iGEM Team Interview Common Questionnaire

Questions :

1. The rise of synthetic biology has evoked mixed reactions from the masses. While the Synbio proponents hail the discoveries in the field, the opponents have a view that 'Man is breaching his limits and trying to become God'. What is your take on this aspect?

   This reminds me of one of the most celebrated physicists, Richard Feynman. Feynman once said, 'What I cannot build, I cannot understand'. The holy grail of this nascent discipline is the creation of synthetic life. If engineering radio is not 'becoming God', why would engineering life be? Certainly, stringent regulations need to be there to prevent the misuse of the enormous potential of synthetic biology, but that should not be a pretext to oppose advancements in the field. From gene therapy to treat dreaded genetic diseases to genome editing to constructing artificial cells, synthetic biology is THE future. To oppose it is to giant step backward.

2. iGEM strives to promote research at different levels and encourage students to come up with practical solutions to real-life problems. What is the goal of your project for this year's competition and how did your team brainstorm and narrow down on the idea chosen?

   Team iGEM IISc Bangalore is dealing with the problem of combating organophosphate pollution. Organophosphates are widely used as pesticides in many countries, including India. However, they leach into water bodies and enter the bodies of various lifeforms, causing adverse effects. Current physical and chemical methods for addressing this problem are ineffective or unfeasible. We are aspiring to build a bacterial cellulose based filter functionalised with organophosphate degrading enzymes to combat this menace. While primarily focussed on organophosphate pollution, we also seek to create a plug and play platform which can be used for bioremediation of other classes of contaminants with minimal modifications.

   During brainstorming, we were focussing primarily on projects related to agriculture and combating pollution. While brainstorming on an idea related to agriculture, we came across this interesting material – Bacterial Micro-Crystalline Cellulose (BMCC). While going through the wikis of some iGEM teams, we were struck by this idea of using bacterial cellulose as a filter base to combat organophosphate pollution. There were iGEM teams who have worked on such BMCC based filters, particularly the team from Imperial College London. We also came across several research papers on organophosphate hydrolases, which led us to zero in on organophosphates. We basically tried to amalgamate the progresses made in BMCC based bioremediation strategies with the Looking at the extent of organophosphate usage in India and the extent of organophosphate pollution made us even more determined to work on this problem.

3. Curiosity-driven research, even with all its awe-inspiring charm can often hit a roadblock without the backing of the all-powerful sponsors. How did you go about garnering funds for the project?

   One great thing about the iGEM experience is the diversity of activities that need to be undertaken by a team. It's almost like running an entire lab. We got a first-hand experience of financial issues involved in research while reaching out to sponsors. We contacted many industrial houses and funding agencies. The Director of IISc was kind enough to fund our project generously as soon as we approached him with details about our project. We're thankful to him and the Dean of the UG programme for their help in this regard. We also approached several companies to sponsor us by providing us free access to their software and/or products. We're thankful to SnapGene and LabFolder for their support in this regard.

4. The iGEM journey is a mosaic of new experiences quite different from usual lab work science students encounter during their formal courses. How do you think participating in a research intensive competition like iGEM impacted your scientific thought and mettle?

   iGEM has shaped our scientific thought in several ways. It has taught us to hit the books every time we got stuck in wet lab. It has taught to streamline our approaches in wet lab based on our modelling results and literature survey. Ideation of a project and implementation is so very different. We have improvised on our original idea so many times now that we have lost track of that number. It also made us think deeper and harder. Our protein wasn't getting purified. There is no literature that has the exact answers we are looking for since we designed this protein. It made us revisit our protein design and made us why we used each peptide sequence and how that could cause a problem. In other words, our iGEM journey greatly improved our critical thinking skills. As far our scientific mettle is concerned, our iGEM journey has drastically improved our resilience. Our team had near to zero wetlab experience prior to starting our iGEM journey due to the on-going pandemic and consequently online education. While we knew in theory how things work, we had to learn how to practically troubleshoot. Finding out your experiment failed after 72 hours of work is very disappointing. But one needs to brush that feeling off, stand up and hit the bench again (well after you troubleshooted your failure). The research-intensive environment of our iGEM journey resulted us in developing better interpersonal skills, better time management skills and better resilience- both inside and outside the lab.

