits, using commercial reagents / preparing buffers or reagents from scratch, handling different types of instruments, individually / with a group, learning a range of analysis software, lab-specific modified experimental protocols, troubleshooting and safety protocols. Apart from acquiring several skills in tissue engineering, cell biology, molecular biology and histology, I also evolved professionally to fit into different work cultures, lab dynamics, supervision styles, work-life balance, research group meetings and activities, attending workshops at both the universities and refining my presentation skills. After 6 years and over 30,000 km spread across three different continents later, I would say that PhD has indeed been a life-transforming experience for me. Behind the 297 pages of condensed,

scientifically phrased thoughts in my PhD thesis, lies detail-oriented experimental planning, several terabytes of data generated in these different labs, systematic analysis, data representations and years of brainstorming sessions with my supervisory team and peers. Obviously, being the first student to pursue a joint-PhD at MAHE and between these universities, I would be lying if I said that there were no challenges in this journey. With a plethora of failed experiments, logistic issues, numerous deadlines, research timelines, rejected manuscripts, minor administrative hurdles and a roller coaster of emotions along the way, there were also times when I was clueless about troubleshooting and the PhD journey seemed never-ending. But I believe that there is nothing that a dessert, an unwavering support system, a dose of positivity, some perseverance and loads of determination cannot fix. At the same time, these challenges were rewarding experiences, in the sense that they equipped me with a whole lot of other skills such as time management, organization, prioritizing tasks, adaptability, being resourceful, optimistic, goal-oriented and critical thinking.

In my opinion, one of the highlights of my Joint-PhD was my incredibly supportive interdisciplinary supervisory team, each one of whom had distinctive styles of supervision, diverse perspectives and inculcated different values in me. In addition to their valuable input in shaping my PhD work, thesis, manuscripts, etc. they gave me boundless opportunities to grow and motivated me to move out of my comfort zone to learn new skills. The other best part was attending conferences and presenting my research work in front of other scientists all over Australia, in India and in the United States. On a daily basis, delving into our research-specific topic gives us very little time to read about the current research in other areas. In my opinion, conferences are the best way to catch up on some of the latest research that we might have missed





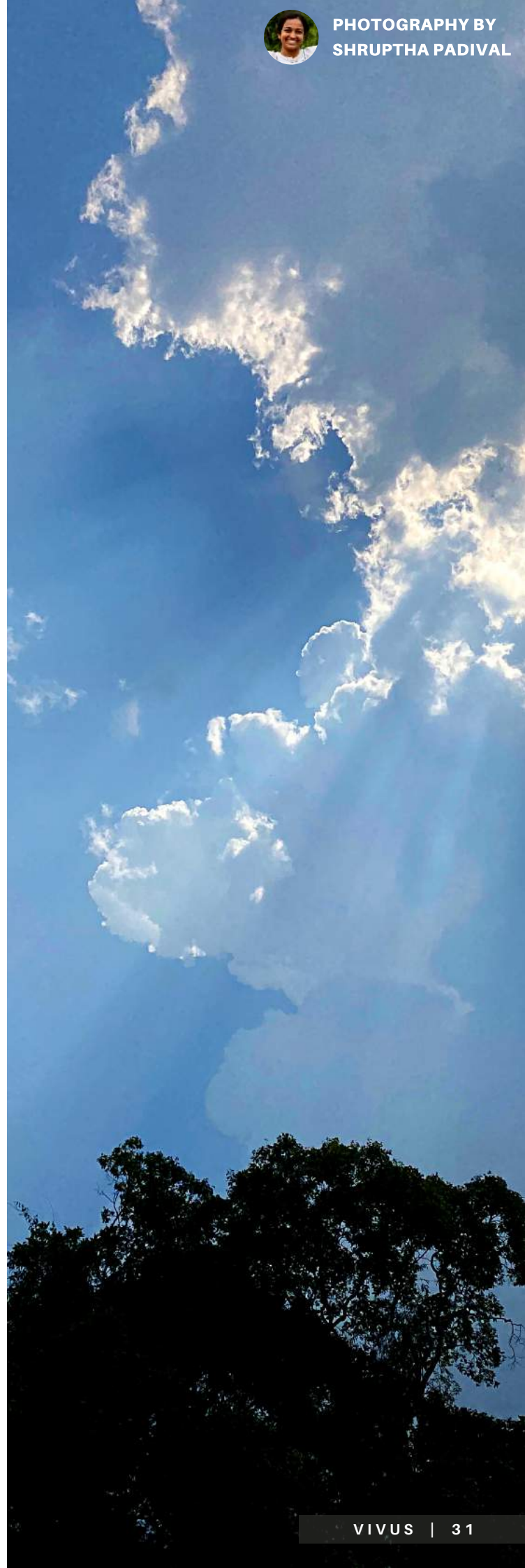
hroughout the year, broaden our knowledge in interdisciplinary fields, meet well-established scientists, network with people from the industry and discuss various aspects of science, PhD life, new ideas applicable to our work as well as experimental hurdles with peers from other labs. In fact, from my experience, I would say that reading about and working on diverse unrelated research areas through internships, bachelor's or master's degree research projects, work experience and other exchange programs, not only enhances your knowledge and technical skill set, but also allows you to explore what you are really interested in. And yes! conferences do come with travel opportunities. I have met wonderful people and visited some magnificent places on my conference trips to Melbourne, Gold Coast and Orlando.

