Focus Area: **Unit title:** Water Tower/ Concrete beam/ Materials experiments/ Tensegrity phone holder.

Description: This introductory unit will allow students to gain a basic understanding of simple properties of materials, their reason for selection, and their structure/property relationship, through the construction of a water tower and concrete beam. These projects develop students' skills in hypothesising, experimenting, plan sketching, marking out, cutting and communicating ideas. Students will consider the properties of the materials used and the form of the structures to be utilised. Students will consider the forces acting on the tower and beam, and some legal and ethical considerations of these structures.

This project will include a project report that will incorporate the following aspects:

- Selection and use of resources,
- Industry related terminology,
- Safety tests
- Societal and environmental implications,
- Sketches and drawings

The project report will be developed using appropriate workplace communication skills.

Suggested unit length: - weeks 20

Outcomes:

A student:

› identifies, assesses, applies and manages the risks and WHS issues associated with the use of a range of tools, equipment, materials, processes and technologies IND5-1

› applies design principles in the modification, development and production of projects IND5-2

› identifies, selects and uses a range of hand and machine tools, equipment and processes to produce quality practical projects IND5-3

› selects, justifies and uses a range of relevant and associated materials for specific applications IND5-4

› selects, interprets and applies a range of suitable communication techniques in the development, planning, production and presentation of ideas and projects IND5-5

› identifies and participates in collaborative work practices in the learning environment IND5-6

› applies and transfers skills, processes and materials to a variety of contexts and projects IND5-7

› evaluates products in terms of functional, economic, aesthetic and environmental qualities and quality of construction IND5-8

› describes, analyses and uses a range of current, new and emerging technologies and their various applications IND5-9

› describes, analyses and evaluates the impact of technology on society, the environment and cultural issues locally and globally IND5-10

Resources:

Metal or Wood workshop
Hand tools and hot glue guns
http://www.pbs.org/wgbh/buildingbig/bridge/basics.html
http://www.pbs.org/wgbh/buildingbig/bridge/challenge/index.html
Internet and other computer resources
WMS proformas
Misc weights to test towers
Concrete molds
Material as per cutting list
CAD
Digital scales
Concrete mixer

Differentiation Strategies Used

- Introduce students to the vocab dictionary with pics. Students to add to the dictionary as they encounter new key terms.
- EALD students to use split screen when on the computer to utilise Google translate to better understand assignment content.
- 8 Ways of Learning -Use a variety of delivery methods to engage a broad range of learning styles.
- Provide scaffolded responses to worksheets.
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INDUSTRIAL TECHNOLOGY – ENGINEERING – Water Tower/Materials/Concrete Beam/Tensegrity phone holder/Hydraulic digger/Mechanism - Geared lolly dispenser.

Core Module 1 - Common Content	
WHS and risk management	**Teaching Strategies or Tasks Used**
Students: • demonstrate safe workshop practices and procedures, for example: – clamp materials securely when cutting or drilling – follow electrical safety procedures – follow workshop signage instructions – work collaboratively • safely use and maintain hand, power and machine tools • select and use personal protective equipment (PPE) when working with tools, materials and machines, for example: – wear appropriate footwear – wear eye protection, eg safety glasses when cutting materials – wear protective clothing • apply the principles of risk management, for example: – hierarchies of control – identify a particular risk and implement risk-reduction procedures • describe elementary first aid procedures, for example: – outline the procedure to follow after a particular incident, eg burns, cuts	**Students complete onguard safety training.** - **general workshop safety** - **hand tools** - **power tools & machinery** **Construct projects to test/prove engineering principals** **Construct** - **water tower challenge** - **concrete beam test** - **materials analysis/experiments** **Worksheet on the hierarchy of control** **Students to complete SWMS on the construction and testing of the tower.** **Worksheet on DRABC and first response procedures.** **Bandaging wounds and putting on slings and tourniquets.**

