

EXHIBIT



THE SCIENCE NEWSLETTER

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Interview with Prof. Kana M. Sureshan

Earlier this month, Anvesha had the chance to interview Prof. Kana M. Sureshan of the School of Chemistry here at IISER Thiruvananthapuram. Prof. Sureshan works on supramolecular chemistry. He spoke to us about the importance and applications of scientific research in chemistry. He also shared some valuable pieces of advice for aspiring researchers, and shed light on some of the career opportunities available to majors and PhDs in chemistry. The following is an excerpt from the interview as hosted by Subrabalan Murugesan (SM) and Nikitha Srinivas (NS) of batch '17. Akshita Mittal (batch '19) and Gokul Prabhu (batch '17) helped transcribe and edit the same.

SM: You were recently inducted as a fellow of the Indian Academy of Sciences. On behalf of Anvesha and Exhibit: A, we express our heartfelt congratulations to you, sir. Can you tell us more about this fellowship?

SK: Thank you. This fellowship is given to scientists in recognition of their work and its overall impact over the years. Impactful research is a time consuming process and success depends on it. That's about it.

SM: Your research focuses mainly on supramolecular chemistry; can you briefly talk us through what supramolecular chemistry deals with and what kind of research happens in your lab?

SK: Supramolecular chemistry is the chemistry beyond molecules. When several molecules come together and interact in a supramolecular assembly, the assembly acquires properties called *bulk properties*. While atoms in molecules are connected through bonds, supermolecules have weaker interactions. These weak interactions, in my opinion, have some advantages over strong bonds. We try to exploit these interactions and tune molecules for various purposes. For example, our work in marine oil spill recovery involved us making a *gelator* (a substance that is capable of forming a gel) using molecules of sugar and its derivatives. These molecules are environmentally benign. They self-assemble through non-covalent interactions and selectively form a gel out of the oil phase. Marine oil spills are very problematic in a broader sense. People are looking for solutions, but there is no ideal solution as of now. The usual practice is to just burn it away, which is a waste of money and resource. The ideal solution would be to collect and recover the oil without harming the environment in the process. To achieve this, we made an absorbent which can selectively *jellify* the oil. We also made a carrier out of cheap cellulose (using recycled paper) to scoop the jelly out. This is very efficient in terms of recovery potential. It has attracted much attention worldwide, and the Indian parliament has discussed this a couple of times. The Indian Coast Guard has shown a great interest in this.

SM: Concerns about the environment are rising rapidly. How active do you think a researcher should be in the conservation and protection of the environment?

SK: Not everyone can research this particular aspect because there are so many other avenues to explore, like going to Mars or finding a cure to various diseases. That said, this planet is also very important. Chemists and material scientists have an especially active role in protecting the environment. They are responsible for the development of materials that can clean the environment and produce less waste. We use the term 'atom economy' in chemistry: you should get back, as products, the same number of atoms you start with so that no atoms go to waste. Hence, processes are very important. All kinds of chemists can contribute to this – a theoretical chemist can design new and efficient chemistry; experimental chemists, like my colleagues, can develop new reactions which produce

less waste. People like me, a supramolecular chemist should tackle the waste that is already present in the system (like oil spills) and try to clear it. There is a lot of atmospheric carbon dioxide. People are looking for ways to absorb this methanol, formaldehyde or formic acid. We have also made an absorbent for this through chemistry. I think chemists and material scientists should work in different areas of environmental protection.

SM: As a researcher working closely in the field of supramolecular chemistry, what kind of hardships do you face, and what would be your advice to students willing to take up a career in this field?

KS: I think research in general. What seemed feasible on paper may not be feasible in a flask. Such setbacks should not cause one to get demotivated. We may have to take detours, but perseverance is key. One failure does not mean you are failing forever. In fact, every failure is actually a success in the sense that you now know what will not work. Other scientists will find this knowledge useful. So, perseverance is very important. I think that is advice. Secondly, students and researchers must be truthful. A scientist is not the smartest person in the world. I am not looking for somebody who knows everything, nor am I always looking for a ten pointer. I look for someone who knows how and where to find the answer. That is what defines a scientist. Students should not worry if they don't have ten out of ten. Most scientists did not have that.