Melisa J Andrade
PhD graduate
Department of Cell and Molecular Biology

Interviewer: "Who are your role models in science? Why?"

I would say that I do not have a specific role model, but I believe that there is so much we can learn from each and every scientist. Every area of research is important in its own way and deserves credit. Even the smallest contributions to knowledge can make a large impact when we see the bigger picture. In this context, I would like to mention a quote by Sir Issac Newton: "If I have seen further, it is by standing on the shoulders of giants", that has stuck with me.

Dr. Melisa J Andrade
Excerpt from First Person Interview
conducted by Journal of Cell
Science. Read more at:
<https://doi.org/10.1242/jcs.258999>



#PANDEMIC #LOCKDOWNS #COVID-19



POEM BY
DEEPIKA BHAT

Small is Big or Big is Small??
Who gets to decide this in Nature at all!!

An Ant is born and dead..
So does a Man who works till the end..
Nobody wants a Lion but an Elephant to mingle..
But who beholds the game in making the Lion the king of the jungle..
A magnificent Tree does its deed..
Not to be forgotten it was brought to Nature by the smallest seed..
Air is all around, but it is the small breath of Life that keeps us moving around...
Breathtaking Ocean dawn...
Not to be forgotten it was made by a single drop of Rain that came down...
A ball of Fire burns it all, but a lamp of Light calms it all..
At last nothing is Big, nothing is Small...
We all are here to play our part after all...
The most evolved form of Life has been brought down by the most primitive form of Life...
Again, the question arises.
Small is Big or Big is Small??
Who gets to decide this in Nature at all!!

Deepika Bhat
PhD Scholar, Department of Biotechnology



ARTWORK BY
INDIRA G



KERALA MURAL PAINTINGS: A WALK BACK TO THE TRADITION



ARTICLE & PAINTING BY
ARYA K

Kerala's ancient murals are renowned for their legacy, linear accuracy, clarity, and unmatched perfection in symmetry. The history of this art form dates back to the 8th century AD, when one of the oldest and largest mural paintings were found on the walls of a temple in Thirunandhikkara, Alappuzha district of Kerala. This artform stands unique and very delicate through the entire process of doing it from preparing the surface for the painting, to the choice of colors and the completion of the painting.

Preparing the surface (wall) is a laborious process, that involves plastering the wall with a mixture of different ratios of lime and sand for several coats followed by 25 to 30 washes with a mixture of quick lime, tender coconut water and jaggery water (may vary) for that extra smoothness, essential for the artist to sketch their subject with perfection. Five fundamental colors/pigments; red, yellow, green, black and white are used in traditional Kerala murals and all are derived by carefully and systematically processing materials like fruits, leaves, stones and ores. The coloring process starts with lighter color washes, gradually added up to increase the depth of the color and finally attaining the desired pigmentation. This remarkable skill of creating this shade progression itself is considered as one of the hallmarks of Kerala mural paintings.

Traditionally, brushes made of natural hair (squirrel tail hair, hair from behind calf ear etc.) are used and the choice of the hair depends on the type of brush required (flat brush/round brush/others). The process from choosing the hair type for the brush to formulating a brush as per the requirement is a mastered technique acquired from years of practice. The colors are generally mixed in coconut shells or wooden bowls specially prepared for painting. The motifs traditionally



depicted were portraits of gods/goddesses and their sagas from Hindu mythology, drawn based on the invocatory verses called "Dhyana shlokas". Backdrops are usually symmetrical patterns, flora, fauna and scenes of nature. The final step of the whole painting process is by completing the eyes of the motif called as "Unmeelanam", which symbolizes the god/goddess finally opening their eyes to see the world around and thereby indicates that the painting has attained its completion.

