iGEM UPPSALA 2017

THE ETHICS GUIDE BOOK

Contents

Introduction

Synthetic biology is a relatively new branch in biology that comprises the genetic modification of existing organisms in order to understand molecular mechanisms, but also with a potential use of the final product and a value on the market. This pamphlet of 2017's iGEM Uppsala team aims to contribute to the necessity of the scientific community to deal with ethical issues regarding this field. With ethical implications as far-reaching as genetic engineering, a systematic approach the topic is of great importance to raise awareness in young student researchers.

We identified 4 subtopics that an iGEM member will eventually come in contact with: (i) intellectual property, giving iGEM is an open-source research community, (ii) work ethics, which comprises the correct working in the lab as well as behaviour in a team, (iii) genetic engineering, with its many implied ethical issues, and (iv) social responsibility, which refers to proper communication with the public. Each topic is briefly presented in a chapter in this pamphlet.

For simplification, we summarized each chapter in 3 questions at the end of this pamphlet that we propose each iGEM team answers for itself. The process of working out the answers should lead the researcher to a profound examination of the ethical implementations of the project, the lab work and being a member of a team. We encourage every participant to devote a part of their time and motivation to such an important issue that keeps being overlooked in science.

CHAPTER 1

INTELLECTUAL PROPERTY

Many people contribute to the project, there is not something like a first author. Protocols and ideas will be taken from multiple places. iGEM as itself requires to be innovative.

Intellectual Property

What is intellectual property?

Intellectual property refers to creations of the mind, such as inventions and artistic works as well as symbols and images used in commerce.
These are usually divided into two areas:
The first category is broadly related to the rights of authors of literary and artistic works, while the second can be further subdivided into two areas, one concerned with the protection of distinctive signs such as trademarks – while the second pertains to such things as inventions/patents, industrial designs and trade secrets. The matter is slightly complicated by the fact that the basis for intellectual property rights is national law, and although treaties exist that harmonize these rights on an international level, there is still some variation between rights in different countries.

When it comes to scientific data the main areas of concern are: copyright, patents and trade secrets. The underlying idea is to try to strike a balance between private gains and public benefits, giving the intellectual property owner the right profit from a new idea. The tradeoff being that the idea must be made public, making it possible for others to build on the idea.

Copyright controls how an original work is used and distributed, and is granted to the author of that work, meaning the one who actually wrote the words or created the tables or figures, in the context of scientific publication. While the actual words and images are protected, the ideas themselves can be used by other as long as they are properly attributed. There is also, in some countries, provisions that supersede the rights of the copyright owner along the lines of fair dealing (UK/Europe) or fair use (US) that allow non-profit use for purposes such as education or research.

Patents pertain to inventions and have to be actively sought, they do not automatically apply as is the case of copyright. To apply for a patent you need something that is new, that has not been published before or even described in a publication and there needs to be an inventive step. A successful application will result in exclusive rights to your invention in the country where the patent is granted. else discovering it independently.

Intellectual Property

Trade secrets are information or data which is valuable as long it is not known. There is no need to make the information public, but also no protection from someone else discovering it independently. As soon as the data is publicly disclosed the trade secret protection is lost.

What does this mean for your team?

In terms of the actual competition there is no need to worry. Unless you have a specific need to access protected data the common practice of proper acknowledgement and attribution should suffice. And even then you can always ask the owner of the patent or copyright for permission. Unless you are going to commercially exploit your results, there is little need to concern yourselves with the finer details of intellectual property right laws. For example the team wiki is published under the creative commons licence, so copyright isn't really a factor.

The purpose of the iGEM competition is to present your results in order to be judged for the competition so trade secrets don't really make sense in this context as your goal is to disclose and thus negate any protection that may have initially applied to your data. You can't patent anything coming directly out of the competition, so if you do discover anything you might want to patent you need to keep it of your official team submission. Alternately, you could build on ideas coming out of your project after the competition is done.
For the most part, however, the average iGEM team shouldn't run into any trouble with regards to intellectual property laws, as long as you are aware under what license your sources are published under and everything is properly cited and attributed. While it might be a good idea to familiarize yourself with your local laws with regards to copyright and especially any kind of fair use/dealing-type of provisions, it strictly speaking shouldn't be necessary.

References

Carroll MW. Sharing Research Data and Intellectual Property Law: A Primer. PLOS Biology. 2015 Aug 27;13(8):e1002235.

"Intellectual Property." National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. 2009. On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition. Washington, DC: The National Academies Press. doi: 10.17226/12192.

