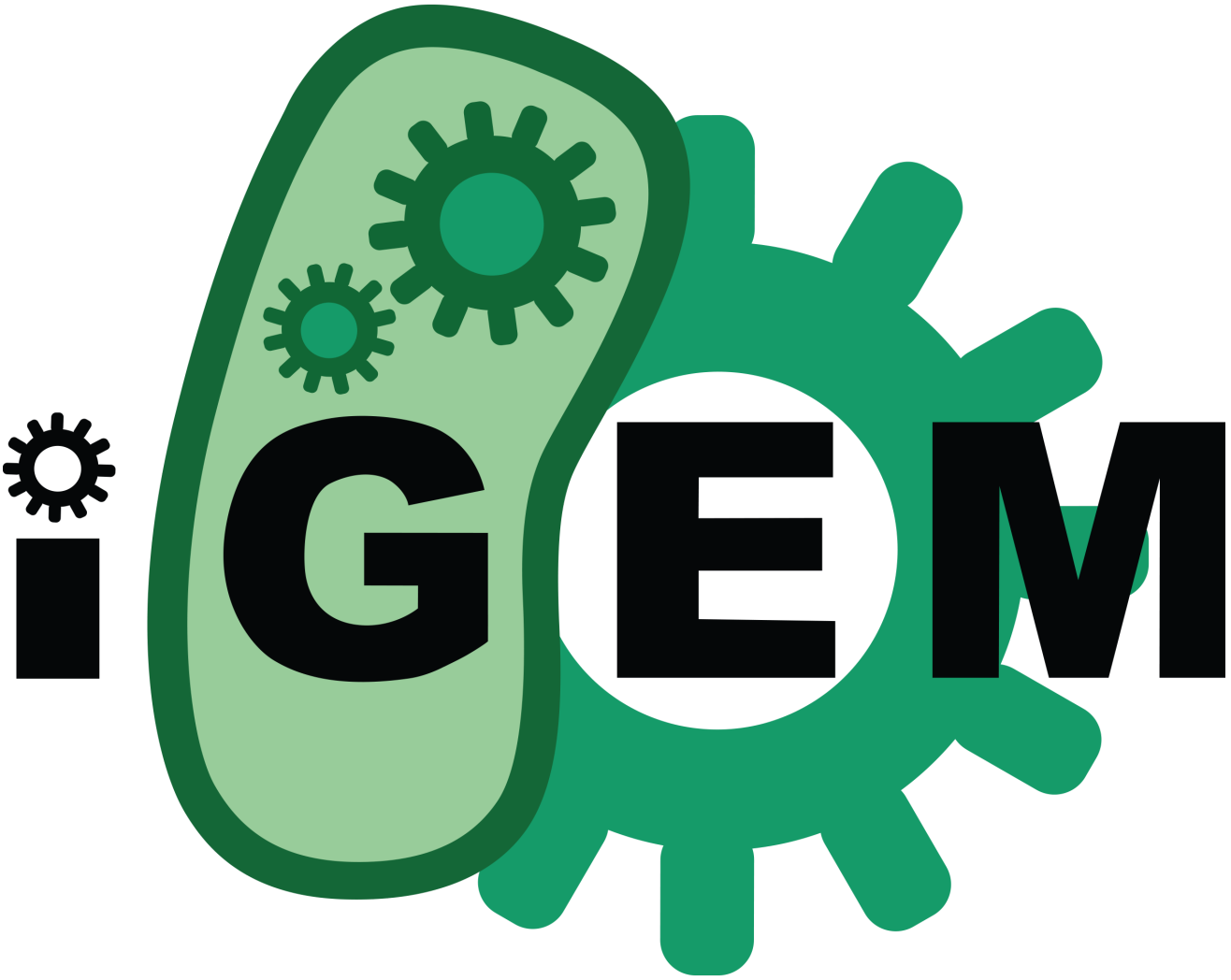


starting a high school team

A HOW-TO GUIDE FOR COMMUNITY LABS AROUND THE WORLD INTERESTED IN IGEM

about this guide

In the following pages you will read about how to start an iGEM team for high schoolers at your community lab. We hope that this handbook provides helpful insights that make your iGEM experience as enjoyable and efficient as possible. If you have any questions, please contact us at the email addresses below.