There was a phase where this art was on the verge of extinction, but exemplary movements to revive the murals in temples of Kerala post-1947 led to the establishment of the Institute for Study of Mural Paintings in 1989 at Guruvayoor, Thrissur district of Kerala. The institute aims and works towards the



Basic steps involved in creating a Kerala Mural painting. (1) Drawing the design onto the primed canvas and outlining with yellow (2) Outlining with red ink (3) Building up pigments by multiple washes (4) Washing with green color and adding background (5) Completing the shading and redoing the red outline (6) Shading of features such as eyes and final outline with black ink.

towards the protection, promotion and teaching of this artform. As with all things, transformation is inevitable. Commercially available synthetic brushes and colors have gradually replaced natural colors. Thus, the modern mural painters have shifted to papers and plywood from lime-primed walls and added improvisations in sketching and shading, which can be distinctively noted in the resulting modern works. However, despite those contemporary adaptations, Kerala mural paintings continue to astonish the world with their magnificence.

Arya K
PhD Scholar, Department of Plant Sciences

MUG UP EDUCATION



ARTICLE BY
CHANDNI SACHDEVA

“Mug this up, mug that up, spill it out on the papers, and now repeat ‘I AM EDUCATED’”

I came across this line and was instantly taken back to my school days. I am sure we all have some memory of being told to by-heart answers for an exam or a test. Unfortunately, or I should say fortunately, I was unable to do rote learning. Without understanding the concepts of a subject, I could never wrap my head around it. Sometimes I scored less than my peers and surely that saddened me as a child, but I always found the results of probing a topic much more fulfilling than simply memorizing words.

A better understanding of a subject helped me with stronger retention of what I studied. This led me to do well in competitive exams, which are analytical and comprehensive.

A very important aspect of learning is relatability to the real world, to be able to connect your theoretical knowledge with the practical. Our ability to acquire new skills has been known to reduce with age, even for folks who have received a quality education. Therefore, it is essential to encourage children to delve beyond their textbooks and learn to apply their concepts and convert them to skills from a young age. A great way to begin understanding concepts is by visualizing the information. Most children have an active imagination, and this comes fairly easy to them. Charts, blocks, number cubes and

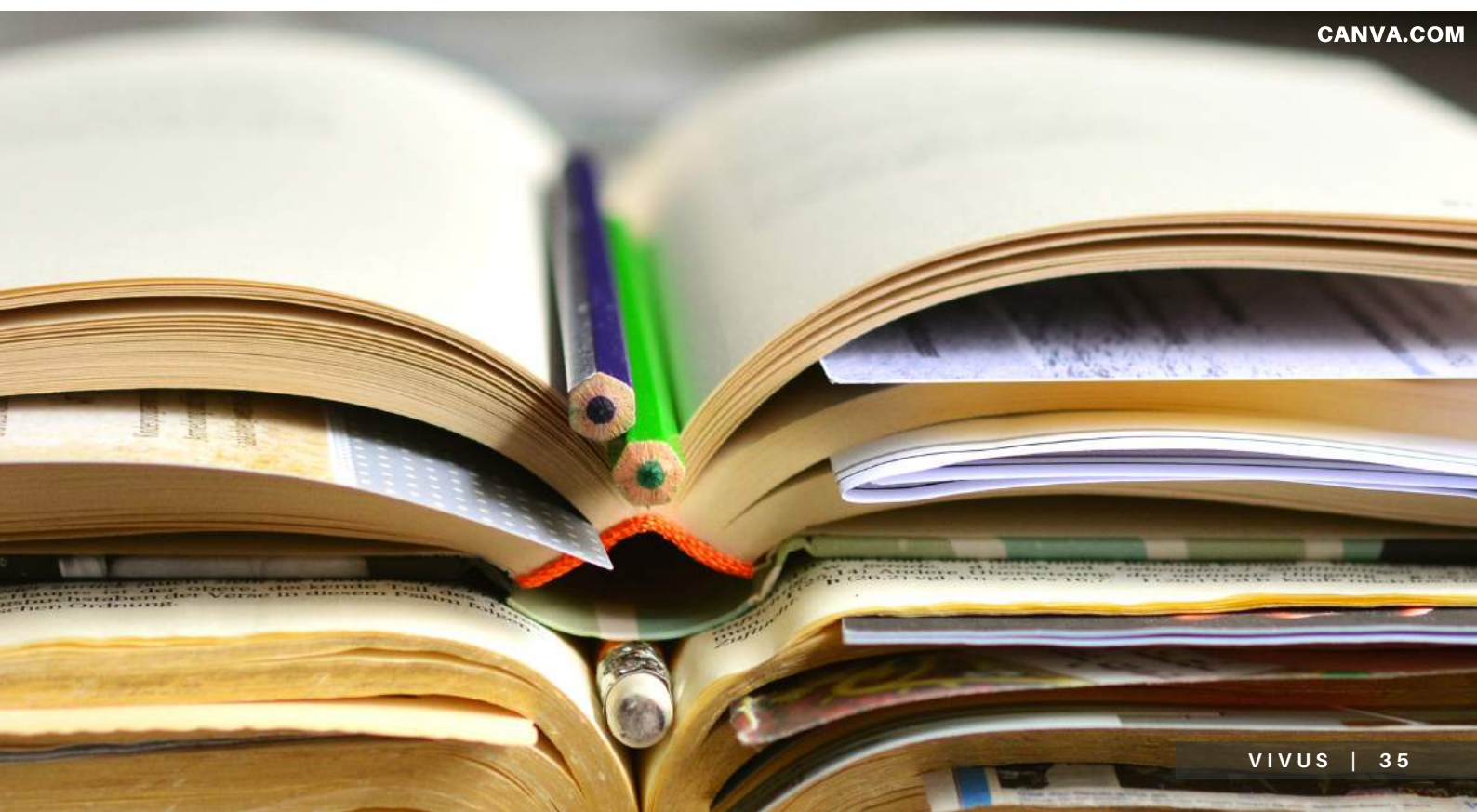
day-to-day objects can be used to represent textbook theories visually. In fact, a lot of videos on the internet do a great job of using diagrams and animations to visually explain topics.

