

Unit of Work

Faculty: TAS	Stage: 4	Year: 8	Subject: Technology Mandatory	Timing: 9 Weeks	
<p>Name of unit: Engineered Systems - Pinball Madness</p> <p>The Engineered Systems context focuses on how force, motion and energy can be used in systems, machines and structures. Ss are provided with opportunities to experiment and develop prototypes to test their solutions. They understand how forces and the properties of materials affect the behaviour and performance of engineered systems, machines and structures. Knowledge of these principles and systems enables the design and production of sustainable, engineered solutions. (NESA, 2017)</p>					
<p>Focus area: Engineered Systems / Digital Technologies</p> <p>Assessment Tasks:</p> <ul style="list-style-type: none"> - Emerging technologies research report - Pinball prototype <p>Equipment</p> <p>Frame: Radiata pine 1.5m x 50mm x 12mm Curved</p> <p>Piece: Radiata pine 19mm x 2mm x 500mm</p> <p>Playing surface: Bamboo/plywood 3mm 350mm x 270mm</p> <p>Backboard: plywood 3mm</p> <p>Flippers: Bamboo/plywood 3mm</p> <p>Flipper buttons: Acrylic 3mm 100mm x 200mm</p> <p>20mm dowel for handle</p> <p>14 M4 countersink bolts 30m</p>			<p>Outcomes:</p> <ul style="list-style-type: none"> - designs, communicates and evaluates innovative ideas and creative solutions to authentic problems or opportunities TE4-1DP - plans and manages the production of designed solutions TE4-2DP - selects and safely applies a broad range of tools, materials and processes in the production of quality projects TE4-3DP - designs algorithms for digital solutions and implements them in a general-purpose programming language TE4-4DP - explains how data is represented in digital systems and transmitted in networks TE4-7DI - explains how force, motion and energy are used in engineered systems TE4-8EN - explains how people in technology related professions contribute to society now and into the future TE4-10TS <p>Related Life Skills Outcomes -</p> <p>TELS-1DP, TELS-2DP, TELS-3DP, TELS-4DP, TELS-9EN, TELS-11TS</p>		

Week	Lesson	Content	Teaching, Learning and Assessment Resources	Resources
1	1	Investigate needs or opportunities for designing an engineered system and investigate and select from a range of materials, components, tools, equipment and processes (ACTDP035) DT ST	<p>Identifying and defining</p> <p>Aim of the <u>Hook</u> – To inform and excite the Ss about the pinball project. As well as the practical project, other aspects include pop culture, art and design, engineering, using tools and machinery, how businesses make money, the prohibition era, etc</p> <p>Watch the <u>Jurassic Park Pinball</u> trailer as a <u>hook</u>. Additional Video - How It's Made - Pinball Machines - Industry Example.</p> <p>Class discussion. Check what they know. (I see, I think, I wonder*) Ss <i>Turn and talk</i> to their table group and discuss what they already know about pinball machines. T could prompt with - Where pinball machines are found, People who use them and why, Who designs them, What makes it an engineered system?</p> <p>New video - The Greatest Pinball Machines -</p> <p>T to introduce the Design Brief and Design Situation for Pinball project -</p> <p>T to discuss -</p> <ul style="list-style-type: none"> - the unit / project*** - assessment tasks - <u>GoogleSlides Workbook</u> <p><i>**Project - discuss with Ss the existing Pinball - standard designs will be used for pushes, flippers and playing surface, backboard. Timber frames will be pre cut with Ss required to cut and construct. Ss will create the mechanisms for the playing surface e.g. bouncers, ramps, spinners etc...that align with a theme. The backboard will include LED lights and be decorated with a self adhesive sticker. Additional stickers can be added - <u>no painting</u>.</i></p> <p>Ss to complete the Thinking Tracks Questions in the Google Slides workbook. Discuss their responses as a class.</p>	<p>https://www.youtube.com/watch?v=nuNOD3CIWLg&feature=youtu.be</p> <p>https://www.youtube.com/watch?v=4gEu--AjaT8&feature=youtu.be</p> <p>https://www.youtube.com/watch?v=9ssQTmZwoPg</p> <p><u>GoogleSlides Workbook</u></p>