NS: What makes a chemist different from other researchers like physicists or mathematicians?

KS: The boundaries we talk about between the major scientific disciplines are diffusing. Traditional boundaries between disciplines will vanish soon, and new boundaries will be created. I think most of the activities in the future will be in the domains between biology and chemistry, biology and physics, and chemistry and physics. Mathematics also can marry well with other subjects. Chemistry is called a central science as it caters to many other branches of science. Chemists belong to a community of people who design, synthesise and apply. In an era when

the traditional boundaries between subjects and disciplines are fading, chemists have a larger role to play. In order to take on this role, a chemist needs to have a broader perspective. There are now a lot of active roles for chemists to fulfil in advancing biology, which is comparatively a very nascent subject. The molecular pictures of many complex biological processes are just starting to emerge. Material science and physics are other areas that have a strong connection with chemistry. Recent discoveries of interesting properties of 2D materials open up opportunities for chemists to tune such materials or design novel materials for improving their properties for practical applications. In a nutshell, I can say that chemists should have a broader perspective.

SM: Apart from academia and research, what other options are open to a BS-MS student graduating with chemistry as the major?

KS: Chemicals are in everything you use, a sofa, a table, paints, fertilizers, medicines, toiletries, soaps, a toothbrush ... the list goes on. Since chemistry is relevant to so many industries, a chemist will surely get a job. Theoretical chemists can find employment in companies who design drugs, agrochemicals, materials, etc. As long as the world exists, we need materials for our convenience and advancement, and we need chemists to develop and process these materials.

SM: Thank you for your time and valuable insights, sir. Before we end this interview, is there a message you'd like to share with us students?

KS: IISER students come from different streams of schooling from different part of the country. They start great, but what I have noticed is that some students lose hope on the way. IISER's curriculum is relatively tough, and naturally, there is a lot of competition. Most of our students were the best in their classes locally before they came here, but when we have 200 such students, not all of them can be topers. It is only natural that some go up and some go down. Students should not get upset or demotivated with these kinds of things. In my opinion, they should not give up but continue to study. In the long run, knowledge is more important than grades. My advice for students is to ask questions. Inquisitiveness and questioning abilities are very important traits in a scientist, and science benefits from these talents as a whole.

[Image source](#)



Dr. Kana Sureshan (left) and Amol Vibhute have developed a gelator than can efficiently and selectively congeal oil



Coronavirus Myths Debunked

Coronaviridae is a large family of viruses that cause diseases of the respiratory tract in mammals. In 2019, a new virus called 2019-nCoV (2019 – Novel Coronavirus) was identified in the Wuhan province of China. It was initially observed that patients who had contracted the infection also had contact with seafood and meat markets, suggesting animal-to-human spread. However, recent cases bring in the possibility of person-to-person spread. The cause is still largely unclear, which has led to a spread of fake news through various social media, especially WhatsApp forwards.

The following messages have been circulating extensively, so let's debunk it, bit by bit.

'The Ministry of Health's emergency notification to the public is that the Coronavirus influenza outbreak this time is very serious & fatal. There's no cure once you are infected.'

The Ministry of Health has released no such notification. The only official advisory issued so far contains precautions for people travelling to and from China. There is no official cure for the viral infection, but once admitted in a hospital, appropriate measures will be taken.

'Prevention method is to keep your throat moist. Do not let your throat dry up. Till the end of March 2020, do not go to crowded places. Wear masks as needed, especially on trains and other public transportation. Avoid fried or spicy food, and load up vitamin C.'

The attached graphic, which contains the government advisory, makes no mention whatsoever of the above measure. There is no guarantee that the virus spread will be minimised by March 2020, so continue following the precautions until mentioned otherwise.

'The illness due to coronavirus can be cured with two simple herbs.'

The canard that a paste of *Phyllanthus niruri* and neem could miraculously cure the corona viral infection is neither clinically validated, nor is there any ongoing research on this claim. The forward quotes the renowned legacy of Bodhi Dharman, making it sound credible and 'forwardable'. As a sense of desperation has set in, such rumour-mongering could easily deter an infected person from visiting doctors, as *Phyllanthus niruri* and neem are well-known and easily accessible plants.

