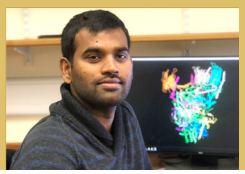
Jani Bolla

Jani Bolla is a Royal Society University Research Fellow at the University of Oxford, UK. The Bolla lab studies the molecular mechanisms of large protein machineries involved in transport across biological membranes using structural tools. Jani is a Fellow of *The Plant Journal*.



Tell us about your background. How did you first become interested in plant science and protein biology?

My fascination with plant biology started at an early age. I grew up on a farm in south India where I spent much of my childhood and teenage years (up until my Bachelor's) helping my dad. However, I am a chemist, and all my degrees are in Chemistry. In my opinion, studying Chemistry is like knowing the rules of the game, and once you master these skills, they can easily be applied to many research fields. Thanks to the interdisciplinary nature of modern research, I was able to transition from pure chemistry to studying proteins responsible for pumping antimicrobials out of bacterial cells, which was the focus of my PhD. I continued researching protein biology during my postdoc, focusing on identifying new targets for antimicrobial development. Throughout my research career, I have always been at the cutting edge of using structural biology tools. Using the skills I acquired during my PhD and postdoc, I recently transitioned to plant biology after being awarded a Royal Society University Research Fellowship. This long-term fellowship here in the UK gives the freedom and flexibility for early career researchers to explore new avenues of research and to establish a research group.

What is your lab working on currently?

In my laboratory, we use state-of-the-art structural tools such as native mass spectrometry, cryo-electron microscopy, X-ray crystallography and mass photometry to elucidate the molecular mechanisms of large protein machineries involved in transport across biological membranes. One strand of our research is focused on understanding the mechanism of protein import into chloroplasts: the organelles that generate most of our food and the oxygen that is required for all life on Earth through photosynthesis. In order for chloroplasts to function properly, they need to import >2000 different nuclear-encoded preproteins across the double-membrane envelope. This transport is mediated by the coordinated action of sophisticated translocation systems at the chloroplasts' outer and inner membranes (TOC and TIC, respectively). Using structural approaches, we would like to answer: 1) What is the subunit stoichiometry and architecture of the assembled TOC complexes? 2) What are the key structural elements important for preprotein binding and translocation? A complete understanding of how these complexes assemble and function will then enable us to modify crops to improve yield and climate resilience.

Another strand of my research is focused on understanding the multiprotein-complex machineries involved in gram-negative bacterial cell envelope biogenesis, with particular emphasis on how the cell envelope components from pathogenic bacteria affect human and plant health. The goals of this strand of our research are to provide useful information for developing more effective antimicrobials, and to identify possible targets for designing new drugs against bacterial infections.

> "The future of structural plant biology looks extremely promising with these new [technological] developments"

What does a typical day look like for you?

This varies a lot, but most mornings are occupied with meetings. As an academic, there is always so much to do other than just research, for example teaching, administrative work for the department or university, and helping the scientific community. I like to dedicate Mondays and Fridays to finishing most of the office work (reviewing articles, writing and revising manuscripts, writing proposals and some admin), and to spend Tuesday-Thursday in the lab doing experiments, analysing data and meeting with collaborators. Of course, this does not always go as planned, especially during term time. I will dedicate 2-3 hours of my time mid-week to tutorials and admin work. When I work in the lab, you can always find me running between the Biochemistry and Biology buildings to use multiple instruments for my research.

What do you most enjoy about your work?

I enjoy most of I what I do. This includes designing projects, performing experiments in the lab, and supervising and mentoring students, research associates and postdocs. I like spending time with my group members; seeing them bringing their ideas to the table and going on to test them. Working at the cutting edge of science, I receive collaboration requests from many researchers. It is fun to see their research questions being addressed in the lab, and I enjoy learning from many different disciplines and fields.

What do you find most challenging?

In terms of research, studying plant proteins through structural methods is quite challenging. This is mainly due to low yields, and as the samples are often heterogenous with complexes containing multiple isoforms of the same protein. However, rapid progress is being made in terms of the resolution revolution in electron microscopy, major developments in high-resolution mass spectrometry, and advanced tools for predicting protein structures. The future of structural plant biology looks extremely promising with these new developments.

Another challenge is helping the people who work with me to achieve their full potential. This is tough, but I am learning, and plenty of established PIs around me are happy to help and to provide suggestions.

> "Science is not about getting the data for papers; it is a process of building skill sets that you can apply to anything that you do in the future"

What is your lab hoping to work on in the future?