			<p>Finish off the lesson - Video: What is Engineering and the Engineering Design Process. (6mins) - use as lead in for discussion on Lesson 2.</p> <p><i>T give Ss 3 postit notes each - ask them to write down one key takeaway from the video when watching it - share with each other the key takeaways from the video.</i></p>	<p>https://www.youtube.com/watch?v=nMwG1wnESDA</p> <p>Postit notes</p>
	2	investigate the role of an engineering professional and their impact on the environment and society.	<p>DISCUSS the role of engineers in helping society. Use the resource below for information.</p> <ul style="list-style-type: none"> - Ss will watch the 'What is engineering?' video. <p>Ss then document their response to the below questions in the GoogleSlides Workbook.</p> <ul style="list-style-type: none"> - What is engineering? <i>Write a definition of engineering in their own words.</i> <p>What type of engineer inspires you!</p> <p>Ss goal is to look into the types of engineers and choose the one that inspires and interests them the most.</p> <p>Once Ss pick a field, they will need to research more about it. Ss will use their research to answer the questions on the next page. T to remind Ss to use valid, trustworthy sources.</p> <p>Ss will individually answer questions in the google slides workbook.</p> <p><u>Extra resources -</u></p> <ul style="list-style-type: none"> - Watch - Inspiring the next generation of female engineers 17 mins Debbie Sterling TEDxPSU - Engineering Connections Videos - Millau Viaduct <p>Extension Activity -</p> <p>DISCUSS the role of mechanical and mechatronics engineers in helping the environment after viewing the video of University of Newcastle competing in Singapore.</p> <p>[example answer - autonomous systems such as self drive cars will save fossil fuels and make transport safer. Mechatronics combines mechanical systems with electronic systems]</p>	<p>GoogleSlides Workbook</p> <p>https://www.youtube.com/watch?v=bipTWWHya8A&feature=youtu.be</p> <p>https://www.youtube.com/watch?v=FAJGx3zP-Eo&feature=youtu.be</p> <p>https://www.youtube.com/watch?v=FEeTLopLkEo&feature=youtu.be</p>

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2	1	<p>Investigate how force, motion and/or energy are utilised when designing engineered systems, for example -</p> <p>(ACTDEK031)</p> <ul style="list-style-type: none"> - Electronic Circuits - Mechanisms involving simple machines 	<p><u>Investigating force, motion and energy.</u></p> <p>Ss are to participate in the Engineering Concepts Kahoot</p> <p>Ss learn to identify and explain -</p> <ul style="list-style-type: none"> - types of forces - Tension, Compression, Torsion, Bending, Shear, - four types of motion - linear, reciprocating, rotary, oscillating. - combining different types of motion - six simple machines - inclined plane, wheel on axle, lever, pulley, wedge, screw 	<p>Engineering Concepts Kahoot</p> <p>https://create.kahoot.it/share/engineering-concepts/58ebfabe-d525-4248-99cc-9edb74af788d</p>
	2	<p>Investigate the way in which technologies evolve locally, regionally or</p>	<p><u>Investigate how the pinball technology has evolved</u></p> <p>Ss can research using the article or their own online research to summarise the development of the pinball technology.</p>	<p>https://commons.princeton.edu/josephhenry/brief-history-of-pinball</p>