India's education system is still evolving and although we have come a long way, we still lag behind countries like Japan, Singapore and Finland. Japan's technology-based educational structure and Finland's alternative schooling methods value effort and application above inherited 'smartness'. In India, visible efforts have been made with respect to Montessori schooling, introduction of STEM learning and the use of technology in classrooms. These strategies have shown tremendous increase in individual learning.

Experience overwrites education any day. That experience combined with education is knowledge.

Debates for alternative learning system against conventional schooling will continue. But what matters is how we can make the most out of what we already have. After all, facts are essential, but the ability to apply those facts is exceptional. We all want to be exceptional, don't we?

Chandni Sachdeva
PhD Scholar, Department of Biotechnology



CANVA.COM



The way it's been



POEM BY HANNAH CHRISTINA

*With every step I take, comes a dream so promising
With every promising dream comes a feeling so secure
Then I say to myself, "it's now safe, it really is. . ."
My heart then leaps to a sense of peace!*

*I open my eyes, and then I realise it was just a dream!
It was a 'feeling. . .' Just another game of hope
To take me through endless and broken roads.
To hold me firm and strong.*

*I still wander, I still stray
Never to learn, each time, I'm trading a part of me.
To each dream, I give a part of me. . .*

*Someday I will find all my missing self
Someday I will live all my dreams
Till then, I close my eyes again and play along.
Hoping. . . It will soon be over
And till then I will keep going, hoping and dreaming. . .
'Never to give up'
And that's the way it's been. . .*

Hannah Christina

PhD Scholar, Department of Radiation Biology and Toxicology

VEGANISM



ARTICLE BY
SAMPARA VASISHTA

If you are a vegan, celebrate your diet-specific date on November 1 (World Vegan Day). The concept of plant-based food was mentioned by Pythagoras around 500 BCE. In the year 1806 CE, Dr William Lambe and Percy Bysshe Shelley also objected to the intake of eggs and dairy products in Europe. The term "Veganism" was coined in the year 1944 by Donald Watson, a woodworker by profession. The famous Arab poet al-Ma'arri was one of the followers of the vegan diet. To promote this dietary fashion, the first International Vegan festival was held in Denmark in 1981.

In a generalized context, we have vegetarians and non-vegetarians. According to "Times Food", there are 8 types of vegetarians in India. They include "pure vegetarians" who prefer vegetarian food. "Eggetarians" are the second category who choose to eat eggs but not meat. People who are tempted by someone to consume non-vegetarians are called "Majboor vegetarians". "Boozy vegetarians" are generally those who eat non-veg when they drink (munching). Another interesting group is "Gravytarians" (only rice/gravy-no pieces). The other classes are "Calenderetarians" (non-veg on one particular day in a week), "Caketarians" (eating cakes made of egg), "Restricted vegetarians" (at home veg and outside non-veg).

Veganism – Indian context

India is the world's largest producer of milk and contributes to 22 per cent of the global milk production. Despite this, a survey conducted in 2019, has revealed that around 63 per cent of Indians were looking forward to shift from food animal-based food to a plant-based diet. The increase in the health consciousness of the people is also one of the reasons for this transition. The social media platforms which served as major publicity platforms for veganism have played a vital role in the rapid uptake of veganism. Support from celebrities and other influential people also gave an uplift to veganism in India.