My lab ultimately aims to use information obtained from our studies to tackle real-world problems, for example, engineering plants for high-yield and climate resilience, and developing new antimicrobials for treating bacterial infections. I have recently received a European Research Council Starting Grant to investigate assembly and functions of β-barrel membrane proteins. These proteins are found across different domains of life, and understanding their assembly could have implications for improving crop yields, fighting bacterial infections, and targeting mitochondrial diseases.

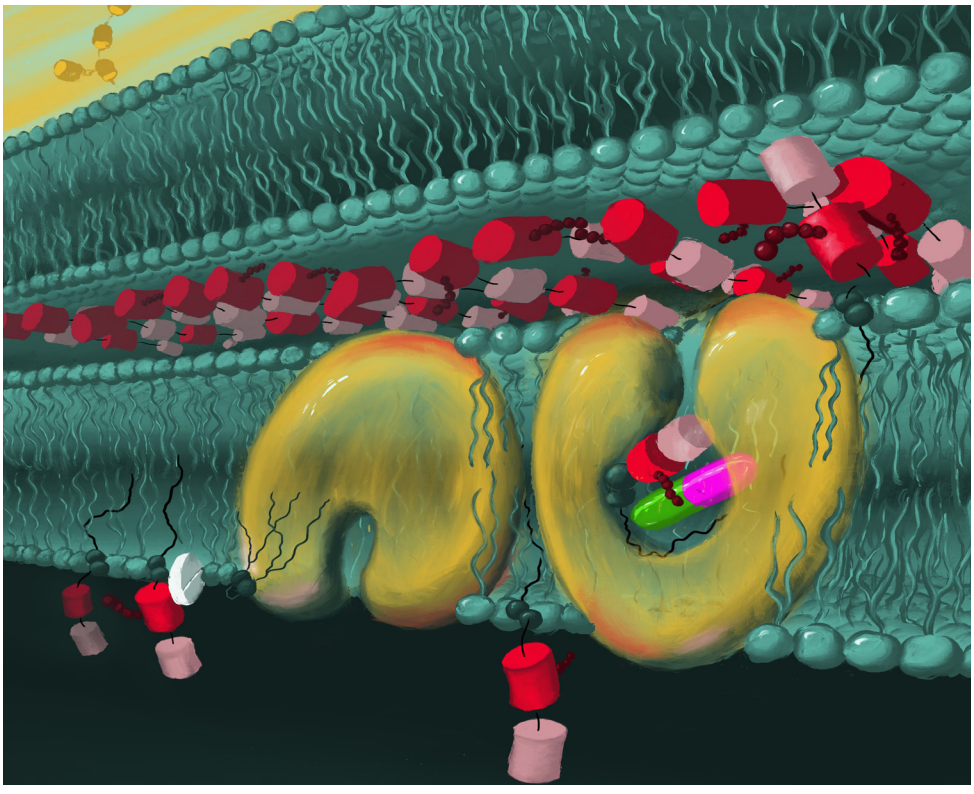
What advice would you give to aspiring scientists in this area?

There is so much unknown at the molecular level in plant biology, and I would say many outstanding questions can be addressed using structural biology techniques. What you need is an integrated approach that combines information from multiple methods and expertise from different disciplines, so think and research broadly and establish collaborations beyond the plant biology community.

As it is a known fact that we work more creatively and effectively when we are happy, it is important to pay particular attention to the lab culture and the mentoring style of the supervisor when you join the lab. Remember, science is not about getting the data for papers; it is a process of building skill sets that you can apply to anything that you do in the future. Make sure to ask the right questions and to think critically about your data. Rejections and failures are common in science, so do remember that you are not alone in the struggle and be sure to seek help from others. Networking is important; attend conferences and workshops, talk to people, and learn more about your field and possible career paths.

Who are your scientific heroes?

Actually, there are many, and all have inspired me at different stages of my career. Early in my childhood, growing up in south India, I was inspired by one of the greatest mathematicians, Srinivasa Ramanujan, who didn't have formal training in pure mathematics. He was meticulous and self-taught. My interpretation of his life is to let your mind imagine and dream freely! A person who I have worked closely with and who has influenced me in the same way is my postdoc supervisor, Carol Robinson. She is dedicated, trusts her gut feelings, sticks to them no matter what and makes transformative discoveries thanks to perseverence. She is also very present, always willing to learn from mentees and very active in their career development.



Left: Understanding the dynamic transport across biological membranes is fundamental to life. Credit: O'Reilly Science Art, LLC.

Selected Publications from SEB journals

Kono A, Chou T, Radhakrishnan A, Bolla JR, Sankar K, Shome S, Su C, Jernigan RL, Robinson CV, Yu EW, Martin HS. 2020. Structure and function of LCI1: a plasma membrane CO_2 channel in the *Chlamydomonas* CO_2 concentrating mechanism. The Plant Journal 102, 1107-1126.