When we share, everyone wins [Internet]. Creative Commons. Available from: https://creativecommons.org/

CHAPTER 2

WORK ETHICS

This chapter summarizes how to work in a laboratory in the safest possible way as well as takes into account the ethics when working in a group together.

Working with microorganisms

When working with microorganisms it is important to consider the potential harm it can cause, both towards the team members and the environment. The first thing to note is which class your microorganism is and which biosafety level is needed for you to work with this particular organism and vice versa. For example working with Escherichia coli DH5α, which is a class 1 bacteria can be worked with in a level 1 biosafety lab. A easy safety measure to consider to limit the potential spread and harm of microorganisms is to frequently use 70% ethanol as a bacterial killer and limit the access of people to the lab you're working in.

Emergency equipment

To make sure the work environment is safe every team should ask themselves some crucial questions. Such as how do we act in case of an emergency, do we have all the equipment available to handle any emergency and do we know how the equipment works? This is to reduce the risks of accidents and also to have a safe workplace for all team members. It is highly recommended to have a safety tour of the lab before lab work is conducted, to make sure all team members are aware of what to do in case of an emergency and where everything can be found. Interesting safety equipment to look out for are bandaids, fire blanket and fire extinguishers. Some lab also include eyewash and showers. It is also important to note that there are also different types of fire extinguishers depending on what is burning. A foam extinguisher should be used in case of fire on wood, textiles, paper, plastics and liquids. A carbonic acid extinguishers is used on liquids, plastics and electronics.

Clothing in lab

Are all team members protected in the best possible way to the limit risk of getting hurt. Examples of protective clothing include lab coats that are long sleeved and lengths to the knees. Feet should be covered by shoes for protection and long hair tied up. Other protective clothing rules to consider is no jewelry around hands, no contact lenses or no gloves when using fire.

Behavior in lab

Lab safety does not just include the equipment in the lab, but the behaviour of the lab crew as well. Standard rules suggest no running in the lab, no food or drink, no bags

or jackets in lab, all the containers should be labeled and no plastic gloves when handling fire.

Otherwise how would you know a clear liquid is dangerous or not? What happens to your skin on your hand when the plastic glove melts? To take percussive measures to make sure the lab crew keeps their eyesight for a number of consecutive years it is important to wear safety glasses when handling dangerous chemicals or fire.

Working in a group

For the work ethics to work well within a group, it is important to set up rules and guidelines beforehand that each team member agrees to and has to follow throughout the project.If changes are done to the guidelines set up beforehand everyone affected should be notified. Below you can see an output of guidelines of rules that you imply on your team.

Workload

How many working hours per day is expected of me to work by the other team members. Do you get paid for your work in some way, if no, then which demands do you have upon yourself and the rest of the team. It is important to note that every team member that is contributing to the project should also get credit for their input, keeping that in mind iGEM is a project built on team effort and not individual achievement, as such the credits should also reflect this. It is of course a huge advantage if each team member contributes to the best of their ability to the research/planning and takes their responsibility seriously for the project. If for some reason a task can't be completed due to that it's unreasonable or too complex, there should always be a person a team member can turn to such as Project Manager for help.

Documentation

It is extremely important that no information is lost and continuous communication is conducted in the team. That's why it's good to have a sharing of documents within the team, such as google drive or dropbox. Notification of changes in documents should be notified to anyone to whom it might effect, this can be done in any form of media, such as messenger, sms, slack etc. It is also important to note that group documentation is a work of the whole group and therefore its content should be agreed upon before handing in/making public by other group members.

Work ethics

Team Meetings

It is good to have team meetings to update one another in the group. Meetings are a good way to make sure everyone knows what is going on as well as creating a feeling of belonging and contributing for all team members. To make sure nothing gets lost or misinterpreted during a meeting it is a good idea to keep a protocol of the points discussed during the meeting.

To make sure the meetings are effective as possible a few rules to consider are the following; Mobile phones be switched off. In case of lateness, message to let the team know. Notify absence and of course if a team member misses a meeting it's their own responsibility to get up-to-date of what they missed.

Team Building

Team building is a great way to create team spirit and a feeling of belonging in a group. It also reduces dispute within a group, promotes communication throughout the group and brings everyone closer together. Team buildings could be anything from a picnic, movie night, lasertag or whatever the team might find fun. It is though important to note that no activity should be obligatory and it should not inflict stress or a greater workload on the team. It is also important to respect other members choice of diet or other preferences.

Conflict solving

It is important to note that each team member has a right to their own opinion and should feel free to express it without interruptions. Bullying in any form should not be tolerated. If a conflict occurs in the group it is important to solve the conflict so it doesn't inflict onto other team members or work. Usually conflicts can be solved by the people to whom it refers, but if this can be done it's a good idea to have an impartial person present, such as a project manager.