Different types of vegan diets:

- Whole-food vegan diet: Comprises of fruits, vegetables, legumes, nuts and seeds.
- Raw-food vegan diet: Diet comprising of raw food sources that are cooked below 48°C
- 80/10/10: It is also termed a fruitarian diet. The prime eatables in this diet are raw fruits and soft greens. It also limits the intake of nuts and avocados.
- The starch solution: Instead of fruits as mentioned above in the 80/10/10 diet, the major portion of the nutrition comes from starch produced during the cooking of rice, potatoes or corn.
- Raw till 4: People opting for this diet will eat raw foods until 4 pm a day followed by a cooked plant-based food for dinner.
- Junk-food vegan diet: It comprises mock meat/vegan meat, desserts and other highly processed vegan foods.

Foods that are not part of the vegan diet:

- Meat and poultry products such as veal, organ meat, beef, pork, lamb, wild meat, chicken, goose, quail, chicken and eggs.
- Seafood dishes containing prawns, shrimps, squids, crabs and lobsters etc.
- Milk, cheese, butter, yogurt, cream etc. and products like honey, royal jelly etc.

The positive vibe – How veganism can be good for the planet

Decades of reliance on animals as a major source of food in the name of "protein requirements" has had a significant impact on the environment. Animal agriculture/sacrifice is one of the major contributors to water pollution and the creation of ocean dead zones in large water bodies. In fact, to produce 1 pound of beef, the industry requires 2,500 gallons of water. In the US, about 91 per cent of the Amazon destruction is due to animal agriculture. In addition, over consumption of animal food is resulting in species extinction and further destruction

of the habitat. About 51 per cent of the greenhouse gas emissions are due to livestock and their by-products. Hence, people moving towards veganism are bringing up an eco-friendly environment. Studies have also shown that vegans are less prone to diabetes, gastrointestinal, breast, ovarian and uterine cancers as well.

The negative shade – B12: The vegan kryptonite?

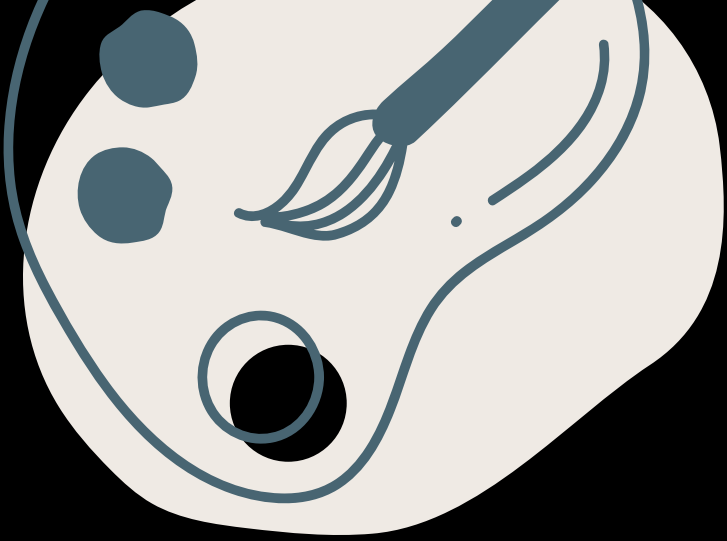
Even though substitutes are available for all the minerals and nutrient sources, it is said that vegans are more prone to vitamin B12 deficiency. This deficiency may cause birth defects. Calcium is a vital mineral and is said to be deficient in vegans.

Nutritional replacement to the animal food

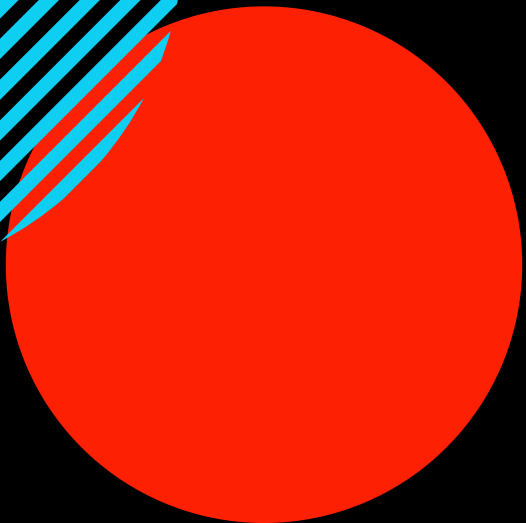
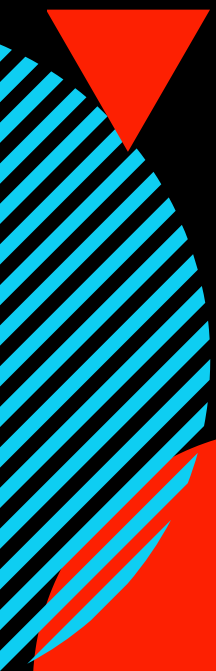
- Protein intake can be supplemented by intake of tofu, tempeh and seitan.
- Beans, lentils and peas, which fall under the category of legumes can compensate for many nutrients.
- Nuts and butter prepared out of unroasted nuts are rich sources of iron, fiber, magnesium, zinc, selenium and vitamin E.
- Fortified plant milk can contribute to calcium intake.

