CRISiSLab Challenge 2024

Kia Ora! Welcome to the 2024 CRISiSLab Challenge! We are excited to invite you to participate in this year's competition, focused on Tsunamis.

The CRISiSLab Challenge is an annual event that brings together high school students to explore the wonderful world of science and technology, with a focus on crisis management. This year's competition promises to be an exciting opportunity for you to hone your talents, learn new things, and collaborate on creative ideas as part of a team.

Throughout this challenge, you will learn to deal with pressure sensors, investigate wave and tsunami concepts, and effectively communicate data. By the end, you will have developed a depth detecting system as well as a way for displaying data. At the end of the challenge, you will be invited to share your findings and showcase your technology at an event with a presentation and demonstration.

We hope you will come away from this challenge with a fascination for the world of science and technology.

Timeline

- [date]: Registration deadline
- [date]: Launch Day - It is important to come receive your kit and learn about the challenge on this day
- [date]: Competition Day!

Overview of the Challenge

At its core, your task is to develop a wave depth sensor system with the tools we give you. (One aspect of the challenge is coming up with an efficient and effective waterproofing system. During your testing, we encourage you to think about different factors such as scalability, practicality, cost, etc.)

Along the way, you should **document** your entire process, with thoughts, experiments, pictures/screenshots as evidence.

Returning contestants will want to focus on:

- What has been done differently and why
- Mistakes and how they were remedied
- What has stayed the same.

While new contestants will be asked to

- Document your testing and learning (Remember, showing mistakes you made is great because it lets us know you are aware of them)
- Why they chose their water proofing method
- Different methods in implementing code and libraries
- Choice of display method

Whether you have previously competed or not, you will need to justify all your decisions (both your changes and your final methodologies).

Once you have finished the basics, you should come up with a few ideas on how you could take the system further, e.g. speed of the waves, the frequency, momentum, period, and how you would store/display this new data and why.

Here are the tools you will be provided with to calculate the depth of the water and beyond:

	**Pressure sensor** SparkFun Pressure Sensor - BMP384 Qwiic Measures pressure but is not originally designed to function underwater. Thus, you must devise a way to waterproof the sensor effectively to make it functional underwater and obtain accurate pressure measurements. User guide: https://learn.sparkfun.com/tutorials/qwiic-pressure-sensor-bmp384-hookup-guide **Important!** Please read the user guide carefully for sensor specifications and connection instructions.
	**Microcontroller board** SparkFun RedBoard Qwiic A small Arduino-compatible computer that can be programmed to control different types of electronic devices. It can read inputs from sensors and use that information to make decisions and control outputs. In this Challenge, the microcontroller board will be used to

	read data from the water pressure sensor and display it on a computer screen. User guide: https://learn.sparkfun.com/tutorials/redboard-qwiic-hookup-guide?_ga=2.20513336.1061416830.1682667624-1863416608.1682667624 **Important!** Please read the user guide carefully to understand how to connect the board to power, pressure sensor, and other devices (e.g. your computer). The user guide also explains how to programme and run the software in an Arduino environment.
	**Connecting Cables** SparkFun Flexible Qwiic Cable - 500mm A cable will be provided to connect the pressure sensor and the microcontroller board. User guide: https://www.sparkfun.com/products/17257 Note: You must also connect the microcontroller board with a cable compatible with your computer (not provided).
	**Balloons** will be the most basic way to waterproof your sensor. But you should innovate this component and find other or better ways to waterproof your pressure sensor. The main objective of the challenge is to make the sensor operational underwater and to use it to identify various types of waves in the wave tank with reasonable accuracy.
	**Container** - the container is not technically part of your sensor system. But it is provided so you can test and experiment with your sensor system while in school. During demonstration day, an official wave tank will be used.

Requirements

- The sensor must be waterproofed and capable of working reliably underwater.
- The waterproof sensor must sink to the wave tank's bottom and lie flat.
- The sensor must be easily deployed and removed from the tank.
- The sensor must fit the entry width of the tank of 50 mm.

Warning: DO NOT test the sensors in salt water as they will break.

- It must obtain pressure readings (In Pascals (Pa)) and water depth (in centimetres (cm)) at a reasonable accuracy. You can obtain the height through either testing, or through a mathematical formula, or a mix of both.
    - This “accuracy” will be partially determined by the water proofing method you decide to use, and the calculations/readings you make in the code, and thus, we ask you to test and trial different methods for these two.