Discrimination

If discrimination occurs within the team the team should know the correct authorities to turn to resolve the discrimination. This can be anything from project managers, university personnel etc.

References

UC San Diego. Biosafety Level (BSL) Practices
Chart. 19.10. 2017.

Uppsala University. Laboratory Safety Section of Chemistry. 2013.

CHAPTER 3

GENETIC ENGINEERING

Ethical issues are a big part of science and we should not forget them while picking our iGEM project.

Genetic engineering

Conceptual ethical issues

The ethics evolving around the work of the researcher are inseparably connected to the intention and the purpose of their experiment. In this chapter, we are exploring the questions arising around the moral point of view of the experiment conductor. With the rapid rise of technical possibilities, the responsibility for the individual research teams increases as well. A product of synthetic biology today is cheaper to make and potentially accessible worldwide, with deep consequences on the biological system in which it is implied.

With the manipulative and invasive nature of synthetic biology due to its usage of genetic engineering, certain dangers come with it that have to be assessed by the ethical responsible researcher. IGEM is a project that demonstrates how the responsibility shifted from the rise of DNA technology in the 1970ies, where few exclusive scientists were developing the technology. Today, young students work with and manipulate genetic organisms and acquire knowledge on complex genetic engineering. This has many positive effects, but also comes with new ethical questions that have to be openly assessed and debated by all members of the public. Ethical issues typically come with potential misuse and/or danger that can arise from a product. For synthetic biology, these are typically uncontrolled release into the ecosystem, bioterrorism, economical and socio-economic aspects. These topics require the researcher to carefully evaluate the nature of their desired designed product and often, to think multiple steps ahead regarding the potential use and misuse of the engineered organism.

Release of the genetically engineered machine

The problem addressed in this part boils down to "What would happen if my GEM ends up outdoors behind my lab?". While the question seems to be straight-forward, predicting its answer remains a challenge as ecosystems are complex and influenced by too many parameters to reliably predict to outcome of an uncontrolled release. Many students participating in iGEM are further coming from the specialized field of molecular biotechnology, an education that does not include deep knowledge of ecology. The underlying danger is the irreversibility once a release had happened that leads to interference with native organisms. Regardless of the constant introduction of new genes in the natural gene pool, artificial engineered genomes are specific for our interest and purpose and never evolved under the pressure of natural selection. The term "natural' refers to organisms or genes that had never been under human manipulation, but solely developed under the evolutionary pressure of the survival of the fittest. Three types of interference emerge: Horizontal gene transfer, which means the permanent integration of engineered genes in natural organisms, competition of the GEM with natural organisms and potentially outcompeting them, or pathogenic interactions, which should by their safety standards not regard iGEM. Thought experiments should include several opinions on consequences of the artificially gained characteristic of the GEM in nature.

Misuse

Following the footsteps of the classic example how the theory of relativity helped developing the atomic bomb, this chapter aims to raise awareness for potential misuse. This topic is especially important in the iGEM competition due to its open-source character and detailed, accessible documentation and protocols. While many iGEM projects aim to solve or improve environmental or health problems, a self-check is important. To pick an example occurring in the US, garage biohackers are very potent in regard of what they can do. The background is simple – second-hand and therefore cheap machines such as PCR and online ordering of chemicals allow the existence of home labs with little to no control over what is happening in them. This requires careful assessment on potential misuse that emerge from the desired GEM, and, equally important, the methods used to design it. A further topic is, of course, terrorism and the misuse to a greater, much more dangerous extent of sensitive data and knowledge. Again, the safety level of iGEM does not permit the work on dangerous organisms, however, it is an important practice to think three steps ahead and be able to produce a thought-through statement about the future usage of the product.

Global justice

This part of the ethical responsibilities of a researcher wants to encourage to think about the economic consequences of a (hopefully) successfully implied, produced and sold GEM product. Many of said products could enter the market of naturally yielded, farmed or produced products, which could threaten the value of a good. This is especially problematic in terms of global justice, if the traditional market is provided by less developed countries and the high-end technology product is introduced by a First World country. Often, besides the patenting issue, a product comes with an economical value, which can in turn create monopolies and profit-driven policies around the GEM. These are consequences that should be especially considered if the GEM is in its final steps of becoming a sellable good. For this, it might be useful to consult economic experts as well. Another aspect concerns false hopes created by projects. Especially in context with certain diseases, some countries are more affected than others and rely on technological solutions and help from other countries. This is prone to create imbalances and dependencies, which in the past surfaced in discussion about medicine prices. It remains important to be aware of these issues when the iGEM team chooses a project close to an economic market.