Good food often reflects in better mental health as well. While "good food" can mean different things to different people, plant-based food is worth a try if one is open to self-optimization experimentation. However, irrespective of the diet you choose, timely consumption of food with healthy sleep is always good and especially in researcher's context, it can significantly enhance the research outcome. Wishing everyone good health.

Sampara Vasishta
PhD Scholar, Department of Ageing Research



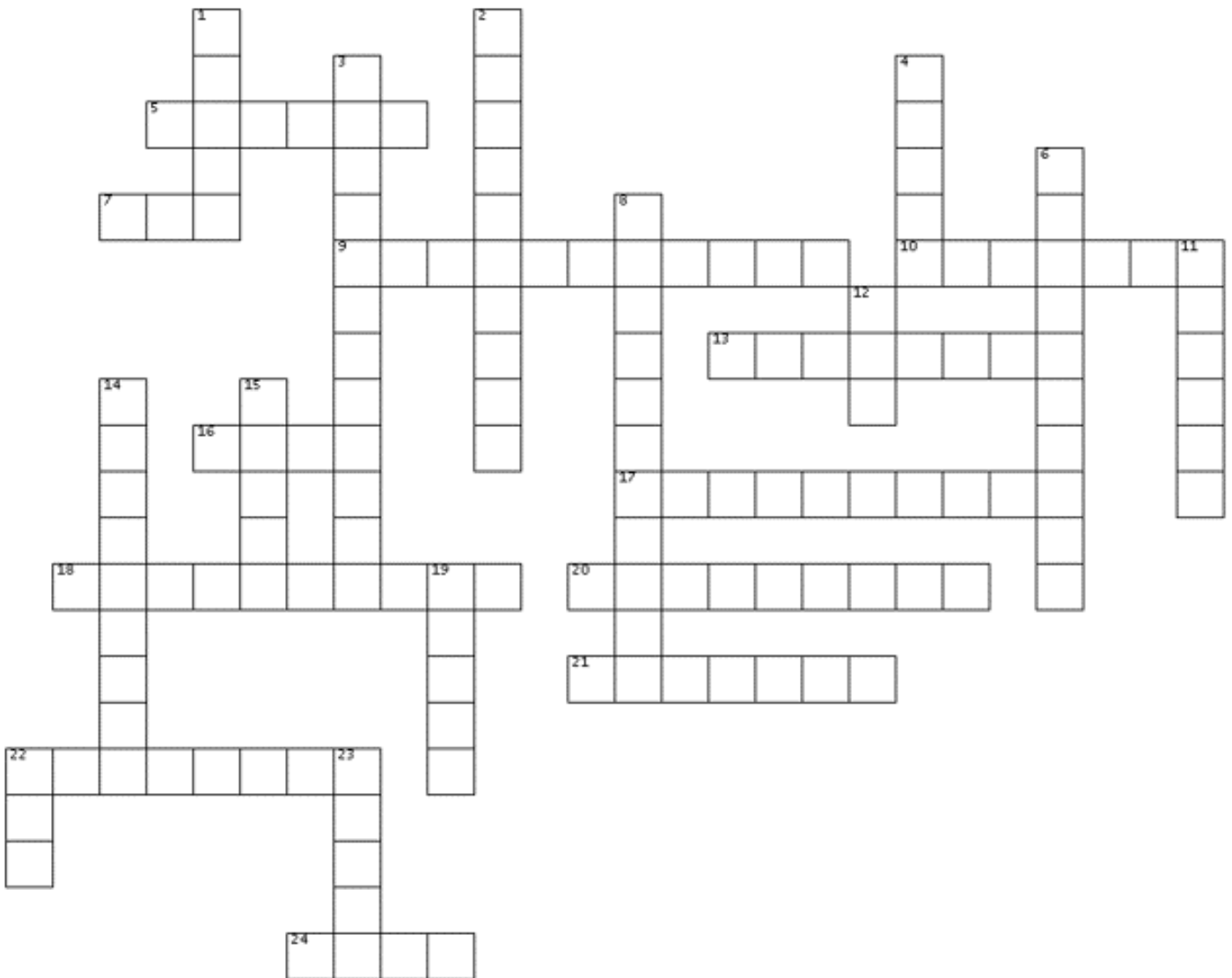
Creative nook



'TIS THE TIME FOR A CROSSWORD!