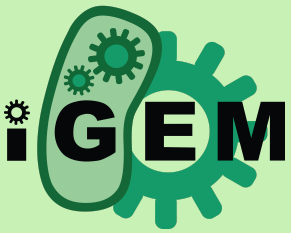
iTesla-SoundBio

itesla@sound.bio

Baltimore BioCrew

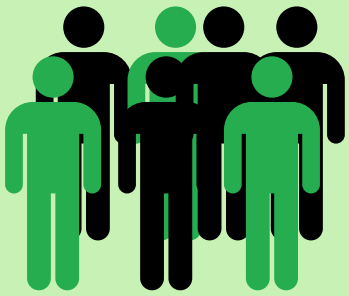
info@bugssonline.org

TABLE OF CONTENTS



Section 1

ABOUT IGEM



Section 2

STARTING A TEAM

Section 3

GUIDE ATTRIBUTIONS

about iGEM

The iGEM (International Genetically Engineered Machine) competition is a synthetic biology competition where teams from all over the world share their projects at the Giant Jamboree, which occurs in either October or November annually. Teams are awarded with a bronze, silver or gold medal that are achieved through the completion of different areas of iGEM. For instance, medals can be awarded based on completion of human practices, collaboration, and laboratory projects.

Teams can also win a variety of other awards like Best Plant Synthetic Biology, Best Product Design, and more. Aside from producing a working project and wetlab work, competing in iGEM also focuses on a few other "areas" such as:

- **Human Practices** - the part of your project that deals with how your project will impact society and how experts and the general public influence your project
- **Wiki** - a website for your team that summarizes every aspect of your project
- **BioBricking** - standardized biological parts from past projects that iGEM keeps in a registry
- **InterLab** - a collaborative study open to every iGEM team that wants to submit data

Starting a team

Recruiting

About Recruiting

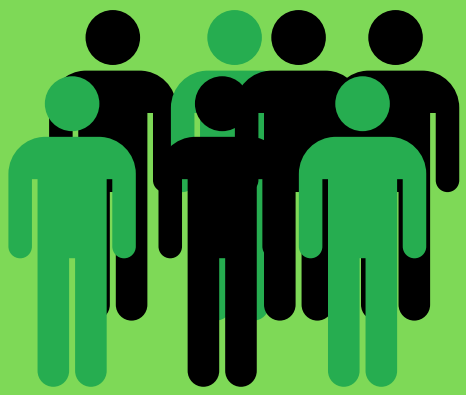
In order to have a successful high school iGEM team, it is important to recruit members who are interested and dedicated in learning about synthetic biology. Most high schoolers have many commitments, so it is helpful to have students who are motivated to participate as well as create schedules that are flexible so students are able to progress the team's project. Additionally, it is important to consider that many students might end up needing to quit iGEM as their schedules may get hectic, so recruiting members who are extremely committed is far more important than recruiting a large amount of members. In addition, even these dedicated members may need to drop off during the year, so teams should recruit accordingly.

Starting a team

Recruiting

Recommended Recruiting Methods

With iGEM not being a very well known competition, at least outside of the molecular biology scene, recruitment is one of the more difficult aspects of building the team. Although many methods of recruitment exist, one of the most effective ways to recruit is word of mouth. Students generally are the best at convincing one another to join a team as they share similar interests. Sometimes the mentioning of a potential resume builder can cause issues with students more concerned with getting credit for the project, and less with the project itself. Flyers, although convenient and easily distributed, tend to be less effective as they are often overlooked by students in the disorganized collage of other club advertisements. However, flyers as well as emailing local high schools, contacting high school science teachers (as they tend to be the most familiar with STEM-oriented students looking for opportunities) or other science professionals in your area may be one method of gaining interest. One way of collecting information about new members is through Google Forms.



Starting a team

Recruiting

Some Sample Questions/Information To Collect

- Email Address
- First and Last Name
- Cell Phone Number
- School
- Expected Graduation Year
- Gender
- Ethnicity
- Parents' Email Address(es)
- Parents' Cell Phone Number(s)

Starting a team

Recruiting

Possible Recruiting Methods

- Advertising on Community Lab Website/Blog/Interest Group
- High School Posters/Flyers
- In-Lab Advertising
- Word of Mouth/Social Media
- Informational Meetings at Libraries, High School, Community Lab, etc
- Contacting Science Educators/Professional
- Public Outreach Events

Starting a team

Communication & Tools

About Communication & Tools

Communication is key to running an iGEM team to any level of effectiveness, as are the tools used by the students to complete the project. It is essential that an entire team can stay up to date on the project's progress, meeting times, and other important dates and deadlines. Also, having all team information in a centralized location that everyone has access to and can share documents, pictures, and other files easily greatly contribute to a team's overall success.