	https://www.medicalnewstoday.com/articles/153849.php
Materials	
Students: • classify engineering materials into groups, for example: – ceramics, eg building ceramics, engineering ceramics – metals and alloys, eg ferrous, non-ferrous metals – polymers, eg thermosetting, thermoplastic • investigate the properties, structure and applications of typical materials used in engineered projects, for example: (ACTDEK043) – metals and alloys, eg steel, aluminium, brass and copper – non-metals, eg polymers, ceramics, composites and smart materials • conduct experiments and tests to explore the properties of materials, for example: – environmental properties, eg corrosion resistance, embodied energy – mechanical properties, eg tensile strength, hardness, toughness, elasticity, ductility • investigate the concept of material corrosion and degradation, for example: – conduct experiments to investigate factors that influence the corrosion of a steel component – outline a range of processes and techniques for protecting materials when in service • investigate the modification of materials to improve their mechanical and chemical properties, for example: – cladding, eg tinplate	**Task on properties and appearance of materials. Experiments on materials eg mild steel, plastic, gal steel & concrete soaked in salty water for 3wks in takeaway containers. Observe and record results.** **Complete Bridges around the world.** **Conduct experiment on the function of a damp proof course in buildings.** **Two bricks stacked in a tray of salty water on window sill. Record observations for 2wk period. Parallel experiment with 2 bricks stacked but separated by a plastic impervious membrane.** **Discuss cost and ramifications of salt damage in the building industry.**

– heat treatment, eg case hardening – reinforcement, eg glass reinforced polymers • compare engineering joining methods, for example: – adhesives, eg laminated timber beams – rivets, bolts and welding • apply materials in the design and production of engineering projects based on an understanding of their properties, for example: – corrosion resistance – malleability – torsional and shear strength – toughness	
Tools, equipment and techniques	
Students: • construct engineering projects, for example: – paper/balsa towers and beams – plaster arches and roller-coasters – slot car with geared drive line • apply measuring standards and methods, for example: – accurately cut and prepare materials to size – measure and mark out project details from a technical drawing • use and adjust a wide range of hand tools in the production of practical projects, for example: – assembly tools, eg screwdriver, rivet gun – holding tools, eg pliers, engineers vice – sawing tools, eg hacksaw, tenon saw	**Construct projects to test/prove engineering principals** **Construct** - **water tower challenge** - **concrete beam test** - **Tensegrity phone holder** - **Ply Hydraulic digger** - **Geared Lolly dispenser** **Test structures to find max load and load to destruction** **Video structures under load and discuss results.** **Produce scaled orthogonal drawing of the Tower**

• conduct experiments, produce prototypes and practical projects using appropriate tools, equipment, machinery, for example: – marking-out tools, eg ruler, try square, scriber, dividers – sawing tools, eg hacksaw, tenon saw – shaping tools, eg file, disc sander – using power tools to drill, cut, sand, shape and join components of practical projects • investigate advanced manufacturing techniques to assist in the production of projects, for example: – CNC equipment – laser/plasma/water cutters – rapid prototyping • explore design construction sequencing and collaborative processes, for example: – teamwork in pasta bridge construction • examine work practices and apply these to quality practical projects, for example: – comparing performance using different construction methods • evaluate work practices and practical projects in terms of quality, for example: – the efficient use of materials	**Construct Tower project.**
Workplace communication skills	
Students: • recognise and comply with WHS signage, for example: – identify the colours and shapes associated with types of WHS signage	**Students to produce a safety sign using "St Claire safety sign builder" for a hazard in the workshop**

• select and use specialist terminology in context, for example: – describe the manufacturing process of a particular part – develop a glossary related to mechanisms or structures – create a record of production	**Produce vocab list**
• read and interpret plans and/or materials lists to prepare materials for the completion of projects, for example: – orthogonal drawings containing projected top and front views – pictorial drawing showing relationships between component parts	**Produce Onshape drawing of Lolly dispenser.**
• produce freehand sketches of project components and/or projects, for example: – position of members in various truss designs – shape options for a component, eg a cam or a ratchet	**Sketch Water tower project.**
• complete graphics applying Australian Standards for drawing, for example: – orthogonal top and front views of a gear or other component of a mechanism – pictorial drawing showing relationships between component parts – use correct standards for representing threaded components	
• develop engineering reports using appropriate ICT, for example: – CAD – graphing results – simulations	**Produce folio for projects.**