DESIGNED BY CHANDNI SACHDEVA
PhD SCHOLAR
DEPARTMENT OF BIOTECHNOLOGY



(Clues and answers to Issue 7.1 puzzles in the next page)

'T IS THE TIME FOR A CROSSWORD!



DESIGNED BY CHANDNI SACHDEVA
PhD SCHOLAR
DEPARTMENT OF BIOTECHNOLOGY

ACROSS

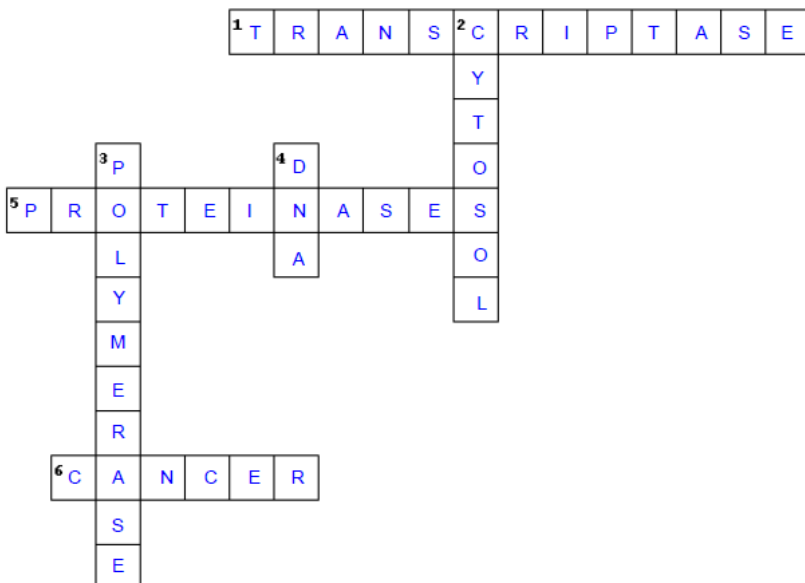
DOWN

5. Milk protein
7. structural changes in host cells that are caused by viral invasion (abbr.)
9. Depth zone of ocean where giant squids are found
10. Body cell
13. Hydrogen peroxide-degrading enzyme
16. Tropical skin infection caused by the spirochete
17. Microbe causes food poisoning
18. Simple cell in Protista kingdom
20. Cellular condition needed for transformation
21. Five-carbon sugar
22. Covid-19 birthday month
24. Blood fluids (pl.)

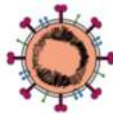





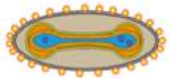





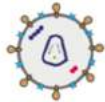





1. Bacterial virus
2. Front line worker at the site of injury
3. Chemistry of life
4. Chemical unions
6. Type of protozoan
8. Asexual fungal spore formed by budding
11. Mass of microbes on agar
12. Deadliest disease in the world (abbr.)
14. Ability to exist in two forms
15. Most harmful radiations (might make you hulk)
19. BSL required to work with microbes like HIV H1N1 West Nile virus
22. Type of vaccine given to children below 7 years (abbr.)
23. Codes for antibiotic resistance