Starting a team

Communication & Tools

Recommended Communication & Tools

Through our experience, we have found that an email list can be ineffective due to a number of factors, but mainly due to the fact that many students are not as adept as using email yet, so there will be a small portion of a team that won't be keeping up properly on communication. However, creating a team email list is still useful for the PIs/adult advisors to create when sharing important all-team memos and adding access permissions to different software.

Better methods of communication revolve around communication-centric applications, such as direct/group messaging apps. Specific examples that worked well for us are Slack and Discord, and teams should try to select one of these two (or a similar tool) so all core communication is centered in just one platform.

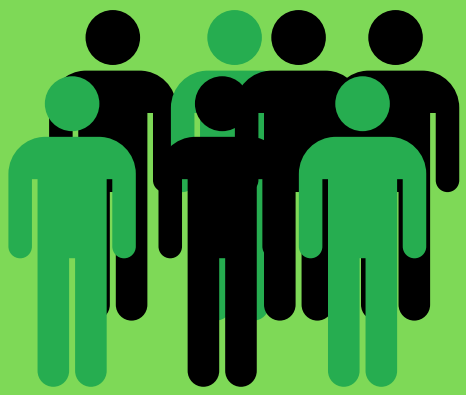
In these two tools, you are able to create specific "channels" that contain discussion on specific topics such as brainstorming or jamboree information.

Starting a team

Communication & Tools

Some "Channels" That We Have Had Are:

- **Brainstorm**: had this channel during the early stages of our project to bounce around possible project ideas
- **Fundraising**: had this channel to discuss all matters of fundraising (donors, events, etc)
- **Human Practices**: had this channel to discuss all matters of Human Practices (people to contact, events to hold, etc)
- **Interlab**: had this channel to communicate about the different deadlines and results that were occurring specifically for Interlab (this is helpful because it is separate from the team's project)
- **Jamboree**: had this channel that was just for the members attending the Jamboree to communicate information about flight times, itinerary information, etc
- **Leadership**: had this channel just for the PIs/advisors and the student leadership to discuss more long-term plans for the team
- **Wetlab**: had this channel to post updates about wetlab as well as meeting dates
- **Wiki**: had this channel to discuss the different parts of the wiki and share photos/files/etc.



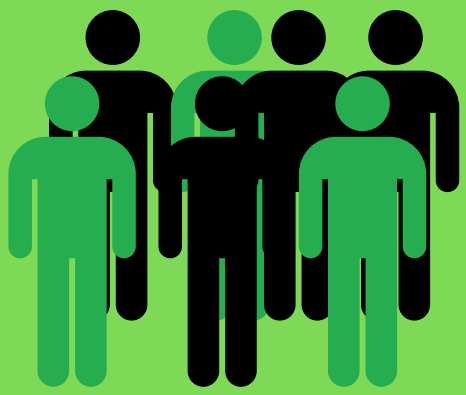
Starting a team

Communication & Tools

Recommended Communication & Tools

These applications often come with features that can send out reminders or notifications to specific individuals or the entire team. Additionally, an added benefit of applications like Slack or Discord are that they can be downloaded on smartphones, making it more accessible for students.

Tools that are useful overall for an iGEM team generally are programs designed to help design genes and protocols, as well as keep all content organized. A couple notable examples are Gene Designer (which designs genes) and Benchling (protocol, sequence, notebook planning) which allow for all designs to be efficiently made, stored securely, and most importantly, accessed easily by all members.



Starting a team

Communication & Tools

Recommended Communication & Tools

Additionally, we highly recommend that a team Google Drive folder is created to store all documents and files amongst the team easily. One thing to note about creating this folder is that it should be made by somebody who runs the community lab or a team's adult advisor to create the folder and also check the option that says "limit other collaborators from sharing." This way, a compromised account from any of the students cannot completely remove the whole team from access.