The legitimacy of fabricating life

This part of conceptual ethics around biotechnology evolves around the question "I can do it, but do I want to do it?" Many researchers have a positive attitude towards manipulating genes and enhancing gene functions of an organism. In order to achieve clear and good communication with the public, it is important to realize that in the process of publishing about the GEM or selling a product, people will be encountered that do not agree with that. Many sensible topics touch the border of what still has a clear use, and what we try to archive for the sake of archiving it. The latter touches the area of potential consequences again, but not necessarily on a biosafety level, but on a very basic ethic level: "Is it ethical to do this and should I do this, just because I can?" Many would argue that that is what has always been driving research forward, while others would highlight that for example human gene manipulation can have severe ethic consequences if treated without caution.

It is of utmost importance to have a vivid discussion about these topics on a societal and political level and ensure that people stay informed. Our inner need to push borders and discover the unknown might not be preventable, so how can we anticipate the consequences with such powerful tools as synthetic biology offers us? iGEM with its young researchers from cultures all of the world has a great opportunity in furthering this discussion and bring it into context of their own GEMs.

References

Uncontrolled release

Av-Gay Y, others. Uncontrolled release of harmful microorganisms. Science. 1999;284(5420):1621–1621.

Prakash D, Verma S, Bhatia R, Tiwary BN. Risks and Precautions of Genetically Modified Organisms [Internet]. International Scholarly Research Notices. 2011 [cited 2017 Sep 29]. Available from: https://www.hindawi.com/journals/isrn/2011/369573/

Williamson M. Environmental risks from the release of genetically modified organisms (GMOS)–the need for molecular ecology. Molecular Ecology. 1992;1(1):3–8.

Misuse

Kaiser D, Moreno J. Dual-use research: Self-censorship is not enough. Nature. 2012;492(7429):345–347.

Selgelid M, others. Ethics and censorship of dual-use life science research. In: Military Medical Ethics for the 21st Century [Internet]. Ashgate Publishing Ltd; 2013 [cited 2017 Sep 30].

Trevan T. Do not censor science in the name of biosecurity. Nature [Internet]. 2012

Global justice

Atkinson HJ, Green J, Cowgill S, Levesley A. The case for genetically modified crops with a poverty focus. TRENDS in Biotechnology. 2001 Mar 1;19(3):91-6.

Smith T. Biotechnology and global justice. Journal of Agricultural and Environmental Ethics. 1999 Oct 1;11(3):219-42.

Toft KH. GMOs and global justice: applying global justice theory to the case of genetically modified crops and food. Journal of agricultural and environmental ethics. 2012 Apr 1;25(2):223-37.

General ethics

Douglas T, Savulescu J. Synthetic biology and the ethics of knowledge. Journal of medical ethics. 2010 Nov 1;36(11):687-93.

Gutmann A. The ethics of synthetic biology: guiding principles for emerging technologies. Hastings Center Report. 2011 Jul 8;41(4):17-22.

CHAPTER 4

SOCIAL RESPONSIBILITY

Words are, in my not-so-humble opinion, our most inexhaustible source of magic. Capable of both inflicting injury, and remedying it.

- Dumbledore -

The way we communicate science can be the line between doing research and actually implementing our findings into everyday lives of people. Nowadays science might get a bad press even before release of the product. GMO, vaccinations and synthetic biology are a hard pill to swallow for a person with little biological background. Therefore, it is extremely important to talk about synthetic biology in the right way. Especially with outreach being a large part of iGEM competition and you as a team will probably eventually reach out to newspapers, write or give presentations about your project.

In this chapter we will go through the general Do's and Don'ts in communicating science and your project. This is done by firstly identifying the issues and threats that people typically see in synthetic biology and being aware of those. These are typically developed by misunderstanding or failing to think through what exactly the project is doing and might be able to do on either end of the dialog. Then you can develop your skills and language that you use in the dialog about your work. We will also touch upon different streams that you can use to communicate your project and their specifics that you should be aware of. That might be extremely important because the "recipe" one can use while communicating in a newspaper article might differ greatly while talking on social media or while making a video.

Use of classical media

During a webinar about science communication and social responsibility we asked five teams about the target audience and how to reach them. All of these team mentioned writing articles and the wiki. So there is a good bet on the fact that you will most likely need to write at least a couple of articles during your iGEM run.