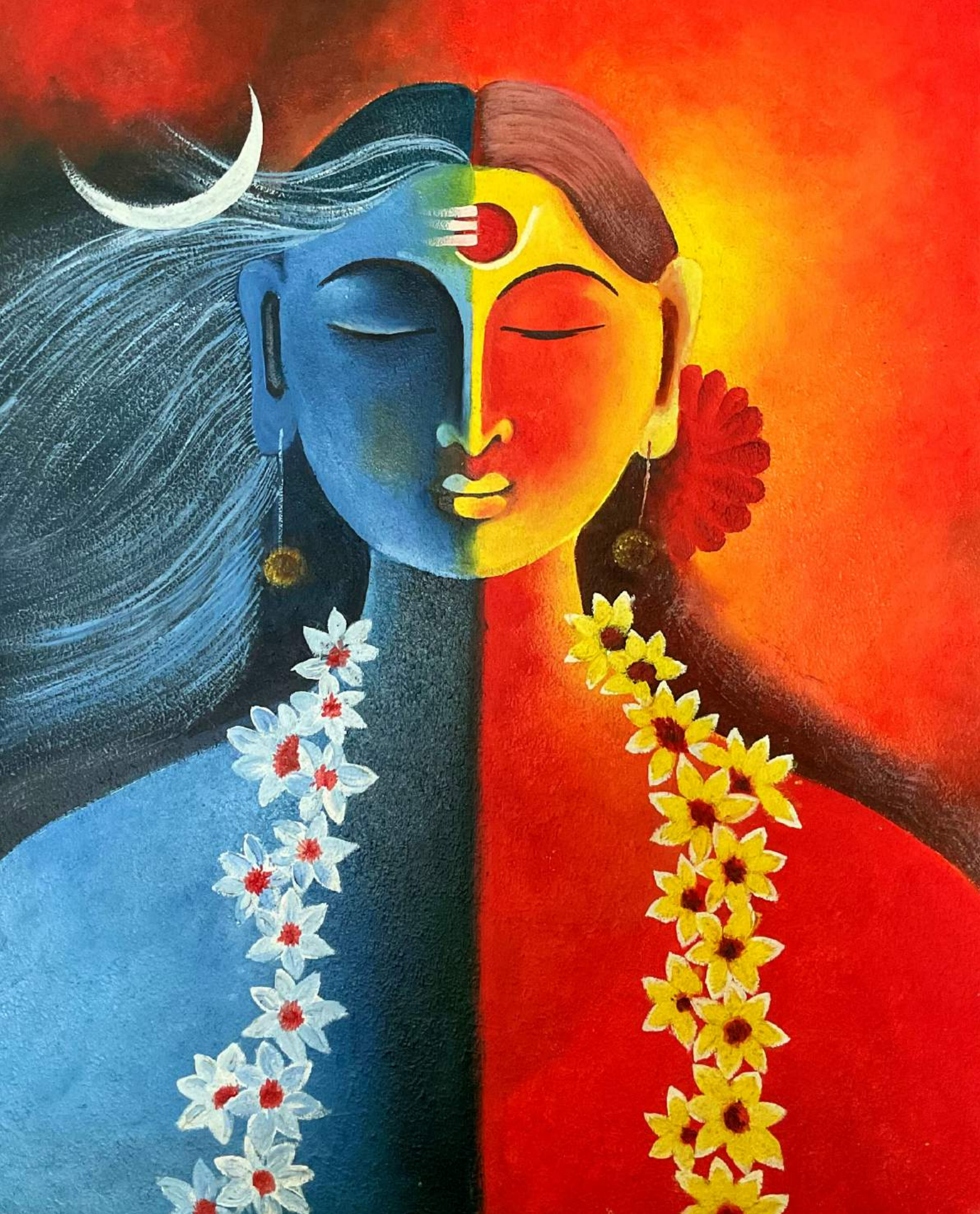
ANSWERS TO ISSUE 7.1 PUZZLES:

CROSSWORD



MATCH THE VIRUS!

[1] 	(D)  SARS-COV2 
[2] 	(F)  INFLUENZA 
[3] 	(E)  SMALL POX 
[4] 	(C)  EBOLA 
[5] 	(B)  HIV 
[6] 	(A)  NIPAH 



OIL PAINTING BY DEBYANI SAMANTRAY
PHD SCHOLAR
DEPARTMENT OF BIOINFORMATICS



PENCIL SKETCH BY NAVYA PRABHU
PHD SCHOLAR
DEPARTMENT OF BIOTECHNOLOGY



PHOTOGRAPHY BY NADEEM KHAN G
PHD SCHOLAR
DEPARTMENT OF CELL AND MOLECULAR BIOLOGY



MANDALA ART BY VAISHNAVI K
JUNIOR RESEARCH FELLOW
DEPARTMENT OF CELL AND MOLECULAR BIOLOGY



ARTWORK BY INDIRA G
PHD SCHOLAR
DEPARTMENT OF BIOPHYSICS



PHOTOGRAPHY BY SAMPARA VASISHTA
PHD SCHOLAR
DEPARTMENT OF AGEING RESEARCH



MANDALA ART BY REKHA KN
PHD SCHOLAR
DEPARTMENT OF RADIATION BIOLOGY AND TOXICOLOGY



PHOTOGRAPHY BY APOORVA JNANA
PHD SCHOLAR
DEPARTMENT OF BIOTECHNOLOGY

*"When we come to it
We must confess that we are the possible
We are the miraculous, the true wonder of this world
That is when, and only when
We come to it."
- Maya Angelou in "A Brave and startling Truth"*