'Fortunately, coronavirus infection can be prevented with homoeopathic medicines.'

This next piece of news claims that there exists a homoeopathic method to prevent the disease. There is no homoeopathic literature, nor clinical trials, which adequately support homoeopathic immunisation.

As educated citizens, we must verify and correct such claims before forwarding them. Much of the fear surrounding the virus has roots in such absurdity. In the words of George Bernard Shaw, 'Beware of false knowledge; it is more dangerous than ignorance.'

– Shreya V. and Vishwathiga J., B'19

[Source 1](#)

[Source 2](#)

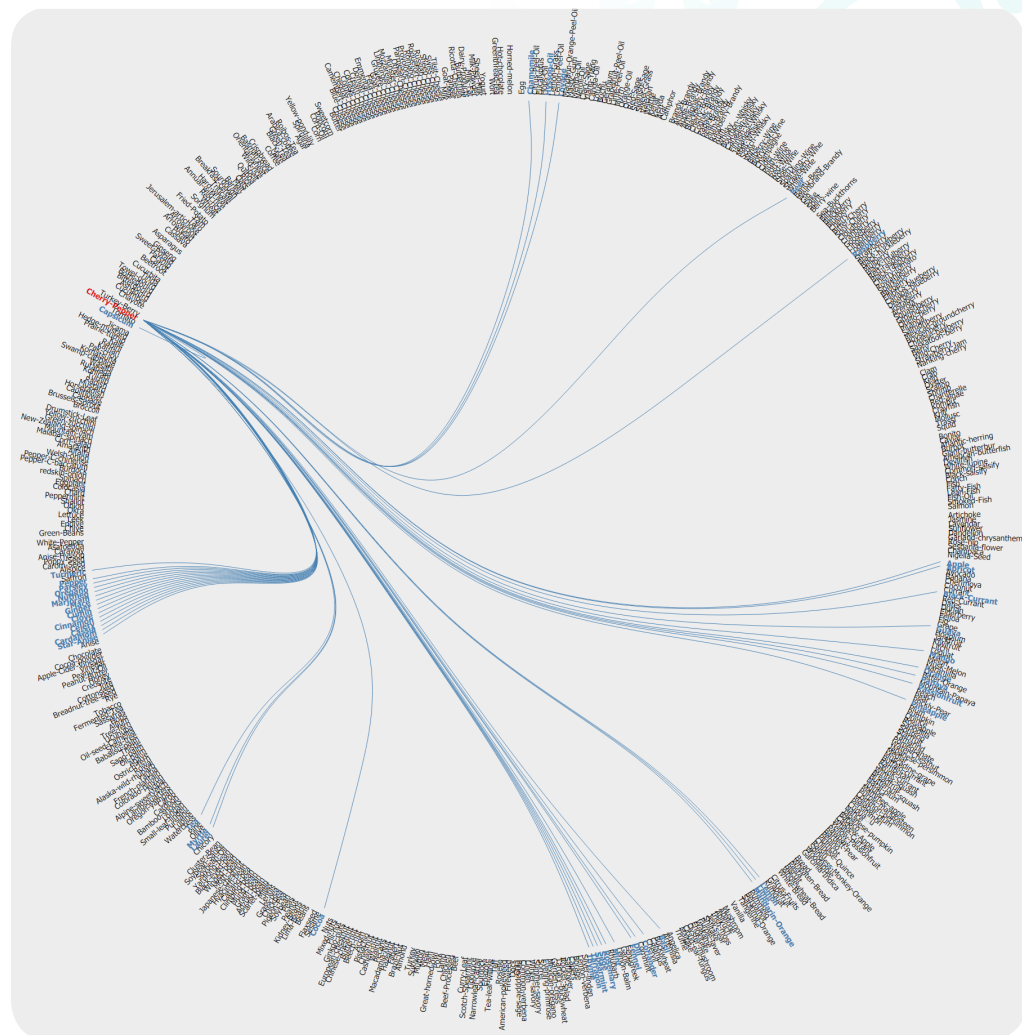
Can Computers Cook?

