Interview with SUDHA RAJAMANI

Sudha Rajamani is an Assistant Professor at the Indian Institute of Science Education and Research (IISER) at Pune. Her research in the field of Astrobiology focuses on discerning the series of events that might have led to the origin and evolution of early life on prebiotic Earth. In this interview with Reeteka Sud, she shares her experiences and insights on the life of a scientist.

Tell us something about your current work

I run an Astrobiology lab at the Indian Institute of Science Education and Research (IISER) at Pune. Astrobiology is a really broad area of scientific research that uses basic principles from several fields — including chemistry, biology, geology, cosmology, to name just a few — to answer fundamental questions about how life came about on Earth. Within this broad area, my lab is attempting to characterise the series of events that would have allowed the chemistry of matter to transition to the biology of life. We focus on some specific questions — how informational molecules were formed, how they persisted and evolved to perform biologically relevant functions. We also have other projects aimed at studying the interaction of amino acids, RNA and other relevant molecules in the prebiotic soup.

What is a typical day at work like?

A typical day at work starts at about 10am. I talk with my students about their work, sit through committee meetings, tend to any upcoming deadlines (for manuscripts/grants) etc. Twice a week, we have lab meetings where students take turns presenting updates on their projects; and a journal club where we discuss papers relevant to our area of work. In teaching semesters, preparing for classes and teaching them is also included in my workday.

What are some of the most rewarding aspects of being a biologist?

That I have the absolute liberty to pick and choose any question, anything I want to study. This, I think, applies not only to biologists, but scientists in other fields as well. Except those in the industrial sector who probably have to work within the mandate of their employers.

For example, my current area of research — the chemical origins of life — is generally something that scientists pursue after having established themselves or as a side project. It is rewarding beyond words that I can choose this, at this stage, as the main focus of my research.

However I also love being a biologist because I am fascinated by all aspects of biology, even those beyond my current area of research. I love understanding different aspects of nature, especially pertaining to life — how it came about, how it survives, how it evolves.

I have always been a very curious person. Curious about how things work, why they work the way they do, and what could be done to make them work differently. This, I believe, is fundamental to how any scientist views the world.

What are some important ethical aspects of your work?

Two aspects, in particular, are of great value to me. One is being completely honest about interpreting results of my work. Scientists are rewarded for publishing their work, especially in journals with high impact factors. The need to publish in a certain journal or at a certain rate can make it tempting to take the easy route — embellish data ever-so slightly to make it seem more than it is. This should be a strict no-no to everyone involved in research! I am very strict about this with my students. It is important to me that they understand that as scientists, we start with a working hypothesis based on valid information and are very careful about designing experiments to test this hypothesis. However, if the results we get do not entirely support or even disprove our hypothesis, so be it.

The other ethical concern that matters a great deal to me is related to managing people. This is a big part of running your own lab — there's a certain inherent power that comes with it. It is very easy to become the kind of person who makes things horrible for people working under you. I am very conscious of this possibility. It is important to me that I know what my boundaries are, and respect boundaries of other people in my lab. I strive to be ethically appropriate while dealing with members of my lab and also extend this to interactions with everyone who I am associated with in my line of work.

Do you remember when and why you made the decision to become a scientist?

There is no one moment when I made this choice. I have always been a very curious person. Curious about how things work, why they work the way they do, and what could be done to make them work differently. This, I believe, is fundamental to how any scientist views the world. By this criterion I believe I have always been a scientist at heart.

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Any early experiences, at school for example, which encouraged this interest?

I think my science teacher, Ms. Usha Thakur, from when I was in the 4th or 5th standard was probably the one person, I would say, who 'stirred the pot' of my innate interest in science. Apart from that, I used to love going to the science library in BHEL Township, Hyderabad, where I grew up. Also, some really interesting documentaries on science-related topics, screened occasionally on Doordarshan, added to the intrigue.

How did you choose your current area of research?

My current area of research — Astrobiology — 'happened' to me. I call it a 'cosmic convergence of events'. I was trained in protein biochemistry, a field largely un-related to what I am studying now. Although I have always been curious about questions like, when did life begin and how, I didn't actively search for ways to make these questions part of my research. In fact, I wasn't even aware that a field called Astrobiology existed. till I stumbled into it by chance, and realised that there are many people who are addressing these questions scientifically. I'm really glad that my professional career took these unplanned detours to lead me to where I am now!

Have you come across any misconceptions about 'being a scientist'?

Ah! Misconceptions galore! One is that scientists are whacked out, lost in their own world, and talk to themselves — things of that nature. Another is that we are one-dimensional, potentially boring people, who are interested in nothing but science. This is definitely not the case — certainly not for me, or for the many other scientists that I know. I need the arts, interaction with social scientists — all that jazz! In fact, I can remember many occasions when I have been chatting with co-passengers on a flight, for example, and they've been very surprised to hear that I am a scientist, often exclaiming that I don't behave like one! There is also the idea that choosing to be a scientist is only about following one's passion, but there is really no money in this profession. Again, not true! Like anyone else, I too care about getting a reasonable salary, which I do.

Fig. 1. Why does the leaf of a papaya plant have this shape? Bringing things from outside to use as props in your class can make science classes more engaging.

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Could you share your perspective on science education at the school level?