But first let's talk about the case when you do not write the article yourself. Maybe you got into contact with local media or even more likely to some sort of scientific popular journal. This is when you might need to work with a journalist or scientific journalist to get your message to your target audience. When talking to other teams in our webinar team DTU pointed out that journalists are just means to get to the general public. But they also put up an extra step between you and your audience.

Social responsibility

During the Nordic iGEM Conference 2017 Torill Kornfeld spoke about how to treat a scientific journalist. According to her there is almost a physical difference between scientific writing that you might already be familiar with and scientific journalism. Even the very core, the purpose, of the form is vitally different. In a lab report, a piece of text you are probably most familiar with, the purpose is to report and reflect on your research and work. But when a journalist will tackle the project you are developing they will want to find the story behind it, the most interesting threads of information for the reader. A lot of scientists then might feel discouraged or even disappointed while working alongside of a reporter, feeling like they are not getting their message across. But if you realize the difference between the writing and the goals of a journalist you might have an easier time adjusting your story telling and your wording.

Then you will need to fill up even bigger shoes by being both the scientist and the journalist. It might be easy to get lost between the two faces you will have to put on, so be careful about what exactly you are letting out into the world when you press the publish button. One reason being that whatever you put on the World Wide Web will, in one way or another, stay there forever. The other being that the way you present your project may do more harm than good.

This is where you should think about the ethics of your writing. When we asked other teams how they are dealing with possible misunderstandings or misuses of their own words all the team we talked to said that they do worry and think about it. All of them also saw solution in a very simple path: being honest and thinking about your audience. As the Netherlands team nicely pointed out that you don't need to go in to the details but you should be truthful about your intentions and the possible risks. The other thing is to think about your audience. If you are going to talk to a fellow iGEMer or a professor you can probably afford to talk about enzymes, kinetics and western blots. But if you are talking to cashier in the store, your family or even other students from different field, they will look at you like you are a crazy person. There is actually a nice story about Albert Einstein from the time when he was working in Prague. He met one of Czech most famous writers Jaroslav Hašek in a pub and he was explaining to him how the special theory of relativity works.

And Hašek wrote this encounter into one of his books. Einstein´s character is a person in a mental hospital blabbering about existence of bigger earth in our earth. This is possible the only time you will ever hear this but: Don't be Einstein! Adjusting your text and wording to your audience is a must. If you are not sure, use your resources! Send the text to someone you know from your target audience and ask them if they understand what are you trying to say. This can be anyone from your high school teacher, your friend to your mom. If your audience does not follow it is not only bad because your project will not get the exposure you want but also because you can easily create a bigger gap between your field and general public.

In today´s fast moving world we need to get information to the end user in fast and digestive manner. The harsh truth about the internet is: People do not actually read here. Try to remember how you yourself interact with different platform. Do you actually carefully read through the whole article, check the writer´s credentials or properly look at the pictures and graphs? The answer here is probably a big no. We don't read, we skim through the page and go to the eye catching parts of the text. Modern internet user reads the big headline, maybe few lines, looks at bullet points and the picture if its eye catching enough. This is something you should think about while compiling your text, not only for the wiki. You need to make your text accessible to the audience. And if this is how your audience reads, this is how you should write. You might want to put the most important parts of your text in the first few lines. Then even if you lose the readers, they will still have a good idea about your message.

There are a couple of things you might want to think about before writing you article. Speakers at a panel titled Engaging with Social Media spoke about good ways for scientists to be part of the internet world and they agreed upon several of things: You should know what you are writing, tell a story and be available. If you don't know what you are writing and why, there is no point in even starting.

Before writing your own article, you might find yourself stumbling around the net and reading scientific articles on websites like Scientific American or IFLScience. These might be a good place to start looking on some good examples on how to write about your project. Make mental notes about what you

like about the articles but also notice the little things that all these sites and blogs have in common. First detail that might strike you are links. It might seem obvious that when internet is a place of sharing and connection a lot of it is about pointing at other people and their content and their idea. Not only it makes the article more trustworthy but it also shows that you understand ethics of the web and how sharing of knowledge on such platform works. You might want to watch Jay Rosen´s talk about Ethics of the link to grasp it a little bit more.

In science especially we have another type of quoting. We quote articles, textbooks and papers. Never forget to quote your original source. That is one of the basic ethical standards of a scientist. In science, people put a lot of their time to answer burning questions of the human kind and reference of another scientist continuing their work is often the only form of recognition we get. So don't be evil and reference. Pick a style and stick to it so others can easily distinguish between your thoughts and what have learned from somebody else. And since you will probably reference a lot it might be good idea to check out some reference software such as Zotero or Mendeley. These can help you not to get lost in the oceans of articles you will have to read.

Use of social media

It appears that scientists are getting used to using social media rather slowly even though a majority of scientists are using social media in their personal life. However, this is not the case when you look at iGEM. When you browse through a wiki page of almost any iGEM team, you will find links to their various social media. Almost every team shares their endeavours on Facebook, Instagram, Twitter, LinkedIn or YouTube. Those are all great platforms to reach out to your audience and share your project. But you also need to really understand what kind of people visits different channels and how these channel differ in their set-up. Sharing a lengthy text post on Instagram will probably not give you as much audience as doing the same on Facebook or LinkedIn. Recently Twitter became a good choice to reach the science community.

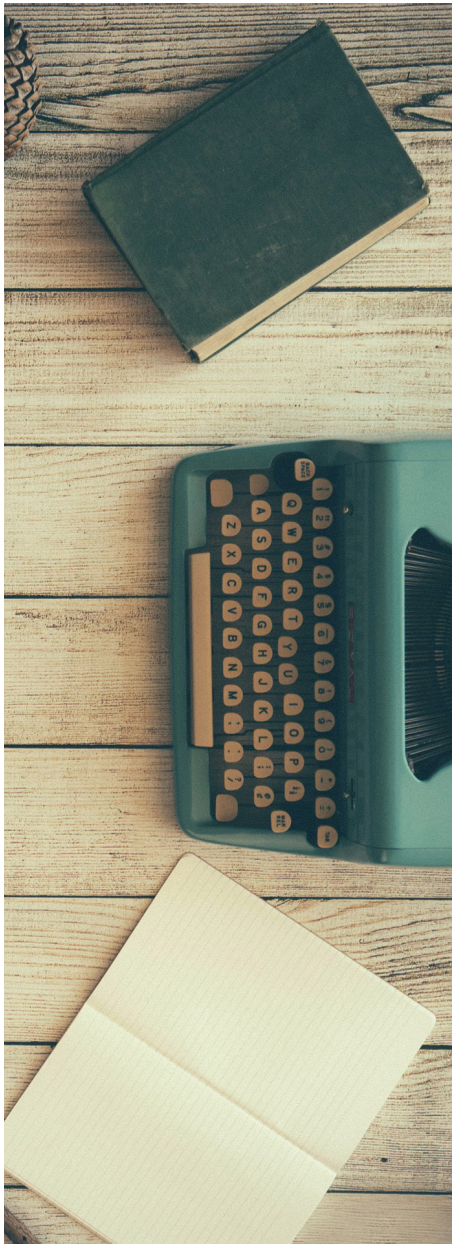
Again misusing media can lead to confusion from the general public or you not reaching them at all. For example, DTU iGEM team suggested during our webinar to use different media for different audience. This comes naturally with various niches of people visiting different websites. You can for example start with online market and demographic research of each media. These are available for free and you can get a good idea about what kind of people you can reach. Then you can adjust the style and language of your posts accordingly. Something that might come to Something that might come to most of us naturally but could be good to keep in mind when creating a new media account is that connecting on the internet always works both ways. Engaging your audience, following their interests and answering them back is one of the basics of social media networking. Create a new hashtag, ask your audience a question or have a small competition! The other is obviously feeding your audience with a quality content

Conclusions

In the last couple of lines, I would like to suggest to you to not be afraid to ask for help. There are institutions in almost every country that try to help bridge the gap between scientists and the users of their technology. These institutions might include for example various non-profit organizations or society groups and even government programs specializing in ethical issues. This part might also vary greatly depending on the country that your team comes from but there are again some general ties between approaches. So as always do your research and contact the appropriate organs. There is never a shortage of help for people who are not afraid to ask for it.

In a book Ambivalences of Creating Life, Mirko Ancillotti and Stephan Erickson looked at the main problems people have with synthetic biology. Between those you can find things like: GMOs, garage biology, monopolies, CRISPR, stealing jobs and markets, playing god or release to the environment. It is true that synthetic biology is a relatively new field and many feel that regulations and laws are advancing slower than the science itself. Despite that, when talking about synthetic biology most newspapers and articles use positive words and focus and the possible good outcomes of the research such as medication, cures, food supplies etc.

Whatever platform you will be using while talking about your project, make sure that you will not give place for misinterpretation. Try to stay honest an approachable and always think about the wording you use. You should not just think about the immediate future but also consider the what if´s. For example, what if our product will take the current market away and strip people of their jobs? Or: What if our product is misused or released to the environment? You should have clear and honest answers to these possible concerns. There is a great power in today´s social media but everyone who knows certain web slinger knows that with great power comes great responsibility. You should be aware of that but not frightened.



References

Bert A. How to use social media for science — 3 views [Internet]. 25.2. 2014. Available from: https://www.elsevier.com/connect/how-to-use-social-media-for-science

Collins K, Shiffman D, Rock J. How Are Scientists Using Social Media in the Workplace? Goffredo S, editor. PLoS One [Internet]. 2016 Oct 12;11(10):e0162680. Available from: http://dx.plos.org/10.1371/journal.pone.0162680

Ethics of Linking: Jay Rosen - YouTube [Internet]. . Available from: https://www.youtube.com/watch?v=RIMB9Kx18hw

Hagen K, Engelhard M (Margret), Toepfer G. Ambivalences of creating life : societal and philosophical dimensions of synthetic biology

iGEM Uppsala. Webinar, Topic: Social Responsibility [Internet]. 15.8. 2017. Available from: https://www.youtube.com/watch?v=LHIO7Ios2uc

Jarreau PB, Porter L. Science in the Social Media Age. Journal Mass Commun Q [Internet]. 2017 Jan 11http://journals.sagepub.com/doi/10.1177/1077699016685558

Tachibana C. A Scientist's Guide To Social Media. Science (80-). 2014 Feb 28 Available from: http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2014_02_28/science.opms.r1400141

The Ethics of The Quote – A Blog Around The Clock Available from: http://scienceblogs.com/clock/2009/06/20/the-ethics-of-the-quote/http://scienceblogs.com/clock/2009/06/20/the-ethics-of-the-quote/

Questions

To summarize this booklet, we want to say goodbye with a couple of questions that we believe every iGEM team should ask before choosing a project. We believe that properly assessing and thinking about ethical issues is essential to iGEM and the future of your project. We tested these questions during our webinars to make sure that they adress pressing issues that different iGEM teams come across. We have also used these questions while choosing our project. This gives us confidence that they might help you and your team and that these might give you a different angle that you might have not thought about. Good luck with your project!

- Team Uppsala

Intellectual Property Rights

1. If a set of data has intellectual property rights associated with it, the holder of the rights may grant permission of reuse through a license. However, data that has no intellectual property right associated with it is sometimes restricted through "terms of use" - and courts in the US and elsewhere have found them to be enforceable as long as the basic requirements for voluntary agreements have been met.

Do you feel that it is appropriate to enforce restrictions on data that is otherwise free of any intellectual property rights?

2. Unlike other intellectual property rights, patent has to be applied for and, in most countries, granted by a public authority.
Are you aware of the rules that govern a patent applications in your country?
Is this something your team has considered? Do you think that seeking patents is appropriate within the context of the iGEM competition?

3. For a patent to be granted, the usual requirements for the invention are to be new, usable and contain an innovative step. How this applies to genetically modified organisms has been debated for a while. With the advent of synthetic biology, however, the possibility to create entirely "artificial" organisms might become a reality.

Do you feel that this changes anything with regards to patentability of living organisms? What is your opinion on the patentability of entirely synthetic cells/organisms?

Work ethics

1. Questions about Safety in the lab

To make sure the work environment is safe, each iGEM team should make sure every team member knows the answer to the following questions. Do you know the rules of the lab? Do you know how to behave in the lab? Do you know how to dress in the lab?

2. Regarding Emergency in the lab

How should your iGEM team act in case of an emergency? Do you have all the equipment to handle any emergency? And do you know how the equipment works?

3. Questions regarding Work ethics

To work well within a group, it is important to set up rules and guidelines beforehand that each team member agrees to and has to follow throughout the project. This can include the workload, documentation, meeting, activities, discrimination etc of your project. Does your iGEM team have any rules or guidelines for respecting? If not, what do you think would be good guidelines to introduce?

Genetic engineering

1. Uncontrolled Release
Can we anticipate how our GEM would behave if released? What would be its growing conditions and could they potentially be met? Can we anticipate any interactions with any form of wildlife?

2. Misuse

Can we think some steps ahead and imagine a potentially harmful usage with our open-source GEM?

3. Global justice

What potential economic influence does our GEM have in its late stages of development and implementation? Do the economic and social benefits change if the GEM is applied in different continents or countries? Are there potential sources of global injustice coming from our GEM?

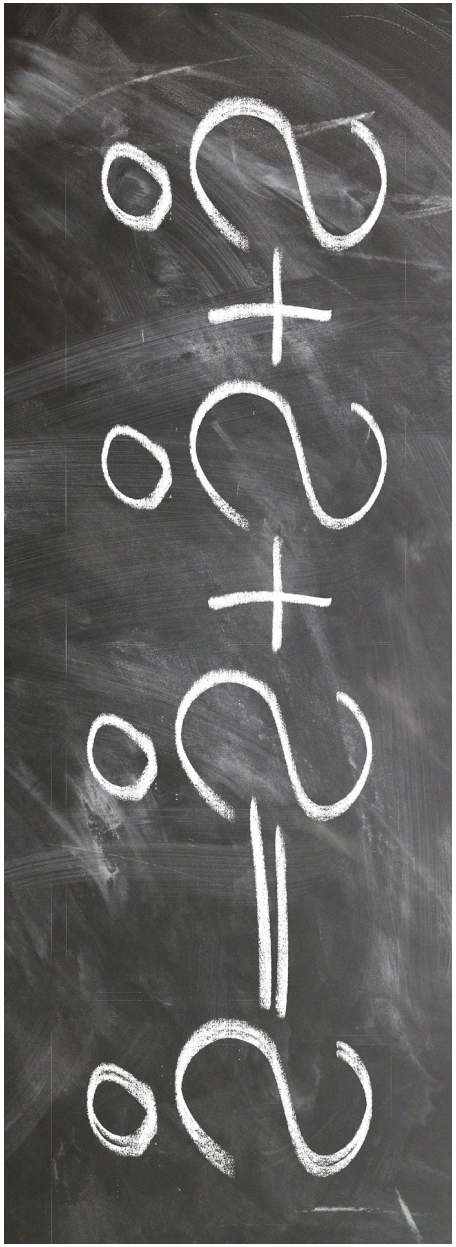
Questions

Reporting Science

1. How can we responsibly and accurately report our project in media and inform public about the science we are doing?

2. Who do we want to report to? Is it other iGEM teams, journalists or general public? What is our niche?

3. What kind of media and language should we use while talking about our project to reach our niche of the public?



zeaxanthin • enzyme • molecule • splice • crocin • experiments • desig
plating • DNA • pathway • modelling • uppsala university • biobricks •
molecule • splice • crocin • experiments • design • ethics • lab work •
uppsala university • biobricks • compound • plating • DNA • sequenc
enzyme • molecule • splice • crocin • experiments • design • ethics • lab
pathway • crocus • components • sequence • zeaxanthin • enzyme • mo
• experiments • design • ethics • lab work • e-coli • parts • crafting crocin
crocus • crocin • compound • parts • modelling • uppsala university •
• sequence • zeaxanthin • enzyme • molecule • splice • crocin • experin
• splice • crocin • experiments • design • ethics • lab work • e-coli • par
• compound • plating • DNA • pathway • crocus • components • sec
e-coli • components • sequence • zeaxanthin • enzyme • molecule •
crafting crocin • program • modelling • uppsala university • biobricks •
uppsala university • crocus • molecule • splice • DNA • pathway • croc
• crocin • experiments • design • ethics • lab work • e-coli • parts • craft
modelling • uppsala university • biobricks • compound • plating • DNA
university • program • DNA • pathway • crocus • components • sequen
design • ethics • lab work • e-coli • parts • crafting crocin • program
experiments • enzyme • compound • plating • DNA • pathway • cro
ethics • lab work • e-coli • parts • components • sequence • zeaxanthi
lab work • e-coli • parts • crafting crocin • program • modelling • uppsal
• compound • plating • DNA • pathway • crocus • components • sec
experiments • design • sequence • zeaxanthin • enzyme • molecule •
crafting crocin • program • modelling • uppsala university • biobricks •
uppsala university • crocus • molecule • splice • DNA • pathway • croc
• crocin • experiments • design • ethics • lab work • e-coli • parts • craft
work • molecule • splice • crocin • experiments • modelling • uppsala
components • sequence • zeaxanthin • enzyme • molecule • splice •
design • ethics • lab work • e-coli • parts • crafting crocin • program
• biobricks • compound • plating • DNA • pathway • crocus • con
pathway • crocin • crocus • molecule • plating • sequence • zeaxanthi
lab work • e-coli • parts • crafting crocin • program • modelling • uppsal
enzyme • molecule • splice • crocin • experiments • design • ethics • co
uppsala university • crocus • molecule • splice • DNA • pathway • croc
• crocin • experiments • design • ethics • lab work • e-coli • parts • craft
modelling • uppsala university • biobricks • compound • plating • DNA
enzyme • molecule • splice • crocin • experiments • design • ethics • lab
pathway • crocus • components • sequence • zeaxanthin • enzyme • mo
• experiments • design • ethics • lab work • e-coli • parts • crafting crocin