Some Sample Folders We Have Had

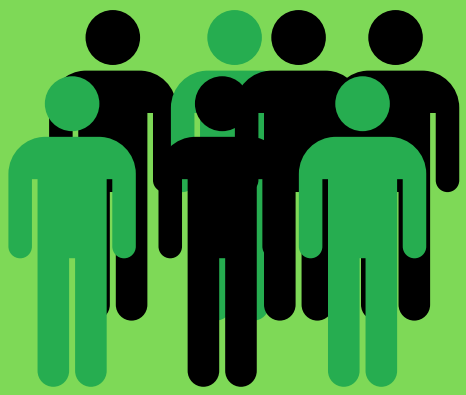
- Biobricking
- Fundraising
- Human Practices
- Interlab
- Lab Notebooks
- Protocols
- Wiki

Starting a team

Communication & Tools

Different Tools & Communications Ideas

- **Google Hangouts or Zoom**: video calling platforms that are good at hosting multiple users
- **Slack or Discord**: communication/messaging app that allows for the centralization of updates, collaboration, and easy sharing of content
- **Benchling or Gene Designer:** allows for teams to design plasmids, primers, and other items with ease
- **Google Drive**: storing documents, photos, and other files.
- **Team & Leadership Emailing List**: help for sending the most important information to people (whereas a central application like Slack or Discord are used more frequently). Also it is good to have the leadership email list to be the address in which other teams/companies/etc contact the team since both the PIs/advisors and the key students can manage external communication.



Starting a team

Leadership

About Leadership

In order to effectively run an iGEM team, some form of leadership structure has to be established so students know who to go to for any questions or advice on the project. This typically consists of the advisors and a few students who are either very knowledgeable about synthetic biology, have had prior experience with iGEM, or are good at giving direction and helping a team move forward.

Starting a team

Leadership

Leadership Recommendations

For larger teams, official positions can be established for people working on specific portions of the project. Students can be placed in charge of each section with a couple of the more experienced students in charge of the whole operation. Also, there should be adult advisors there in case of questions or help needed from the student leaders. In this case, students who are “in charge” of specific areas should be responsible for making sure things are moving at an optimal pace and on track.

Some Suggested Leadership Roles Are:

- Wetlab Lead(s)
- Fundraising Lead(s)
- Wiki Lead(s)
- Human Practices/Collaborations Lead(s)

Starting a team

Leadership

Leadership Recommendations

Smaller teams have a slightly different situation. Although specific groups can be made, any students missing could mean an entire group is left without members. What we have found to be effective is to have the older members be the de facto leaders of the team. These students are typically: interested in being a student leader and has demonstrated the potential to learn the skills for leading the team. The adult advisors will be there to guide these leaders, and the other students if none of the leaders are able to come.

Starting a team

Timelines

About iGEM Timelines

In iGEM, there are many deadlines that need to be met, namely closer to the Giant Jamboree. These important dates, such as the Wiki Freeze (when teams are no longer able to edit their Wikis), DNA Submission, or InterLab Data Submission need to be kept track of as they are essential for teams striving to win any type of award. In addition, generally speaking, it is important that each team creates their own schedule to make sure that their project is moving along at a timely pace and has enough time for analysis and improvement.

Starting a team

Timelines

Timeline Recommendations

Often, for high school teams, it is difficult to establish a concrete schedule in which everyone will be able to attend every meeting as students often balance iGEM with other commitments like school or sports. In addition, having a team in a community lab poses additional challenges as a team may need to work around other lab members or community lab events. In order to work around this, our teams have worked closely with the community lab supervisors to determine a schedule that works best for the students and the lab. In general, this aspect of designing a team is up to the discretion of the individual teams as no specific plan will fit everyone. However, setting at least a semi-regular schedule for meeting times, check-ins, and research/design deadlines is extremely useful to keep everything organized.

Some Things To Consider In Making Schedules Are:

- What times does the school day end?
- Does your community lab have regularly scheduled events that the team needs to work around?
- What school holidays/days off are there?
- How long do certain procedures take? Do they require overnight/multiple day steps?
- What times can each member typically meet?

Starting a team

Timelines

Timeline Recommendations

Some suggestions would be to use either an app to create and publish the schedules (When2Meet or Google Sheets are some ways to gauge for availability), or just using the methods of communication discussed earlier. Additionally, when we were expecting many consecutive days of meeting, in our teams' communication platforms, we typically send messages announcing the dates of the meetings and ask our team members to respond with the dates that they are available. This way, we are able to more accurately gauge attendance.

Starting a team

Protocols & Lab Notebooks

About Protocols & Lab Notebooks

A protocol is essentially a procedure outlining the materials and steps needed to do a certain task. A lab notebook is a compilation of protocol(s). Lab notebooks are used to delineate what was done on a wetlab meeting in on that day, the results, and the people who attended.