While I wouldn't say that any of my science teachers have discouraged me

I would also strongly encourage teachers to take their students out of classrooms while teaching science. Simply put, nature is the best teacher! You could also bring in things from outside to use as props in your class. Saying, for example, *"Here are branches from two different trees. Why do you think these leaves are small, and these other ones large?"* This could start a discussion on leaf sizes that can eventually lead to one about the differences in their transpiration rates etc.

from choosing this career, now that I am a science teacher myself, I do wish that science was taught differently in school. Science classes should expose students to a wide variety of things related to nature and its workings. The best way to get young people interested in science is to pique their interest early on, at the school level.

Can you tell us some things that you think teachers could do to encourage an interest in science?

For a teacher to be excited about science herself, goes a long way in getting her students interested in it too. Let your excitement infect your students naturally!

Use inquiry, use their sense of curiosity, make observations a natural part of science classroom. Getting your students to ask how nature works can do wonders. So, for example, have them think about why a leaf is shaped a certain way; or why one plant is a shrub, while another is a tree. Or, how a rainbow is formed and why it has seven colours. If you involve them in inquiring about such aspects of the natural world, very soon they will be thinking seamlessly about the underlying concepts in various fields of the natural sciences like physics, botany, chemistry etc.

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Another thing that can help is to use an integrated approach while introducing students to science. After all, the study of nature involves an understanding of principles from different fields of the natural sciences. Rishi Valley School, I am told, follows one such system. They teach science without breaking it up into biology, chemistry, physics etc. This is probably the most organic way of learning science.

Do what you can to make sure that students read extensively — including biographies of scientists. Badger (if you have to) your school administrators to take students to good libraries. Schools should also do whatever is possible to introduce student's first-hand to experiences where you have them see how science is really pursued. As part of IISER, Pune's outreach activities, we arrange for school students to visit our labs and research facilities on campus, and the students are just mesmerised — it's amazing to see that!

How important are observation and wonder in science education?

Oh, so important! Observation is absolutely fundamental to science. Sticking to teaching strictly from textbooks is the issue, maybe even the

Fig. 2. What causes the immense diversity we see among insects? Getting your students to ask how nature works can do wonders.

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stumbling block if I may say so. Every now and then, close your textbook, step outside with students and look around…to observe science-in-action all around us.

Curiosity and wonder are intricately linked to learning science. We don't even need to inculcate curiosity — kids are just naturally curious, more so than adults. Instead, teachers can help channelize their innate curiosity to learning about things in their environment: how do tiny ants make giant ant-hills, sometimes the height of a thousand-storey structure (for an ant)! How do they do that?! Asking questions about things you see around you, being in awe of things around you — that is the way to learn (and teach) science.

How important is it for researchers to be involved in school science?

Absolutely important, in my opinion. It is unfortunate that a lot of researchers are either completely disconnected or do not find the time to do science outreach. I think we should all try and make time to contribute in whatever way we can to excite young and bright minds.

It is especially important for us to reach out to middle- and high-school students to talk about our work. Most textbooks incorporate a lot of subject-specific jargon. It is in meeting scientists from a certain field that students get a real sense of what many of these terms mean, what the value of knowing about them is, etc. We (scientists) also stand to gain from it in many ways — science outreach greatly helps improve our communication skills. I try and do this in whatever way possible, whenever I can. In fact, I was recently in a college in Ahmednagar with two of my colleagues. The science faculty of this college are unusually proactive about exposing their students to various aspects of biology. This is particularly striking in a city like Ahmednagar, where opportunities to do so are far more limited than in bigger cities like Mumbai or Pune. I am also trying to be associated with a group of scientists from the Blue Marble Space Institute of Science or BMSIS (https://www.bmsis.org/), a virtual gathering of Astro-biologists, who are committed to education and outreach in this field. Some research organisations, like IISER have a very vigorous outreach program. Others, like the National Centre for Cell Science and National Chemical Laboratory, have open days when anyone can walk into their labs, check out the research happening there. Platforms like this provide a wonderful opportunity to engage with not just school and college students from across the globe, but also with the general public at large.

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Fig. 3. Can other planets sustain life? How do we colonise other planets? These are just some of the questions that are interesting to many people, across different age groups.

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What are some of the most important ways in which the practice of science as a profession is evolving?

The number of institutes offering advanced training in science has increased, as has government funding for research and salaries for junior trainees and research fellows. A career in science, today, offers umpteen choices. It is no longer limited to teaching or doing bench-work (e.g. lab research). Just off the top of my head, there are opportunities in science communication,

pedagogy, writing, outreach, policy and administration. However, a lot more needs to be done to further the practice of science as a profession. For example, it is important for the government to support and create opportunities in these alternative science careers.

What are some of the fields in science that you think are going to take centre-stage in the next few decades?

Astrobiology, human cognition, areas of science at the intersection of social and natural sciences — these are all interdisciplinary in nature — and, I believe, some of the hot areas in science that are going to take center-stage in the coming decades.

What are some questions in science that you think can interest anyone (8 years or older)?

I think this goes back to something we were discussing earlier — how do things in nature work? It's almost like we can't stop wondering about it, ever! And there are several aspects to this question. One of the grandest (and a very challenging one too) of them all is — how did we come about? More fundamentally, how did life originate on Earth? Then, there is the other mystery human beings have been grappling with for so long — how does our brain function? Another problem that is immediately relevant to this day and age: how will the Earth sustain all of us given the way the world population is growing and how humans are mistreating the planet? This brings us to another relevant and pertinent question — whether life (as we know it) can be sustained on other planets or moons, and if yes, how do we colonise these planets or moons? Will that be possible at all? All of these are questions that are interesting to many people, across age groups.

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