– spreadsheets • prepare engineering reports to describe the management and processes undertaken in the production of practical projects, for example: – identifying the materials, processes and equipment used	
Societal and environmental impact	
Students: • recognise the importance of the conservation of materials and recycling in engineering, for example: – recycling of concrete, eg aggregate, steel – design of members to reduce excess material usage • outline the impact of engineering on society and the environment, for example: (ACTDEK041) – street-sweeper vehicles – wind turbines – lifting of wheelchairs onto vehicles • explore ethical, social and legal issues that apply to engineered solutions, for example: – damage to water courses during construction of infrastructure projects – increase in accessible architecture – introduction of mechanisms that reduce the number of workers in a manufacturing sector – mobile phone communication towers • compare and contrast renewable and non-renewable resources, for example: – steel production, eg iron ore extraction compared to recycling	**Complete research assignment.** **Harbour bridge task.** **Discuss use of Ply v Aluminium sheet for the construction of the Hydraulic digger.**

Links to industry	
Students: • compare industrial production processes to those used in the classroom, for example: – computer numerically controlled (CNC) machinery compared to traditional mechanically controlled machinery – material cutting technologies • describe recent and emerging technologies in engineering, for example: – computer simulation and testing – tilt slab construction • investigate a range of career paths in engineering, for example: – aeronautical engineer – mechanical engineer – project manager – structural engineer	**Show video of Hydraulic digger components being CNC cut.** **Complete engineering careers task.**

Topic 1 - Engineered Structures	
Design	
Students: • develop and produce practical projects allowing for the characteristics and properties of materials, systems, components, tools and equipment available (ACTDEK046) • identify and investigate factors influencing design in engineered structures, for example: – Sydney Harbour Bridge	Construct: -water tower in pairs as per design sheet. Video to testing aid understanding of concepts of forces on structure -concrete beam then test to destruction. Complete theory task on the Harbour Bridge.

• apply elementary engineering principles and processes in the design and production of structures, for example: (ACTDEK043) – cantilevers – strength to weight ratios – the use of triangles in frames • investigate innovative design solutions appropriate to engineered structures, for example: (ACTDEK043) – the design and construction of landmark structures, eg Olympic stadia around the world – the London Eye • select correct International System of Units (SI) and Australian Standards for design, for example: – correct units for length, area and volume • use and/or modify existing designs when completing projects • calculate quantities and costs of materials and components used in the completion of projects, for example: – use spreadsheets to calculate material quantities and monitor project costs • apply project management techniques and follow a planned sequence through to project completion • evaluate the impact of design and work practices/processes on the quality of finished projects, for example: develop criteria to evaluate engineering design choices	Complete theory sheet on SI units Produce a SS on the costing of the water tower as if it were 30m high not 300mm. Constructed from 150 x 150 x 8mm SHS @ $246 per length. Students to calculate number of lengths, total weight and cost. Investigate the impact on weight by changing wall thickness. Students to analyse lengths, cross sections and mass/metre from the link below. **https://www.libertygfg.com/media/163086/metalcentre-know-your-steel-mass-book-pipe-2014.pdf**
Engineering principles and processes	
Students: • investigate the reasons for engineered structures, for example:	PPT on bridge types and how materials affect their design. Discuss impact of improvements in materials over time.

– access, eg bridges, roads – resources, eg dams, wind farms – shelter, eg houses, unit blocks • explore the elements and design of structures, for example: – bridges, eg arch, beam, cantilever – truss components, eg joints, members, supports, struts, ties • identify fundamental quantities, derived quantities and their units, for example: – force, mass, acceleration • identify the forces that act on structures, for example: – wind loads, live loads, weight • explore the effects of forces on structures, for example: – calculate reactions for a simply supported beam – destructive testing – non-destructive testing, eg online simulations • design and construct simple structures for specific purposes	Stone arches to poor quality cast iron to stainless steel. Implications of maintenance on cost and longevity. Complete Bridges around the world. Complete the following bridge design challenge online http://www.pbs.org/wgbh/buildingbig/bridge/basics.html http://www.pbs.org/wgbh/buildingbig/bridge/challenge/index.html https://www.youtube.com/watch?v=nFzu6CNtqec Worksheet on force types, and mass and acceleration.