		<p>globally and how competing factors are prioritised in the development of design solutions, for example (ACTDEK029) ST</p> <p>Investigate the way Aboriginal and/or Torres Strait Islanders People use engineered solutions to serve community needs including those of cultural identity, for example, tools.</p>	<p>Ss will read the article on the History of Pinball Princeton University and using words/ drawings/images/ facts create a timeline in their workbook showing the technological advancements.</p> <p>Ss will use the Australian Museum website to research the traditional design and use of Aboriginal toys which utilised force and motion.</p> <p>T to refer to slide in Ss GoogleSlides workbook and complete the task.</p>	<p>https://australian.museum/learn/cultures/atsi-collection/aboriginal-toys/</p> <p>GoogleSlides Workbook</p>
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3	1		<p>SAFETY 2 & ONGUARD -</p> <p>T to introduce machinery and software to Ss.</p> <p>WHS - T is to introduce the safety rules using demonstrations and the OnGuard Safety Tests. Ss must read the tutorials and complete the safety tests prior to carrying out any practical work.</p> <p>OnGuard Safety tests -</p> <ul style="list-style-type: none"> - Woodworking Hand tools - General Machine Safety - Bench and Pedestal Drill - Drill / Driver - Cordless - Disc Sander 	Onguard

			<ul style="list-style-type: none"> - Scroll Saw - Hot Melt Glue Gun - Corded <p>Ss use protective clothing when working the machinery room e.g. goggles, apron, covered in leather shoes.</p> <p>T carries out practical demonstration highlighting the key safety features for each of the following - Sander, Sanding blocks and mats, Scroll Saw and Drill Press- including T demonstration</p> <p>T is to provide active supervision when Ss are using the machinery to produce their key tag and final toy design. T provides oral feedback to Ss when they are using the equipment.</p> <p>T could do this over two lessons splitting the class in ½ for each demonstration - other half of Ss work on their Onguard Tests.</p>	
	2		<p><u>Lesson 2 Safety - Onguard and Safety Demonstrations - finish Onguard for homework. Ensure T logs date of demonstration on Onguard.</u></p> <p>Safety Lesson Continued - Lesson 2 of 2.</p> <p>Continue machinery demonstration for class.</p>	Onguard
4	1	<p>explains how people in technology related professions contribute to society now and into the future TE4-10TS.</p> <p>Investigate how force, motion and/or energy are utilised when designing engineered systems, for example - (ACTDEK031)</p>	<p><u>Researching and Planning</u></p> <p><u>Emerging Technologies -</u></p> <p>Read Emerging Technologies Report</p> <p>View the <u>Emerging Technologies Report Requirements Google Slides</u> containing case studies of emerging technologies with an engineering focus.</p> <p>Read the Assessment notification, marking criteria and the task outline.</p> <p>Ss Assessment Task -</p> <p>Ss are required to write a report on one current emerging technology. Ss must research and write a report based on one of the case studies presented in class.</p> <ul style="list-style-type: none"> - Ss to complete the Planning Scaffold to plan their report. - Ss then use their planning scaffold to prepare a written report with images if applicable. 	<p>https://docs.google.com/presentation/d/16XPdQdLIVHlcwVILNCKNhIn5qHwzfpzKculRVPdZsWo/edit?usp=sharing</p>

		<ul style="list-style-type: none"> - Electronic Circuits - Mechanisms involving simple machines 		
	2	<p>Produce products or systems that apply engineering principles, for example - (ACTDEK031, ACTDEP039) DT</p> <p>A product that applies force, motion and/or energy for a purpose, e.g. toys</p> <p>Develop models, prototypes or products using a range of tools, materials and equipment to test the functionality of design ideas and consider innovative applications of advancing technologies, for</p>	<p>Producing and Implementing. Prior to Idea Generation Ss build their frame for their pinball machines and then decide on their theme, sketch ideas and begin experimenting with prototypes Show Arduino as well - specifically focusing on the length of the LED so that Ss can integrate this into their design.</p> <p><i>Discuss with Ss the existing Pinball - standard designs will be used for pushes, flippers and playing surface, backboard.</i> <i>Timber frames will be pre cut with Ss required to cut and construction as per guide in the google workbook. Ss will create the mechanisms for the playing surface e.g. bouncers, ramps, spinners etc...that align with a theme.</i> <i>The backboard will include LED lights and be decorated with a self adhesive sticker. Additional stickers can be added - <u>no painting</u>.</i></p> <p><u>STAGE ONE ON PRODUCTION -</u> Do demonstration of each process - - EACH OF THESE ARE STATIONS* -</p> <ul style="list-style-type: none"> - Station 1 - Cutting out rectangle of the long side - mirror image other side (<i>Ss must practise on scrap before they do the real deal</i>) - Station 2 - Flippers x2 glue + glue wingnut and washers - Station 3 - Countersinking top of the playing board - 8 holes - Station 4 - Countersinking the 2 acrylic pushes - clamp to scrap timber + addition of the bolt plus the lock nut using the allen key (clamp) into the bench. <p><i>*Each row in the classroom is a station so Ss support each other in the production of each step</i> <i>*A range of jigs will be required to assist with accuracy of drilling holes for frame and making of standard components..</i></p> <p>T set up 4 stations within the room then Ss can go to a station - at each station they have all the equipment and instruction cards they need to complete that step with.</p>	<p>Stage one production Instruction cards</p> <p>Frame guide - google workbook</p> <p>Jigs Countersinks Jigsaw Wingnuts WashersAcrylic Pushes Clamps Scrap timber Wood glue Allen key Drill</p>

