BIOTech Futures Challenge 2021

Guidebook

BIOTech Futures: A Gateway to Innovation

What is 'innovation'?

Innovation is often referred to as ideas or creations that are new or different. You may hear businesses use the word 'innovation' to describe how they have an 'edge' over their competitors. However, in science and engineering, innovation is at the heart of discovery, as we strive to take scientific knowledge and use it to create new and exciting technologies that can revolutionise society.

Australian researchers have long been celebrated as innovators at the forefront of biotechnology. From the cochlear implant, revolutionary developments in pacemaker design and ultrasound imaging to flat plate and evacuated tube solar hot water systems, not to mention campaigns like Earth Hour and Clean up Australia- Aussie academics have had a hand in bringing to life some of the most prolific developments in medicine, energy and the environment.

However, all of this comes at a great cost. The development of a new technology takes a lot of time, energy, money, and mental resilience. There will almost certainly be obstacles as things don't work out the way you expect them to, and it's not unusual to have to throw all your work away and start from scratch- over, and over again. Thus, innovation is not just simply about creating a new idea or technology, but persevering through constant setbacks, reviews, and changes right through to the end. Remember – innovation is sparked from imagination but realised through dedication!

What makes effective innovation?

Much like an art form, the process of designing and creating new technologies requires a variety of skills and expertise, and often involves experimenting with different things. Here are some things that contribute to effective innovation:

- **Background knowledge** – a thorough examination of previous research in the field of interest will provide a strong foundation for understanding your chosen problem.

- **An interdisciplinary approach** – research in different fields can provide inspiration and/or different approaches to developing an innovation.

- **Communication** – teammates, teachers, mentors, members of your school or local community, people who work in an area of research related to the problem, biotech industry reps – these are all people you can gain insights into your project from.

- **Stepping out of your comfort zone** – don't be afraid to explore different ideas to solve your problem, even if it turns out to be wrong. Every mistake is a chance to learn and broaden your knowledge, so keep going and don't give up!

- **Testing** – by conducting first-hand investigations and/or making prototypes/models.

We hope that by participating in the BIOTech Futures Challenge, you will be able to build these essential skills and discover what it takes to become one of the scientific innovators of tomorrow.

Challenge 2021: Structure & Timeline

Over the next few months, you will research a current problem in either **Health & Medicine** or **Energy & Environment** and come up with an innovative solution to tackle this problem. This innovative solution can be a product/device, treatment, technique or method – anything so long as it is able to address your chosen problem.

The Challenge is designed to test your ability to gather and process scientific information, 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 scientific researcher is like.

Your innovation and your research findings will be presented at the **Symposium** on **8-9th February 2021**. 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 A0-size **poster**
- A **3-minute presentation** with single, static Microsoft PowerPoint slide
- A **1000-word report** (optional)
- A **prototype/model** (optional)

Even though they are not compulsory, we strongly encourage you to draft a report and/or build 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 prizes will be available for individuals/teams with best report or model (please check the BIOTech Futures website for more details).

Submission

The poster and presentation slide (as well as report and photo of prototype/model) need to be submitted online by **17th January 2021**.