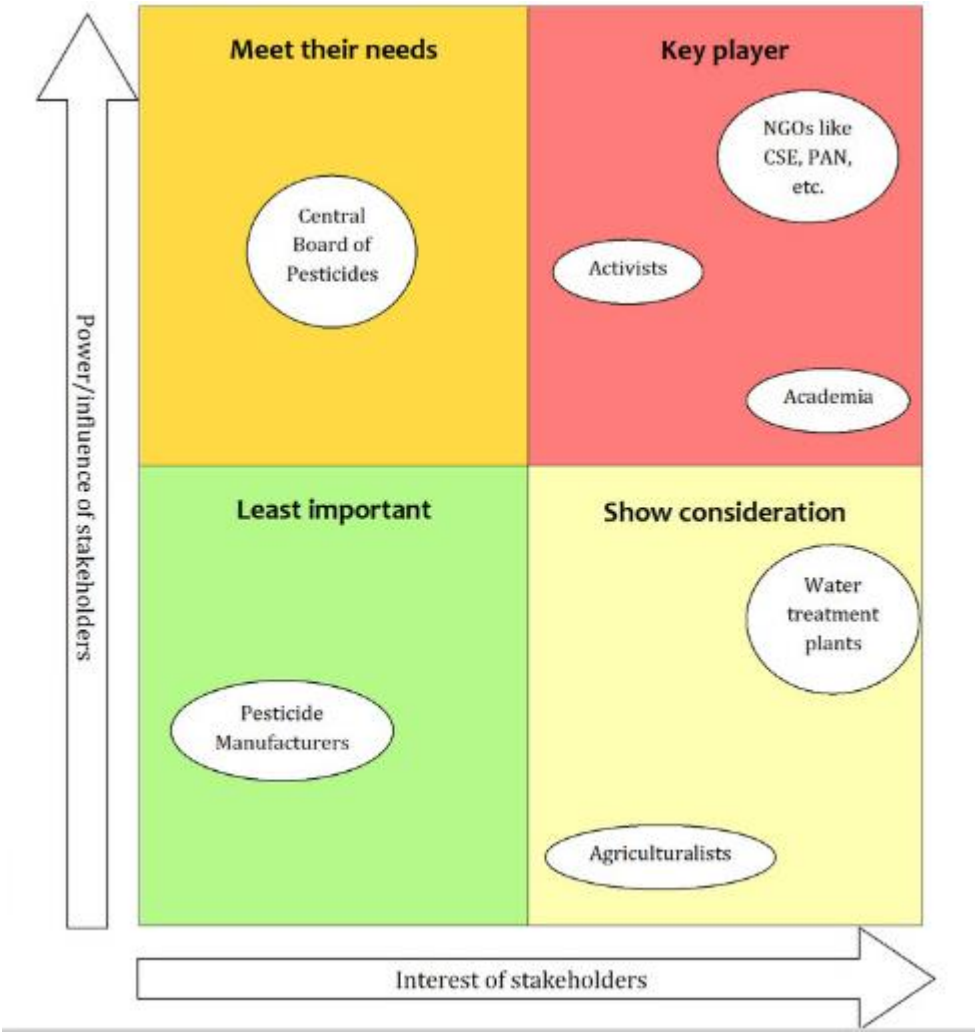
5. One of the striking features embellishing iGEM projects is the need to make them responsible and good for the world throughout the project lifecycle. What are the human practices being taken up by the team? How did the team try crafting their human practices to be effective in the wake of a global pandemic?

   We started out by identifying stakeholders and prioritising them according to a power-interest map. We then began to engage in a dialogue with the key players of the project – members of the academia and environmental activists and NGOs like PAN and CSE. We sought their inputs at every stage of our project design and tried to understand their needs. Besides this, we have also engaged respectfully with those affected the most by this burgeoning organophosphate toxicity – the farmers. We have conducted surveys to gauge their levels of understanding about this. We have also approached the biotech startup ecosystem in Bangalore to know more about the scalability of our project. Besides this, we have also focussed on disseminating information about our project and SynBio through symposia and primers. We have penned a book detailing the basics of SynBio for school students in India, which has been accepted by the IISc Press. Due to the pandemic, we had to keep most of our HP activities online, but we tried to make the best use of the opportunity we had by interacting with stakeholders cutting across narrow geographical boundaries.

6. What are the practical implications of your conceived idea and who are the stakeholders of your project?

   Our idea goes a long way in fulfilling the SDGs enunciated by the UN, particularly SDG 3. Organophosphate toxicity and its associated effects are ravaging the rural populace of India who sustain on agriculture, primarily due to carcinogenic impacts. The infamous "Cancer Express" is a living testament to it. Reports by the Centre for Science and Environment have in fact established the presence of organophosphate residues in the blood of farmers from Punjab and in bottled drinking water in various parts of India. In keeping with iGEM's spirit of keeping the society as heart of science, we have tried our

best to identify possible stakeholders and interact with them. The stakeholders of our project include academia, civil society activists and NGOs (like PAN), agriculturalists, sewage treatment plants and entrepreneurs. We have tried to follow a systematic and rational approach to stakeholder interactions throughout our Human Practices journey by prioritising the stakeholders according to a stakeholder map constructed by us. You can find more details about these in the Human Practices page on our wiki.