Description:

Students are to construct a Hydraulic digger from the components supplied. They are to experiment with the syringes and levers provided to maximise the efficiency of the design. Students will complete a number of worksheets to research how a variety of control systems work.
In building the hydraulic digger students are to be mindful of weight, materials and levers as factors.
Students will also design and construct a Lolly dispenser utilising a number of laser cut gears and levers.

This project will allow students to develop problem solving skills and enhance design their design skills..

This project will include a project report that will incorporate the following aspects:

- Work Method statements,
- Selection and use of resources,
- Industry related terminology,
- WH&S regulations,
- Societal and environmental implications, and
- Design processes.

The project report will be developed using appropriate workplace communication

Topic 2 – Engineered Mechanisms	
Design	
Students: ● develop and produce practical projects allowing for the characteristics and properties of materials, systems, components, tools and equipment available (ACTDEK046) ● identify and investigate factors influencing design in engineered mechanisms, for example: – energy sources – intended application – material choices ● describe past, present and future challenges in the application of engineered mechanisms, for example: – assistive technologies, eg prosthetic limbs – development of the bicycle ● apply correct International System of Units (SI) and Australian Standards relevant to engineering design	**Construct Hydraulic digger and design Geared lolly dispenser.** **Discuss suitability of materials used. Energy sources and applications.**

• use and/or modify existing designs when completing projects • apply Australian Drawing Standards in the development of engineered mechanisms • calculate quantities and costs of materials and components used in the completion of projects, for example: – use spreadsheets to calculate material quantities and monitor project costs • apply project management techniques and follow a planned sequence through to project completion • evaluate the impact of design and work practices/processes on the quality of finished projects, for example: – develop criteria to evaluate engineering design choices	**SS costing task.** **Collate folio for projects in Google classroom**
Engineering principles and processes	
Students: • analyse and describe the function and operation of mechanisms, for example: – dismantle and reassemble mechanisms to understand how they work – gears, belts and pulleys, levers, chains, cam and follower, linkages • conduct experiments to demonstrate an understanding of engineering principles – components that make up mechanisms – the nature and purpose of mechanisms • investigate mechanical advantage (MA), velocity ratio (VR) and efficiency in mechanisms, for example: – calculate MA of a lever system, eg increasing the length of a lever arm or moving the fulcrum position	**Complete mechanism worksheets.**

– calculate VR of a pulley system • investigate friction and its significance to the operation of mechanisms, for example: – how friction can be both an advantage and disadvantage in a mechanism – investigating the effect of contact surface area on static friction • investigate energy sources that may be used in mechanisms, for example: – batteries and motors – gravity – rubber bands – springs • investigate the relationship between components in complex mechanism, for example: – develop projects using combinations of mechanisms • design and construct mechanism for specific purposes	**Assemble gear train and motor assemblies. Experiment with different gear combinations.**

Week	Planning & Theory	Practical	Registration
1	• Intro lesson PPT on engineering fields. Class discussion on various engineering projects around the world. •	• Discuss forces on structures • Have students weight timber so they can better quantify the mass of each component.	
2	• Complete tests on general workshop safety and handtools. • Present PPT on types of forces.	• Watch vid on past towers being tested. Discuss successes and explanations for failures. • Discuss types of forces and obsolete members. • Construct water tower •	
3	• http://www.pbs.org/wgbh/buildingbig/bridge/basics.html • http://www.pbs.org/wgbh/buildingbig/bridge/challenge/index.html •	• Continue constructing towers	
4	• Complete project report for Water tower task.	• Continue constructing towers	
5	• Complete Bridges around the world.	• Test water towers underload.	
6	•	•	
7	•	•	
8	•	•	