		example - (ACTDEP037) DT		
5	1		<p><u>CONTINUE WITH STAGE ONE OF PRODUCTION</u></p> <p>While building the pinball machine, Ss will develop an illustrated visual production guide of how to construct the whole machine.</p> <ul style="list-style-type: none"> - In relation to production plans, T discuss the use of a production plan as a management strategy in developing successful design projects – emphasise how materials, tools and techniques are identified in the production plan. - Within the Production Plan Ss are encouraged to use graphics/photographs to support their steps of the process. - Ss may hand draw or use illustrator or a combination of both. <p>Refer Ss to Production Plan content on their class canvas tile.</p> <ul style="list-style-type: none"> - <i>Designers use Production Plans to map out each step involved in making their product. It must be detailed and in a logical order so that the designer knows which step comes next.</i> 	<p>Canvas</p> <p>Adobe Illustrator</p>
	2		<u>CONTINUE WITH STAGE ONE OF PRODUCTION + Production Plan</u>	
6	1	Develop models, prototypes or products using a range of tools, materials and equipment to test the functionality of design ideas and consider innovative applications of advancing technologies, for	<p><u>STAGE TWO ON PRODUCTION -</u></p> <p>Do demonstration of each process - - EACH OF THESE ARE STATIONS -</p> <ul style="list-style-type: none"> - Steps 5. Then fastening all of these to the playing board - pushers on the flippers - using the bolts, lock nuts... - Step 6. Use the jig to drill holes in the long sides and the short sides of the frame to the countersink. - create 2 L's with the outside pine - Step 7. Put the playing board in and place one L around it and then slip the other L on the opposite side and counter sink the remaining 2 sides together..... <p><u>Concept Boards - work on concept boards prior to starting idea generation.</u></p> <p>Ss brainstorm themes and ideas for their pinball machine, then create a concept board that reflects their theme.</p>	<p><u>GoogleSlides</u></p> <p><u>Workbook</u></p> <p>https://docs.google.com/document/d/1xP2E-tBDtNtZFpidOwOgRiD-Kh6P_jvAOPRe3QfNeel/edit?usp=sharing</p>