7. What do you think are the major milestones and challenges to be crossed in bringing your idea to fruition in the future?

   First major milestone would be to improve the thermal and pH stability of the enzymes we used in order to ensure applicability of our filter over a broad range of environmental variables. We'd also need to experimentally assess the threshold concentration above which the OPs can be degraded, say to 90% levels. These would allow us to make an informed choice about the relevant installation sites. We'd also need to find out the ways to coat our filter on microchannel walls without affecting functionality of the proteins.

8. As the research community worldwide has started to adapt to the current climate and shifted to online platforms, iGEM has seen an increased focus on the aspects of mathematical and computational modelling. What are the pros and cons of participating in a challenge such as iGEM via the online mode?

Our team unfortunately wasn't able to participate in last year's iGEM since we did not have access to our labs due to the ongoing pandemic situation. Our team strongly believes in the importance of dry lab + wet lab. Experiments in a wet lab doesn't mean everything. The power of computational and mathematical modelling helps streamline the wet lab experiments and discourage a trial and error approach. A very important benefit was increased emphasis on modelling from the iGEM foundation's side and we think this is a good change that is meant to stay! Traditionally computational and experimental approaches are separated, well they do require different skillsets. But iGEM's increased emphasised on modelling has helped diversify our skillsets as a team. The cons of participating in a challenge like iGEM via online mode is the heavy technological requirements. Instead of being able to present your project, we pre-record a presentation video. The limited interactive mode is a major drawback. Audience questions are very interesting and the opportunity to interact with the audience is lost in the online mode. Although iGEM presentations and science have become more accessible. You no longer need to fly to attend the Jamboree to hear the ideas various iGEM teams have. You can very easily get a comparable experience by watching their presentation on YouTube.

9. What, according to you, are the benefits and other perks that students can obtain by participating in iGEM? How do you propose to popularise this competition among the mainstream scientific institutes and universities in India?

iGEMers are exposed to doing science in a holistic manner and I can't emphasis on this enough! Not only are you identifying a problem in your community that you want to tackle but you develop a solution and test that out! You share the solution you are proposing with the synthetic biology community in the rest of the world but also your own community. You improve your approach to problem solving based on the feedback you get from your stakeholders. There is no parallel to this invaluable experience. But apart from the experience, you get the opportunity network with budding researcher from all over the globe who are also passionate about solving problems using synthetic biology. Personally, for me and for many members of our team, the biggest benefit is working on science that that has the potential to change lives today. Often the bench to world translation takes decades or even lifetimes. iGEM offers you to take your science from your bench out to the people who suffer from a problem that your science can help resolve.

As far as popularisation is concerned, all the Indian iGEM teams should consciously reach out other colleges within their vicinity and inform them about the opportunities available. iGEM is a research competition and funding thus becomes an important aspect. Having more government funding for Indian iGEM teams can help boost participation. Usually, iBEC grant is available however recent due to the pandemic, it wasn't available in the year of 2021. Some teams had to resort to crowdfunding.

10. How do you envisage the world of synthetic biology a decade from now?

Well from a decade from now, I would expect synthetic biology to invade every life science discipline. Synthetic biology provides one the tool to investigate fundamental questions in life science. One of our PIs uses synthetic biology to gain a better understanding of cell cycle. In a decade time, hopefully synthetic biology tools will be rampant (even in Indian laboratories). Synthetic biology tools would have probably helped us to discover several underlying principles of living organisms. I would also expect synthetic biology applications to be more widespread and well-accepted in translational science settings. The community of iGEMers would be larger than ever and there would be an entire

generation of iGEM-inspired scientists running their laboratories in several different scientific institutions and R&D companies all over the world.

11. Finally, what would be your message to students who are looking forward to participating in the upcoming editions of iGEM?

    iGEM is a wonderful learning opportunity particularly to young researchers. iGEM competition's pillars strive to provide a holistic approach to solving the problems present in your community using synthetic biology tool. It promotes and emphasis on science communication, collaborative spirit, and multi-disciplinary approaches. In many ways, it imbibes essentials skills in individuals to not only be good researchers but also active members of their community (not just the scientific community). I would also say "Get started as early as you can!!!"

Team Logo: