BIOTECH FUTURES CHALLENGE

2024 Guidebook

BIOTech Futures Challenge: A Gateway to Innovation

What is 'innovation'?

Innovation involves ideas or creations that are new or different. It stems from people wanting to solve problems. In the fields of science and engineering, researchers innovate using their scientific knowledge. Australian researchers have a strong history of innovation - cochlear implants, pacemakers, ultrasound imaging to flat plate and evacuated tube solar hot water systems. Australians have developed campaigns such as Clean Up Australia and Earth Hour.

Innovation often requires many resources - time, energy, funding and mental resilience. There may be obstacles as things don't work out as expected, and it's not unusual to have to throw original ideas away and start from scratch - over, and over again. Thus, innovation is not just about creating a new idea or technology. It needs the ability to persevere through setbacks. It needs the ability to monitor and adapt. It needs the ability to accept change right through to the end. Remember – innovation is sparked from imagination but realised through persistence and dedication!

The BIOTech Futures Challenge also emphasises the roles other fields have in seeing a scientific innovation realised. Initially these may be based on ethics, regulations and/or economics. An interdisciplinary approach to innovation is, therefore, essential.

What leads to effective innovation?

Here are some things that may contribute to an effective innovation when solving a problem in the BIOTech Futures Challenge. We hope that by participating in the BIOTech Futures Challenge, you will be able to build these essential skills and discover what it feels like to be an innovator!

- **Background knowledge** – a thorough examination of previous research in the field of interest provides a strong foundation for understanding any problem that needs to be solved.
- **An interdisciplinary approach** – research in different fields provides inspiration and/or different approaches to developing an innovation.
- **Communication** – with teammates, teachers, mentors, members of your school, members of your local community, researchers, industry representatives – all these people can give you insights into solving a problem.
- **Stepping out of your comfort zone** – don't be afraid to explore different ideas to solve your problem, even if some ideas turn out to be wrong. Every mistake is a chance to learn and broaden your knowledge, so keep going and don't give up!
- **Testing** – once you have developed a solution, test it! Use methods that are appropriate for the problem e.g. by conducting first-hand investigations, making prototypes or models.

2024 Challenge: Structure & Timeline

The following Challenge Structure is consistent with the Sydney Challenge and across all our Satellite Chapters. Key dates highlighted are specific to the Sydney Challenge. If you have any queries about dates for your relevant Chapter, make sure you ask the team or check the website Satellite pages. Winners and runners-up from the **Satellite Chapters** will compete as finalists in the **Sydney Symposium**.

Over the next few months, you will research a **current problem** in either Medicine and Health, Sustainable Environment or Emerging Technologies. You may choose a problem related to the Ethics, Regulations or Economics of seeing an innovation realised. You will come up with an innovative solution to tackle the problem. This can be a product/device, treatment, technique or method – anything if it addresses your chosen problem.

The Challenge is designed to test your ability to gather and process information related to solving your problem, as well as your critical thinking and creativity. On top of that, it gives you the opportunity to experience first-hand what a career as a researcher is like.

Your innovation and your research findings will be presented at the **Sydney Symposium on 14th October 2024**. There are a lot of great prizes on offer for the best innovations, so good luck!

Requirements

To complete the Challenge, you will need to prepare:

- A full-colour A2-size **poster**
- **Short answer questions**
- A **1500-word report** (optional)
- A **prototype/model** (optional)

Even though they are not compulsory, we strongly encourage you to draft a report and/or produce a prototype/model. Doing so will aid you in your research and design processes, and we strongly recommend reading through their respective sections in this guidebook. Please note that a separate category of prizes will be available for individuals/teams with the best report or model (please check the BIOTech Futures website for more details).

Submission

The **poster** and **short answer questions** (as well as your report and a photo of your prototype/model - if you decide to submit either of these) need to be submitted online by the **9th of September 2024**.

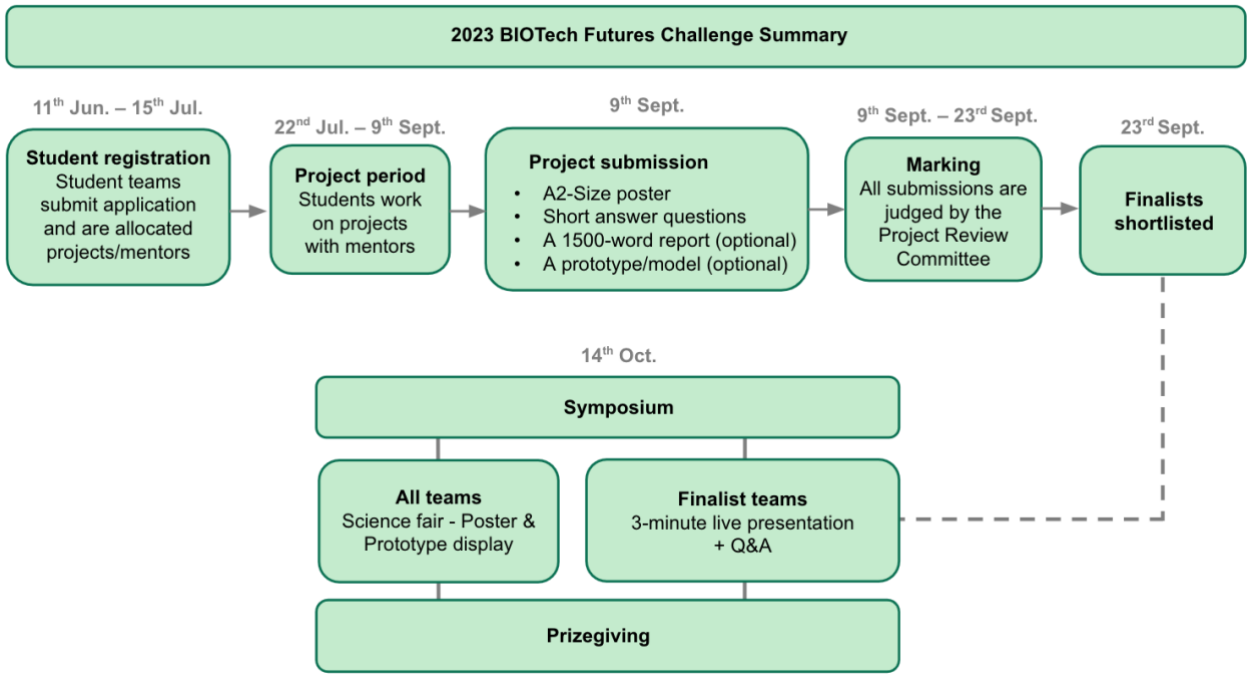
A **submission link** with further instructions will be provided on the BIOTech Futures website in the weeks leading up to the deadline.

Symposium

The posters of all teams will be displayed at the **Symposium** to be held on the **14th of October 2024**.

From the **poster** and **short answer question** submission, the top teams will be selected to give a **3-minute live presentation** at the Symposium. They will also be asked questions by the judges and audience and given the chance to defend their solution. Winners will be chosen based on the judging of these presentations.

Below is a summary of the Challenge process:



The Research Process

Scientists, engineers and academics in other disciplines follow a research process when coming up with innovations.

The first step is to **obtain background knowledge** in their field of interest. This provides the researcher with an overview of the field, including, for example, current products on the market, and the challenges that need to be solved. The second step is to **formulate a research question** – usually, this involves the formation of an idea or concept which has the potential to address one or more of the challenges identified in the first step. The third step is to **carry out research** to provide evidence that the idea or concept can address the challenge(s) in the field. This involves following an intensive design process by which the idea is constantly tested, modified, and re-tested until the most suitable iteration is found. The final step is to **present the research findings**, which involves presenting the innovation and explaining how it can address the challenges in the field. This often occurs at a conference or exhibition (or a symposium!).

Let's go through these four steps in a bit more detail.

1. Obtaining background knowledge

Before you can tackle a problem, you need to know what's going on in your field. Researchers will ensure that they're up to date with all the latest information by performing a **literature review**. As the name suggests, a literature review provides background information on the field and a summary of the research done so far.

How do I conduct a literature review?

The first step of conducting a literature review is to think about what you and/or your audience might want to know about the field. You should start by reviewing general information about the field and its key aspects so that you have some basic background knowledge of the field. Then, you should start exploring different aspects of research in the field that could play a role in solving your problem.

This might be a bit overwhelming because you won't necessarily know which aspects are important and which are not- and that's not to mention the enormous amount of information

available on any given topic! As such, you should take a methodical approach to searching for, and organising, any information you read.

This includes:

- Developing a specific research topic
- Making a list of relevant keywords or phrases pertaining to that topic
- Creating flowcharts or brainstorms of how different concepts fit within that topic

As you search, you should constantly be taking notes and reviewing the literature/results you read. If necessary, you may also need to revise your original research question. Once you're confident that you have a good grasp of your research topic, you should identify aspects that are the most relevant and focus on them.

Here are some **examples** of what literature reviews in various topics might look like:

Topic: Pacemakers for growing kids

- Anatomy/biomechanics of the heart
- When do you use a pacemaker? (arrhythmia/ weakened contractions)
- Historical review of pacemakers
- Principles of guided growth/product development

Topic: Incorporating environmental economics into the reduction of microplastics

- Bioaccumulation and biomagnification of microplastics
- Biotechnologies to reduce microplastics in marine environments
- Environmental economics and human health
- Cost benefit analysis of marine microplastic reduction in relation to human health

Bear in mind that these are just examples – the actual structure and contents of a literature review can vary significantly between different projects, even in the same field, and depend on the scope of each project.

What are some good resources to use?

You will come across many different types of literature during your search. Most information and research findings in any field can be found in the form of journal articles. However, more general information about the field and its key aspects may be obtained from more general resources. Here are a few examples.

- **General resources**: magazines (e.g. Scientific American), textbooks, accurate news sources, TED talks, YouTube channels, books, talking to a teacher, talking to a mentor, etc. You may use Wikipedia for initial research, but **do not rely on Wikipedia** for data and facts. Refer to other sources in order to assess the reliability of Wikipedia.
- **Specific resources**: peer-reviewed journals, conference proceedings, etc. A good way to find these is to use, for example, scientific search engines (e.g. PubMed, Google Scholar). Note that some journals require a paid subscription to read their articles- you'll need to find journals that are **open-access**.

How do I know if my resource is reliable?

Since you are building your research on your literature search, it is vital to make sure that the sources you use are credible. The following questions can help you evaluate the credibility of the source:

- **Where was the research published?** Generally, research that is published in a journal with a high impact factor (you can do a Google search for 'name of journal impact factor') is considered reliable.
- **When was it published?** Fundamental knowledge can be found in older papers e.g. 1990s or older. However, for some booming fields e.g. tissue engineering a paper from 2015 can be considered quite old.
- **Has it been peer-reviewed?** Does the author have good credentials? Is the article free from bias? These are some advanced criteria to help you evaluate the literature, but these are not required at this stage. If you want, Google them to see how they work as this could be helpful in the future.

2. Formulating a research question

Once you have familiarised yourself with your field and research that has been done in it, you will need to come up with a research question to answer. You should start by identifying challenges or knowledge gaps in the field – what are some of the drawbacks with existing studies/products/solutions? You should also think about the necessary requirements for addressing these challenges/knowledge gaps. Once you're confident that you've identified the problems and requirements for solving them, you can propose a solution.

You should be able to summarise all of this in the following manner:

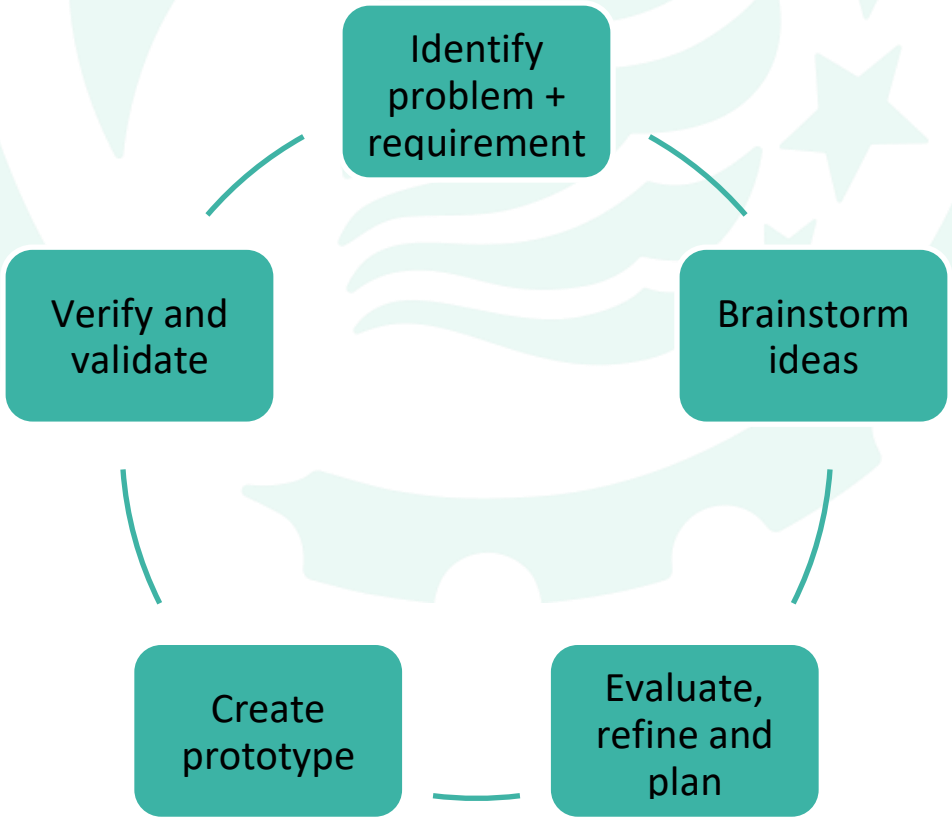
"There is a serious need for <your idea> due to <challenges in the field >. The primary focus of this project will be on the proposed innovative design for a <your design concept> to solve <problem that is the motivation of entire project>."

3. Carrying out the research

Now we move onto the fun part – designing your innovation and testing it. Every good researcher knows that you need to be able to prove that your idea actually works before you can use it to solve a problem! While we don't expect you to do firsthand investigations to prove that your idea works (though you're more than welcome to do so if you wish!), you will need to be able to explain how your idea works and provide evidence for why you think it will work.

The Design Process

The design of your innovative solution will take up the bulk of the work you will undertake. For example, the process of designing a new technology is one of constant research, coming up with ideas, testing them and tweaking them until you end up with something that meets your requirements.



The aspects of the design process are:

- **Identify the problem + requirements** – Once you have defined the problem, delve deeper and find out *who* your solution is for. Are there any contextual constraints or limitations? What does your design need to accomplish? Specify the exact needs and requirements of your solution.
- **Brainstorm ideas** – Take all that you have learnt and start brainstorming designs! Build off technologies/ideas you have found in your research, combine parts of different designs/processes or come up with completely new and wacky ideas, it's up to you.
- **Evaluate, refine and plan** – Evaluate all your solutions and choose the best one. Refine it, referring back to what the specific needs are to solve the problem. Plan how to move forward with your chosen solution.
- **Create prototype** – if applicable, and possible, build a model of your prototype and test it!
- **Verify and validate** – Test your solution. Does it actually fulfill the requirements and meet the needs of who the solution is for? Will it work in the context you are trying to use it in?

During the design process you should constantly be tweaking and refining your solution. If it doesn't meet all the requirements, could it be improved in any way, or does it need to be needs to be scrapped in favour of another solution?

4. Presenting your findings

Once you've settled on a solution you're satisfied meets all the necessary requirements, it's time to present your findings! This is generally done at a research conference or exhibition, where researchers will give a presentation, present a poster, or show off a prototype of their solution at a stall.

These activities are what have inspired the structure of our Symposium and what you are expected to bring to it- so let's take a look at what you need to do to showcase your research.

Poster

During the Symposium, you will have the opportunity to share your innovative solution with your peers, university academics and biotech industry representatives through a 'science fair'-style poster display.

Posters are an incredible way to display your research in a format that is concise yet detailed – as they say, a picture is worth a thousand words! Posters are also a good indicator of how well you know your own research, as it often hard to show the entire scope of your research on a single page.

What should go in your poster?

The main purpose of your poster is to showcase your solution and how it addresses a problem in your chosen field. It should also reflect the research you have done into the problem and walk the reader through your design process for your solution. It is important that you can convey how your solution meets the necessary requirements to solve your problem and why your chosen design is the best for solving this problem.

Poster Requirements

Please use the template provided to create your poster. While there are no specific formatting requirements for the poster, do note that it needs to display the following information:

- Title of project
- Team Code
- *BIOTech Futures* logo
- Your school's logo
- Names of all participants, including mentors and academic advisors
- Affiliated school/institutions of all participants, including mentors and academic advisors
- Contact details of a nominated contact person

Short Answer Questions

The first round of submissions also requires responses to a list of short answer questions. These supplement your posters, allowing you to be more descriptive about your problem/ solution without cluttering your poster. Use these questions as an opportunity to guide your project and reflect on your design challenge. This part of the submission is very typical of what you might expect at university and high-level research. It is encouraged that groups work on these short answer questions over the duration of the Challenge, and not just leave it to the last minute!

Questions

- What it does
- Your inspiration
- How it works
- Design process
- How it is different
- Future plans

You'll have a **150 word limit (max)** for each question, so make sure you're concise and to the point

Presentation (Live)

Finalist teams will be required to present a 3-minute presentation which showcases their research and solution.

Presentation Guidelines

The presentation will follow the 3-minute thesis format.

- Maximum of 3 minutes in length
- Presentations must be spoken word only （i.e. no songs or poems）

A maximum of **three PowerPoint slides** (excluding title slide) can be displayed during the presentation. You also must ensure to reference to any figures/data used throughout the presentation that are not your own.

The following information should be shown at least once during the presentation. This can be on a title slide powerpoint slide.

- Project title
- The names of all participants, including mentors and academic advisors, and their affiliated school/institution should be directly underneath the title
- Clearly display team code

Please note that if you are presenting as a team, **at least two members of the team must present**.

What should go in your presentation?

Your presentation should cover the following points:

- Demonstrate a need for your innovation
- Identify a 'target market'
- Explain how your innovation works
- Outline how your innovation is superior to currently available solutions

What makes a good presentation?

At the heart of every good presentation is good communication. Here are some tips that will help you prepare your presentation.

- **Use language appropriate for your target audience** – Remember that your target audience consists mostly of your peers, many of whom will not be familiar with your problem or the research you have undertaken to solve it. Think about how much jargon (e.g. scientific, economic) you will need to use to communicate your research.

- **Have clear take-home messages** – What do you want your audience to take away from your research?
- **Keep it simple** – Unlike a YouTube video, there is no rewind button for your audience – try to use shorter words and shorter sentences to make it easier for your audience to both understand and process what you are saying.
- **Engage your audience** – Asking rhetorical questions, telling stories or using humour are all good ways to engage your audience and allow them to relate to your research area better. However, it is important to make sure that you don't go on a tangent if you choose to use one or more of these devices.
- **Be enthusiastic –** If you look bored when you're presenting, then your audience may feel bored too. Think about it this way – if you were an audience member at your own presentation, would you be excited or think 'hey, this is cool' after seeing it?
- **Practise, practise, PRACTISE!** Getting nervous on stage or while recording is normal – rehearsing your presentation will provide you with something to fall back on if you get stuck. Practising will also allow you to fine-tune key aspects of your delivery, such as your talking speed, your vocal range, body language and stage positioning.

Here are some more links which you may find useful:

- https://threeminutethesis.uq.edu.au/resources/3mt-competitor-guide
- https://biteable.com/blog/tips/how-to-make-good-presentation/

Report

Submitting a report is a non-compulsory part of the Challenge. If you/your team wish to write a scientific report, there will be a separate prize category for this.

The **report** will contain detailed information on the research and design process you undertook in the process of coming up with your solution. It should consist of two parts: a **literature review**, and a **logbook**.

Literature Review

The literature review should encompass the research undertaken in steps 1 and 2 of the *Research Process*. You can refer back to this section of the guidebook for tips on how to conduct and write your literature review or consult with your mentor for advice.

Logbook

Your logbook should provide a detailed record of your *Design Process*, including any data and analyses relating to the design and testing of your innovative solution.

The logbook should include:

- At least 3 designs, including your final design for a solution to your problem
- An analysis of each design, why it addresses the issue and what features/reasons made you choose your final design over the others. This should act as a justification of your final design with reference to all the background research you have conducted in the literature review.
- An analysis of methods and materials that will be used for your product (if applicable to your problem and solution)

If it is appropriate for your design to produce a prototype, your logbook can also include:

- Materials and methods used in making the prototype
- An analysis of what your prototype highlights about your design

If it is appropriate for you to carry out a firsthand investigation to aid of your design your logbook can also include:

- Aim & Hypothesis of the experiment
- Method and materials
- Results
- Discussion

If there are previous studies that have relevant data to aid in the justification of your design, you can reference the study and its data as an aid to how you came up with your design. This can be used to prove concepts or assumptions that have been made in your design.

In discussing your design/firsthand investigation/prototype it is important to cover how your final design meets the needs of the problem to be solved and how well it addresses the need.

Tips for writing up your logbook:

- **All steps should go into the logbook**. It is important that you document everything you do, such as meeting minutes, idea brainstorms, etc. and should include avenues that lead to 'dead ends'. The process of refining and exploring ideas is often just as important as arriving at the final solution, and it's not uncommon for seemingly irrelevant ideas raised at a meeting becoming the 'light bulb' moment that solves your problem. These can be evaluated in your discussion.

- Be as **detailed** as possible. Detail is incredibly important, as small observations or subtle pieces of information may play a key role in solving the problem.

- Provide **labels** for any figures or tables. These labels should allow the reader to understand the figure/table if they are viewed out of the logbook.

- Be **concise**. It is important to show detail, but don't get too wordy.

- **Three questions** you should ask yourself to help you check the quality of your logbook:
    - If I read it out loud, will it make sense?
    - Do all members of the team understand the content?
    - Could you come back six months later, read your notes, and make sense of them?

Structure & Formatting

Report Structure

The structure of your report should be as follows:

- Cover page – project title and group/student names - the project title should be specific and interesting
- Abstract – a one-paragraph summary of your report -a neat guide on how to write an abstract can be found here.
- Acknowledgements – especially acknowledge your mentors
- Table of contents
- List of figures, tables and abbreviations
- Literature review
- Logbook
- Challenges and Future Work – a summary of what needs to be done in the future - mention any potential issues that may come up in the production/distribution of your design
- Conclusion
- References
- Appendices

Formatting Requirements

Your report should be formatted to the following specifications:

- Word limit: 1500
    - Only the Literature review, Logbook, Challenges and future work, and Conclusion are included in the word count

While there are no set formatting requirements, we offer these as suggestions:

- Times New Roman font
- Font size 12
- 2.54cm margins (normal)

Academic Integrity

As a participant of the BIOTech Futures Challenge 2024, you are expected to uphold a culture of academic integrity. It is important to acknowledge any work that is not your own, as it shows that you recognise that your work is built on the collective body of scientific knowledge and discoveries that were pioneered by researchers before you. In addition, anyone who examines your research should feel confident that your study has been carried out in a scientific manner and thus, has academic merit.

Referencing

Every statement that is not general knowledge to an audience needs to be backed up by evidence – which, in most cases, is an in-text **reference** to another study or resource. Not only does this improve the credibility of your research, but it also allows other researchers and academics to review your work.

When used in-text, the reference(s) accompanies the statement they it is being used to back up. For example:

"numerous studies have explored the use of hydroxyapatite-based scaffolds and reported excellent mechanical properties with compressive strengths ranging from 5-20GPa [1], though decreases in the mechanical strength over time have also been observed [2-5]."

A **bibliography** or **reference list** should then appear at the end of the document that contains a list of the references used in the document.

Note that many **scientific journals** generally have their own unique **referencing style**. You may use any referencing style, so long as it is **consistent** across your whole literature review. APA, MLA, Oxford, Harvard and Chicago are the most common referencing styles. Some other papers may use AMA, NLM, Vancouver (both more commonly used in medical disciplines) or IEEE (more commonly used in engineering disciplines).

Please note that you are expected to use references in your poster (applicable to all teams), presentation slides (applicable to finalists) and report (if your team has chosen to submit a report).

Resources that may help you with referencing:

- **Cite This for Me**: an easy-to-use website which will automatically generate citations for you, but these may not be 100% accurate.
- **EndNote**: a professional reference management software package. If you can get access, give it a try, because you will likely use it in the future.

Academic Dishonesty & Plagiarism

We consider any attempt to gain an academic advantage by dishonest or unfair means to be academic dishonesty. Fraud and misconduct are not condoned at any level of research or competition**.** BIOTech Futures reserves the right to revoke recognition of a project subsequently found to have been fraudulent, with any findings of academic dishonesty or plagiarism resulting in immediate disqualification from the challenge.

Plagiarism in the context of the Challenge includes but is not limited to:

- Copying and pasting text from online media, such as encyclopedias or journal articles without attribution.
- Transcribing text from any printed material, such as books, encyclopedias, newspapers, journal articles and magazines, without attribution.
- Replacing a few selected words using a thesaurus or just using words from your head to get synonyms.
- Using photographs, videos, or audio without permission or acknowledgement.
- Using another student's work and claiming it as your own, even with the other student's permission.
- Acquiring work from commercial sources, including buying papers off the web or paying someone to do the work.
- Translation from one language to another without citations.

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