Accelerated STEM Education Leaders Program Case Study
Golden Grove High School

Learning Area: Science  Year Level: Year 9  Activity: Unit 6 weeks

**Purpose:** Students will learn about the different forms of engineering and other forms of vocational trades. Students will have an understanding of the opportunities that an engineering career can give them. Students will participate in model making, practical investigations and other research tasks.

**Student cohort:**

This course can run in a year 9 science class and has been developed around STEM, ATIP and the Australian curriculum. The unit was trialled with 2 classes, Year 9 Science 3J of 22 students consisting of 12 females and 10 males and Year 9 Science 2D of 24 students consisting of 17 females and 7 males. These classes have students with varying ability.

**Activity description and links to Australian Curriculum:**

Students will participate in a variety of activities where they are exposed to different types of engineering and the concept of STEM. Activities include: Newspaper Structures, water filters, production line management, model designing for a community and Building development for earthquake regions.

Students will develop their skills in planning and investigation methods during laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS165). Students will develop their understanding of the advances in science rely on the development in technology and that technological advancements are linked to scientific discoveries (ACSHE158). Students will develop their understanding of the values and needs of contemporary society influence the focus of scientific research (ACSHE228). Students will make conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data (ACSIS171).

**Outcomes:**

By the end of this unit students should be able to:

- Meet Australian Curriculum links
- Understand the many different facets of engineering.
- The concept of STEM and where that can take them.
- Design, build models and gather experimental data and present it appropriately with effective evaluations of model design.
- Justify ideas based on evidence collected to from scientific arguments.
Links with careers:
Speakers and workshops with:
Lock Heed Martin
Engineers without borders
Lean Manufacturing - NARMIG
Engineering links to different job types
University of South Australia

Results from student Survey

Students participated in a pre-survey prior to undertaking the engineering unit to collect information on aspects of STEM and what the students previously knew about STEM and the concept of engineering. It also collected information about student learning styles and a reflection on the teaching practices that the students have been previously exposed to. The students participated in a post-survey to show a understanding of what the students have learnt over the unit. The response to the survey will reflect their new perceptions of STEM, their learning style and the teaching methodologies being used.

According to the 33 participants, 85% clearly have not heard the term STEM which indicates that year 9 students at Golden Grove High School are not being exposed to the concept of STEM enough.

![Student response to having heard the term STEM](image)

Figure 1: Pre-Survey Student Response to the term STEM

![Student STEM Career Possibilities](image)

Figure 2: Pre-Survey Response to the Possibility of choosing a STEM career

Figure 2 represents the number of students that would possibly choose STEM related careers prior to participating in the engineering unit. Only 41% chose that they might possibly choose a STEM career as their pathway. According to the students that participated in the post-survey, 60% of them possibly believe that they might choose careers in STEM. This is an increase from the pre-survey. There is some issue with the validity of the results of the post survey as the total number of students participating has decreased by 50%.

Out of the total number of students that participated in the survey only one student was able to say that STEM is related to "construction and building robots". The building of robots response can coincide with the student remembering a task that is conducted at year 8 where all year 8 students participate in a program called robo-gals which run by the University of South Australia.
Figure 3 represents the students' word responses to what they believe engineering do in their career. The main words that are emphasised from their responses are that it is "work", "build", "different", "cars" and "fix". There are a number of smaller words that do resemble more specific aspects of engineering, but these responses occurred less making those words much smaller, for example, electronics, machines, electrical, mechanical, engines, software, rebuilding, make, and construction.

**Identified advantages of engineering course content:**

Students are applying their knowledge of the theory learnt into practical activities (hands on, design) that have a purposeful connection to STEM. The course allows students to show their creative side and bring that into the science classroom as the tasks are open to allow students the opportunity to take change in their own learning and shape the direction of the assessment.

Students have the opportunity to work in groups to complete a set engineering project based on their own research and design which is linked to real world examples to help them understanding the importance of engineering in the wider community.

Students watched an episode of Big Bigger Biggest (submarine development) where they discussed the concept of change in the world of engineering.

**Refinement or changes recommended for the future:**

During the unit, the PICSE Science Investigations were also completed. It would be recommended that teachers do the engineering unit as a separate entity and complete the PICSE Science Investigations during another unit. As both these concepts require a lot of attention and focus from the students and direction by the teacher.

The aspect of exposing students’ real world examples of where engineering and STEM concepts is a good idea, but the aspect of trying to model the engineering tasks that the students complete around the current EWB program in Sandikhola (India), was a big challenge for some students. This open-ended assessment could be modified by having a number of different tasks that students could attempt to engineer, by allowing them to choose if which concepts they wanted to persue.
The addition of the practical investigation about buildings and earthquakes would make this unit connect further to real world examples. This task is suitable for the Earth and Space Section of the year 9 course but is extremely appropriate to be used as another summative task in this engineering unit. It gives the students another connection to Asia exploring the concepts of engineering through the aspect of a natural disaster context.

There has been consultation with University of South Australia, Celina Bolding in regards to what this unit entails. She is extremely happy and excited that this unit has been developed at our school as we have been developing a good partnership with the university. From the discussions with Celina, she has modified the program that our students will receive at the university as she originally had included the EWB water filter concept, which has been included in this unit and she did not was to double up between the programs. This allowed her to be able to develop a Civil Engineering Tour about the water catchment at Mawson Lakes in which the student would get to experience. This tour would be developed for the year 9 students next year.

**How do you feel this unit related to STEM (and careers)?**

I feel that the unit relates well to STEM careers because as the unit progresses different careers and types of engineering are being mentioned at different points during the 6 weeks. Including speakers from different industries to engage with students and talk about careers in STEM as well as participating in different activities was well received by students, as the post-survey suggested that more students would be more likely to choose a pathway in STEM. Feedback from Celina Bolding about the engineering unit was very positive and she has expressed her interest in helping further develop our concept of engineering at Golden Grove now and in the future.

**What did you find the most enjoyable from this unit?**

The most enjoyable aspect of this unit was seeing the students work well in groups and making models. It was a good way of allowing students to engage by completing relevant practical engineering tasks. The tasks allowed all students to access the concepts of engineering at their own level. The students attempted all tasks which showed their keen desire to experience something new and innovative. This unit allows teachers to develop their student teacher relationships further as the teacher and get more involved with the students decision processes which help to develop a better understanding of how students learn.

**Assessment Tasks (Assessment of learning):**

- Newspaper Written Discussion: Students provide a detailed science investigation discussion that reflects on their Newspaper structure.

- EWB - Water filter construction and exposure to the concept of humanitarian engineering

- Practical Investigation: Earthquake building design investigation

- Research Task – Students work in groups to design and build a model of a design of a product that could help a community in Nepal. The students demonstrated their understanding of their design by detailing the science and engineering concepts behind their built model and how their design impacts the community and the environment.

**Tasks/Activities (inc. Assessment for learning)** -

- Practical activities include: Newspaper Structures, water filters, production line management and model designing for a community.

- Group work skills - Lean Manufacturing - NARMIG

- Big, Bigger, Biggest (submarine) discussion (how engineering can change and develop the world)