Starting a team

Protocols & Lab Notebooks

Protocols & Lab Notebook Recommendations

The break down of a protocol is fairly simple. As stated before, it is just a materials section and a procedure section. To make sure your protocol is right, base it off of a trustworthy source, but adapt it to fit with the exact equipment in your lab as well as to fit with your project. Since different reactions for a digest (for example) might change each time you do it because of concentration variability, make your protocol templates versatile for any situation. This can be accomplished by highlighting the “variable areas” in your protocols so it is easier to refer to what needs to change depending on your wetlab session. Kits from companies like Qiagen or Epoch provide a cheap and simple option for doing standard molecular biology experiments that will be needed to complete your project. Generally, the protocols provided or recommended by the producers of the individual kits work the best. Of course, many times it is good to follow whatever has worked best in the context of your lab and project. For instance, use the QiaGen handbook for your protocols, but shorten it so that anyone can follow it on the fly. Additionally, add an “x” or blank everywhere a varying measurement of a certain material is needed. Next to it, add instructions on how to find how much material to use. This way your lab notebooks will be accurate and applicable to a variety of procedures.

Starting a team

Protocols & Lab Notebooks

Protocols & Lab Notebook Recommendations

Documentation is also an extremely important part of any project. Lab notebook entries should be as detailed as possible so your project can run smoothly. It is often helpful to have templates for lab notebooks and protocols ready ahead of time rather than making each one from scratch. Usually lab notebooks are created at least one day in advance to the actual meeting. Here's an example of what a lab notebook may look like:

Attending members:
Alex Richardson
David Lu
Sophie Liu
JJ Wheeler
Charlie Anderson
Jimmy Zhong

Objectives:
1. Miniprep BBa_J04550 plasmid (with pSB1C3 in it)
2. PCR fragments 1 and 2 and run an analytical gel
3. PCR purify fragments
4. Digest (BglII) and ligate the fragments together
5. PCR the ligation (maybe after a column clean up) and run an analytical gel

*If by some miracle the pSB1C3 primers arrive today, we'll move ahead with FastClone stuff as well
1. PCR pSB1C3 and run an analytical gel
2. Mix with fragment 1 PCR and digest with DpnI

*If we get everything needed for transformation
1. Overnight cultures of NEB 5-alphas

Expected Outcomes:
1. 4 minipreps of at least 10 ng/uL, but hopefully around 50 ng/uL
2. Successful PCRs of fragments 1 and 2

Minipreppping pSB1C3+mRFP (BBa_J04550)

Materials:
- overnight cultures pSB1C3+J04450 [should be in shaky, red cultures with blue tape]
- MX1 [Chilly, on the inside of the door on the first shelf, **keep cold, only take out when needed and return once done**]
- MX2 [epoch kit under bench 4]
- MX3 [epoch kit under bench 4]
- Gencatch columns [epoch kit under bench 4]
- collection tubes [epoch kit under bench 4]
- Elution Buffer [epoch kit under bench 4]
- sterile microcentrifuge tubes [on top of Shaky, inside autoclave-taped pipette boxes]

Procedure

3. Use a p200 to put some amount of clean water on a wipe, then use said wipe to wipe off the black circle and the corresponding part on the lid. Keep the wipe around for reuse.
4. Pipette 0.65 uL of Elution Buffer into the middle of the black circle on the NanoDrop machine, then slowly close the arm.
5. Press "Blank" (in the application) to blank the NanoDrop (this gives it a baseline from which to measure your sample's concentration).
6. After it's finished blanking, wipe the NanoDrop off with the wipe from earlier.
7. Pipette 0.65 uL of [whatever is being measured] into the NanoDrop as before. If you've just done the miniprep or taken the tubes out of the freezer, make sure to flick them a few times to a more consistent concentration. Close the lid.
8. Label the sample in the "Sample ID" box.
9. Press "Measure."

Results:

Label	Concentration	Volume	Location	Notes
pSB1C3 miniprep 1	119.2 ng/uL	~ 30 uL	Yellow box, sniffles	
pSB1C3 miniprep 2	76.1 ng/uL	~ 30 uL	Yellow box, sniffles	Curve appeared unusual at first, but on second measurement it looked fine
pSB1C3 miniprep 3	113.4 ng/uL	~ 30 uL	Yellow box, sniffles	
pSB1C3 miniprep 4	108.9 ng/uL	~ 30 uL	Yellow box, sniffles	Curve appeared unusual at first, but on second measurement it looked fine

All minipreps went very well. These four minipreps should last us a pretty good amount of time.

starting a team

Fundraising

About Fundraising

One of the most difficult aspects of iGEM is fundraising. iGEM as an activity is quite expensive, considering travel, registration fees, and material prices. This is often a concern for teams, and and it is difficult for high school teams to receive funding, as undergraduates often can receive funding from their school or departments.