On 17th January 2020, students at IISER TVM got a chance to listen to Dr Ganesh Bagler (pictured below) talk about his work on an afternoon filled with an eclectic collection of ideas: computer science, mathematics and food. Dr Ganesh Bagler is an associate professor at IIIT Delhi and works in the niche field of computational gastronomy.

After being introduced by Dr Ravi Maruthachalam, Dr Bagler began by telling us about his journey through science, which is as unconventional as his work; starting out as a physicist, he made his way through computational biology before landing in computational gastronomy. His transition was, in his own words, 'from astronomy to gastronomy'.

He highlighted that food is not merely a means to acquire nutrition; it is a central component of any culture, and many argue that the ability to cook is a distinctly human character. Why do we combine ingredients the way we do? If we can study the patterns behind food pairing, could we teach a computer to cook? Dr Bagler set out to answer these questions with a novel data-driven, computational approach.

Using the number of flavour compounds common to a pair of ingredients, Dr Bagler's group developed a food-pairing index, and identified that Indian cuisines were more likely to use contrasting ingredients and western cuisines similarly tasting ones. Unsurprisingly, their work also verified what all of us have always known: spices play a unique and important role in recipes, and are sensitive to tampering.



Dr Bagler also talked about Flavour DB, an app that he has developed. Available on the Android app store, Flavour DB is a repository of over 900 ingredients and their flavour molecules. His team is currently working to develop an algorithm that can come up with new recipes that take taste, accessibility to ingredients, nutrition and the local cuisine into account. He believes that personalized nutrition, where recipes are tailor-made for individuals, can mitigate and prevent health problems. Attached alongside is a picture of the Flavour Network, which represents the graph of flavour sharing across various ingredients.

He ended his talk by reminding us that we should always look to expand our horizons and embrace the interdisciplinary nature of science. His talk was sprinkled with humorous anecdotes, and definitely made it an afternoon to remember.

Ira Zibbu, B'19
[Image source 1](#)
[Image source 2](#)



Mathematical Proofs and Mizar

Mathematical proofs can vary from intuitive five-minute verbal explanations to elaborate writings that employ various notations and pre-existing proofs. Irrespective of the rigour, the process of developing, writing, verifying, and organizing proofs, is fairly difficult.

The Mizar system was pioneered by Andrzej Trybulec, at the Plock Scientific Society in the 1970s, as a means of formalizing and mechanically verifying the proofs of mathematical theorems using computers. Mizar is the name of both the formal language that Trybulec developed, and the computer program that can verify proofs, known as Mizar articles, written in the language.

Mizar was derived from mathematical vernacular, modelled for concision and formality, in such a way that it is easily readable by mathematicians and is also rigorous enough to be processed by software. Proofs written in Mizar primarily follow a style called Jaskowski natural deduction, which makes the system particularly popular. Proof skeletons in Mizar are checked by the verifier module of the software, known as Reasoner.



The development of the Mizar Mathematical Library has been fundamental in the digitisation of mathematical knowledge. The MML is an archive of proved theorems and definitions, to be referenced and utilized in new articles. It not only is an essential standard library for Mizar users, but has proved advantageous in other projects involving mathematical processing. It has contributed significantly to training automated theorem provers, and has allowed for experiments that use dependencies in formal mathematics. The most recent progress has been made in employing machine learning methods to examine informal mathematics, compare it to MML standards, and automatically generate articles for the Formalized Mathematics journal.

Mizar has undoubtedly become an indispensable tool for interactive proof development, largely due to the library. Proponents of the MML believe that the development of the library, regardless of the efficacy of the system, is crucial.

Rithika G., B'19
[Image source 1](#)

We hope you enjoyed this month's edition of Exhibit: A!

If you are interested in contributing any content, artwork, or want your research featured here, please get in touch with us at:
anveshacontent@gmail.com

Send your suggestions to: <https://forms.gle/pBzJW7GSv7bC5r7RA>

Have any science-related questions you'd like answered? Send them to us and we'll get our best minds on it!

Visit: <https://forms.gle/MFbK9YKxmqK86GEEA>