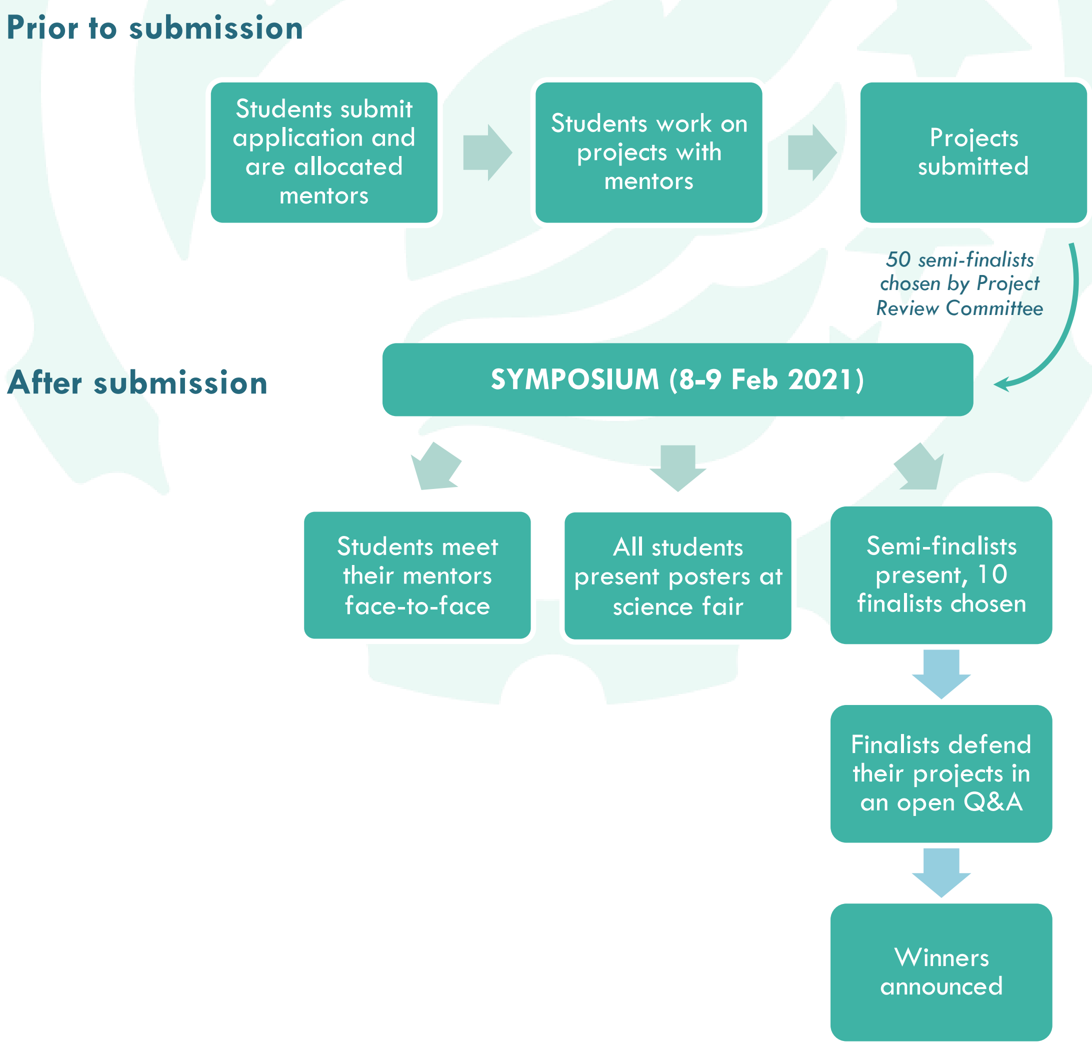
A submission link with further instructions will be provided on the BIOTech Futures website in the weeks leading up to the deadline.

Symposium

The presentation, poster and model will be delivered at the Symposium to be held on the **8th-9th February 2021**.

All participants will showcase their posters at the Science Fair on the first day of the Symposium. From these, the participants with the 50 best innovations will be selected to give their 3-minute presentation to a live audience. From these, 10 finalists will be selected to present their innovations again, this time taking questions from the audience to defend their pitch.

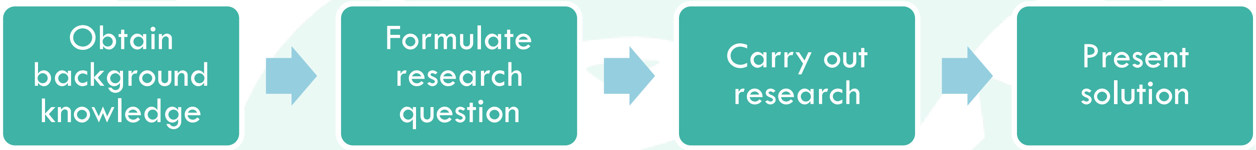
Below is a summary of the challenge process:



The Research Process

Scientists and engineers follow a research process when coming up with new 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 the 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 indeed 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 then to **present the findings of the research**, which involves showing off the innovation and how it is able to address the challenges in the field at 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 forming a **literature review**. As the name suggests, a literature review provides background information on the field as well as a summary of the research that has been done in it.

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 off 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 scientific 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: Microplastic pollution in rivers

- Sources of microplastics in aquatic environments (marine and freshwater)
- Distribution and abundance of microplastics in rivers
- Negative consequences of microplastic pollution
- Review of current methods of reducing microplastics in rivers

Bear in mind that these are just examples – the actual structure and contents of a literature review can vary significantly between different projects 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 scientific information and research findings can be found in the form of scientific journal articles (which is where the term 'literature' comes from). 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**: scientific magazines (e.g. Scientific American), textbooks, accurate news sources, TED talks, YouTube science 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.
- **Scientific resources**: peer-reviewed scientific journals, conference proceedings, etc. A good way to find these is to use scientific search engines (e.g. PubMed, Google Scholar). Note that some scientific 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:

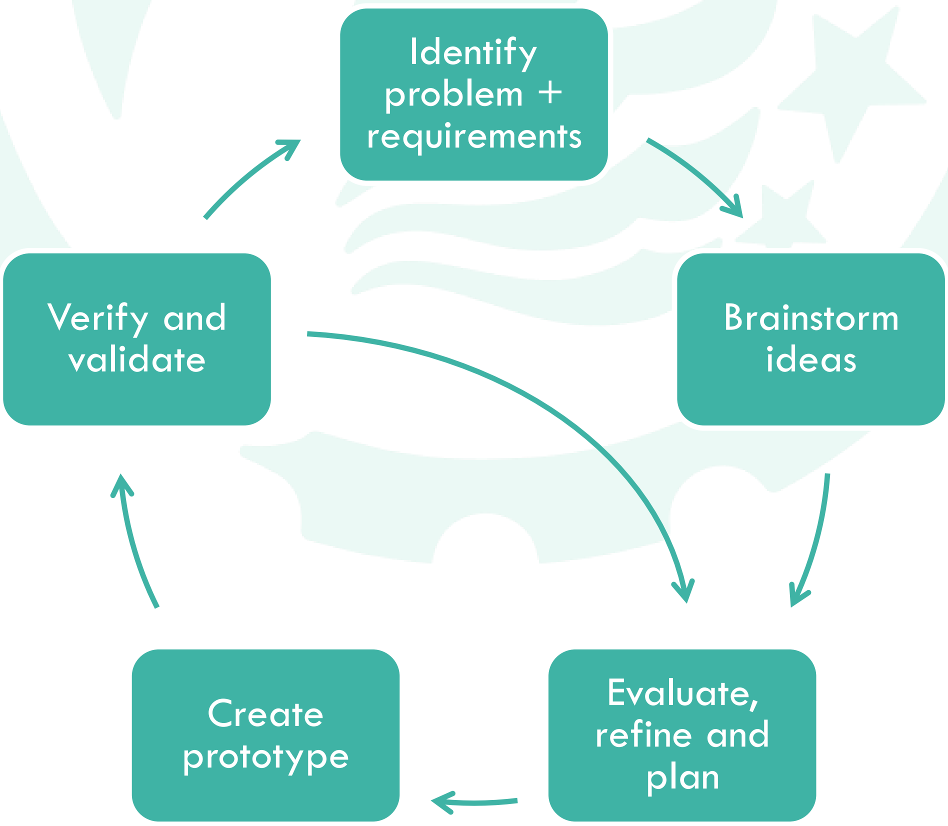
"There is a serious need for <your idea> due to <challenges in the field >. The primary focus of this project will be on the proposed innovative design for a <your design concept> to solve <problem that is the motivation of entire project>."

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 experiments 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. 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 you have found in your research, combine parts of different designs or come up with completely new and wacky ideas, it's up to you.
- **Evaluate, refine and plan** – Evaluate all your designs and choose the best one. Refine it, referring back to what the specific needs are for your solution. Plan how to move forward with your chosen design.
- **Create prototype** – if possible, build a prototype of your model and test it out!
- **Verify and validate** – Test your prototype out. Does it actually fulfill the design 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 design if it doesn't meet all the requirements, could be improved in any way, or needs to be scrapped in favour of another design.

4. Presenting your findings

Once you've settled on a design you're satisfied meets all the necessary requirements, it's time to present your findings! Scientists and engineers will generally do this at a research conference or exhibition, where they 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 you 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
- *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
- Team code
- Contact details of a nominated contact person

Presentation

Participants with the most interesting, innovative, and best-designed solutions will be invited to present their research in a short 3-minute business pitch-style presentation during the Symposium. This presentation is a chance for you to further showcase your work to an audience that includes academics at leading Australian universities and educational institutions, as well as industry representatives from a range of companies.

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)
- One static PowerPoint slide permitted as a visual aid

Please note that if you are presenting as a team, **at least two members of the team must speak**. You are also permitted to use a **prototype or model** of your innovation as an additional visual aid during the presentation.

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 scientific jargon you will need to use to communicate your research.
- **Have clear take-home messages** – What are 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 will 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 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/

Slide Requirements

One static PowerPoint slide will be shown throughout the entire duration of your presentation as a visual aid. As with the poster, you should use the slide template provided to create your slide. Requirements for the slide are as follows:

- Project title must be clearly visible at the top of the slide
- The names of all participants, including mentors and academic advisors, and their affiliated school/institution should be directly underneath the title
- Must be static (i.e. no animations, audio, videos, etc.)
- Must clearly display team code in the top right corner
- Must contain references to any figures/data used that are not your own

What makes a good slide?

Slides are a visual aid that can greatly enhance your presentation – but keep in mind that a bad slide can potentially ruin your whole presentation. Here are some things to think about when making your slide.

- **Keep it simple:** As with the presentation, a slide that has a simple, clean design will be much easier to process than one that's fancy and complex. Think carefully about your choice of colours and background, as well as the sizes and positions of any font and images you may wish to include.
- **Don't add too much text:** Remember, you want your audience to focus on you and what you're saying – not spend the whole 3 minutes trying to read what's on your slide!
- **Focus on the key message**: Your slide should focus on the key message(s) of your presentation – nothing more.

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 **scientific 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 it is appropriate for your design to make 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 an experiment in the 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/experiment/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 lab book.

- 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 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: 1000
  - Only the Literature review, Logbook, Challenges and future work, 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
- 2.54 cm margins (normal)

Academic Integrity

As a participant of the BIOTech Futures Challenge 2021, 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, slide and 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. Scientific 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.

BIOTech Futures

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