Keep in mind, the accuracy of your data *alone* will not suffice, teams who have demonstrated innovative thinking in their decision to to use their chosen depth/pressure calculations will be awarded. This understanding can be shown through answering questions aptly and good documentation.

- Finally, you *must* present your data in some manner on your laptop screens (or another method you see fit).
    - *Show a real-time graph of the changing pressure (pressure in Pascals vs time)*
    - *Show a real-time graph of the changing water height (height in cm vs time).*
    - *The system must capture the maximum height of the water produced by the generated wave conditions.*

Note: Three types of wave conditions will be generated for your sensor system to measure. For each of the three generated wave conditions, you would need to capture the maximum water height. Demonstrate that your sensor system is functional by presenting the three distinct maximum heights from the three types of wave conditions.

Then three wave conditions will be generated:

1. **Small waves**, tiny ripples on the water's surface. These will be triggered by blowing air on the surface of the wave tank. These waves represent the normal sea waves triggered by wind passing over the sea or ocean’s surface.
2. **Medium waves** will be bigger than the ripples of the small waves. These will be triggered by submerging a block to displace the water. The displacement caused by this action will have shorter wavelengths and higher amplitudes than the small waves. These waves represent tsunamis in real-life scenarios. Landslides, underwater explosions, or earthquakes can cause large volumes of water displacement, causing tsunamis.
3. **Large waves** will be bigger and stronger than the medium waves. The waves will be triggered by submerging a block with a larger volume or bigger force to displace the water. Note that in real life, tsunamis can come in different sizes due to various factors, such as the size and location of the water displacement.

By the end of these three trials, you will have calculated 3 maximum depths, which you will record on a whiteboard at the testing centre.

Demonstration Day

Firstly, you will have to come up with a name for your team.
Keep in mind, throughout the steps below, judges will be taking notes for their decisions.

- You will then be asked to carry out a presentation (10 mins) for the following:
    - Sensor system design and components
    - Process and testing
    - Software and coding
    - A quick overview of your documentation PDF.
- At the end of the presentation you will be prompted with a quick **Q&A** - be ready.
- Then you will demonstrate your system - graphs and all.
    - Remember: The 3 wave conditions will be generated and Real-time data on pressure and water height should be seen in the display in real-time.
    - Capture and show the maximum height of the waves.

Judging

Once everyone has completed your presentation and demonstration, the judges will decide the winners!

Criteria:

1. Design and Innovation (10 points) – The judges will evaluate the creativity and ingenuity of the sensor system design, as well as any innovative approaches used by the team to improve the sensor system's performance and reliability. This includes how you took the system further than what the requirements are. How impressive, and innovative your new ideas are.

2. Sensor System Performance (20 points) – The judges will evaluate the sensor system's ability to measure and present water pressure and height. The assessment will also look into the sensor's ability to differentiate the wave heights from the generated wave conditions. Points will be awarded based on the accuracy and effectiveness of the sensor system's performance.

3. Data Display (20 points) – The judges will evaluate the effectiveness of the data display on the team's computer screen during the demonstration day. Points will be awarded based on the clarity and ease of understanding of the data displayed. This will take into account the quality of your code.

4. Presentation (20 points) – The judges will evaluate the quality of the team's presentation, including the clarity and organisation of the team's description of the design, construction, and testing of their sensor system, as well as their description of the data display. Teams should be mindful of the time constraint and the need to deliver a clear, concise, and engaging presentation.

5. Q&A (10 points) – The judges will evaluate the team's ability to answer questions with certainty and clarity during the Q&A session on the demonstration day.

6. Iterative Improvement (20 points) - The judge will evaluate how you improved your design over time. This means you should document your changes as you develop your waterproofing method, sensor system, and data display – with images/screenshots as evidence. This is

especially important for returning teams, and should show evidence of how your design changed from last year.

Awards

- Ultimate Winners (Gain a summer internship with Massey University)
- Sensor Performance award
- Data Display Award
- Presentation Award
- Iterative Improvement (Documentation) Award

Support

Should you encounter major issues, we will offer some guidance in two ways.

1. A discord server: LINK
   Here you can ask us questions, talk to other contestants, etc.
2. Zoom sessions: LINK
   Times TBC

Remember: Try to have fun, the more you enjoy the project, the more work you will put into it, and the more interesting it will be.