Starting a team

Fundraising

Recommendations for Fundraising

To gain substantial funds, teams should explore contacting local biotech businesses. It is a more detailed process that is more about building the connections and gaining the business' interest rather than just asking for funds from the businesses, however having these connections are vital as they can not only offer monetary support but can often help with questions about designs or getting materials. To do this, teams would need to be able to schedule informative and detailed meetings with the businesses to describe their project and ask the business for their input/expertise, their thoughts, and potential interests. Another method that teams should try is applying to local or national grants. Many school districts, grocery stores, and other businesses often offer grants to high schoolers for STEM/science projects, like iGEM projects, as it is a way to "further STEM education for youth" in the community. However, these grants can take a long time to find, to apply for, and do not always yield a desired or any result, but they are also another alternative if there are no biotech companies/businesses in the area.

starting a team

Fundraising

Recommendations for Fundraising

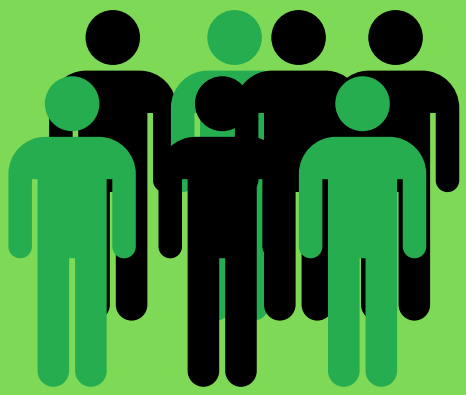
- **Crowdfunding**: we have used Experiment.com and GoFundMe to raise money for our projects
- **Matching Donations**: many companies, like Microsoft or others, match donations. Finding companies in your area as well as people with connections to these companies are useful in bringing in donations. A good resource to check is https://doublethedonation.com/ to find companies that match donations.
- **Fundraising Events**: there are many different products and businesses that allow teams, clubs, or schools to hold an event or sell products to raise money. Some companies that we have used are Menchies, Krispy Kreme, Chipotle, and Jamba Juice, but these always vary by a team's location, but are good to look into. Also, hosting events like these also allow teams to interact with their community and talk about their project.

Starting a team

Human Practices

About Human Practices

In iGEM, Human Practices consists of the ways that the community influences the direction of a project and how a team's project can contribute to or affect the community. Often for Human Practices, teams get in contact with local and other experts, professors, or community members to learn more about the importance of their project and see in what ways their designs can improved. More information about Human Practices as well as examples can be found on iGEM's website.



Starting a team

Human Practices

Recommended Approaches

Human Practices content differs drastically from team to team as it pertains specifically to the outcomes and goals of a team's project. However, we've included it in this guide as it is something that isn't always considered early enough in the project by new iGEM teams, given it is often difficult to conduct. Typically, it is useful to have students engage with their local community to identify problems that exist and possible synthetic biology solutions of which to focus their project on.

Some Things To Consider In Making Schedules Are:

- **Reaching out to different professors, experts and organizations:** doing this early on helps meet iGEM's expectation that Human Practices have actively changed or made an impact on a team's project
- **Holding events and activities that the general public can attend:** setting up booths at science or maker fairs, holding talks or discussion groups at libraries or community centers, or garnering community engagement through social media such as YouTube, Instagram, or Facebook

attributions

This iGEM Guide was created by the iTesla and Baltimore BioCrew 2018 team members. Both teams are located in community laboratories and host a team of high schoolers from schools across their city.

The Baltimore BioCrew began its journey with iGEM in 2016. The Baltimore BioCrew has completed their research projects throughout the years in the Baltimore Underground Science Space (BUGSS),which is a community research laboratory located in Baltimore City. The team continues to expand each year with the improvement of recruitment and has managed to achieve a Bronze medal each year it has participated in this competition.

Team iTesla-SoundBio was started in 2017 by students from multiple high schools in the Seattle area. Team iTesla-SoundBio has done their research for the past years at the SoundBio Community Lab which is located in University District in Seattle, Washington. In the past, iTesla-SoundBio has been able to win a Bronze medal and continues to expand its team, garnering members from around nine schools across Washington.

attributions

We would also like to thank the following community labs for their support and feedback on our proposed iGEM Guide for Community Laboratories around the world:
BosLab, BioCurious, Bricobio, ReaGent, Ronin Genetics, The Open Science Network, DIY Bio Hong Kong, Victoria Makerspace, AbroBios, BioBlaze, and Bioscope.