		<p>example - (ACTDEP037) DT</p> <p>Select and use a variety of critical and creative thinking strategies to generate innovative design ideas, for example - DT ST</p> <ul style="list-style-type: none"> – brainstorming – sketching – 3D modelling – experimenting 	<p>Create a concept board that reflects your theme for your pinball. Consider layout and layering of images to create a cohesive look</p> <p>Select one image from the <u>Concept board inspiration page</u> in the google workbook to expand these images. Discuss with Ss what makes an effective concept board - get their input. Before allowing them to access the quizlet.</p> <p>Ss must consider layout and layering of images to create a cohesive look. Use Photoshop/Canva to complete.</p> <p>Ss develop a Concept Board</p>	<p>https://quizlet.com/notes/creating-a-game-concept-board-opus-web-design-2016-3d663242-c38d-4879-b53f-5f70fb450b97</p> <p>Adobe photoshop</p> <p>Canva</p> <p>https://www.onlinedesignteacher.com/2016/12/how-to-create-concept-board.html</p>
	2		<p><u>CONTINUE WITH STAGE TWO OF PRODUCTION -</u></p> <p>Ss can be working on Concept Boards whilst waiting for equipment OR T assistance.</p>	
7	1	<p>Investigate needs or opportunities for designing an engineered system and investigate and select from a range of materials, components, tools, equipment and processes.</p> <p>Select and use a variety of critical and creative</p>	<p>Introduce <u>Idea Generation</u> - Ss can be working on their <u>idea generation</u> whilst finalising the construction of their pinball machine frame.</p> <p><u>Idea Generation</u></p> <p>Before sketching, Ss should consider the following</p> <ol style="list-style-type: none"> 1. Brainstorm possible props for their theme. 2. Ss learn the correct terms for the parts of a Pinball Machines as they read the following articles Pinball Makers Anatomy of the Pinball 3. Ss fill in the Pinball Anatomy drag and drop in the google workbook to demonstrate understanding 4. Ss brainstorm possible types of mechanisms for their pinball machine, referring to the links above. 5. With reference to their brainstorms, Ss begin sketching initial thumbnail sketches of props & mechanisms using the drawing templates in the workbook 	<p>https://pinballmakers.com/wiki/index.php?title=Basics&Switches</p> <p>https://pinballsales.com.au/anatomy-pinball-machine-pinball-parts-terminologies-know/</p>

		<p>thinking strategies to generate innovative design ideas, for example -</p> <p>DT ST</p> <ul style="list-style-type: none"> – brainstorming – sketching – 3D modelling – Experimenting 	<p>Use colour and brief annotations.</p> <p>These sketches do not have to be perfect; it is about generating as many designs and ideas as possible</p> <p>Design Ideas</p> <p>After completing a range of thumbnail sketches, Ss use the Pinball Drawing template to sketch 3 design ideas for pinball layout demonstrating where the mechanisms will be and the potential theme. All sketches to be in colour and black felt tip. Annotate materials, techniques, mechanisms, themes.</p> <p>Class/ Pair/ Individual Brainstorm - Ss apply creative thinking to brainstorm alternative materials or repurposed items.</p> <p>Ss then use critical thinking to narrow the list to materials suitable. Think critically about materials that are easily available, does the school supply it, can be formed quickly and easily, do I need training to use cutting equipment, is my workshop set up to handle it or would I need to leave the room, considers the environment, can I make some parts at home and bring them in, etc,</p> <p>After 20 minutes working on concept sketches, all Ss walk around and spy on other Ss concepts. Each Ss has one postit note, then chooses one Ss work to give feedback on. They jot a comment on the postit note and must be constructive and kind.</p> <p>Peer Assessment</p> <p>If a Ss wants to copy another Ss idea, that's allowed, however, they must let the T know as well as the owner of the IP (the idea), who receives a bonus mark.</p> <p>IP = Intellectual property.</p> <p>Respecting other people's work is part of acting ETHICALLY use the website to inform Ss.</p>	<p>GoogleSlides Workbook</p> <p>Postit notes</p> <p>https://www.ipaustralia.gov.au/</p>
	2		<p><u>ASSESSMENT TASK DUE</u></p> <p>Ss could be working on -</p> <p><u>Stage Two Production</u> <u>Concept Board</u> <u>Idea Generation</u></p>	

8	1	<p>Generate and communicate the development of design ideas, plans and processes for various audiences using appropriate technical terms and technologies including graphical representation techniques, for example - (ACTDEP036) CT DT</p> <p>Sketches, drawings and computer-aided design (CAD)</p>	<p>DISCUSS the benefits of CAD, computer aided design, in the design of new products after viewing the 3 minute video.</p> <p>T to spark discussion points for discussion (Teaching resource of deeper reasoning is provided)</p> <ul style="list-style-type: none"> - CAD enables visualisation - Quick to market - Stress analysis can be conducted virtually - Benefits teams working from home - VR - Easier to mass produce. <p>Once Ss are satisfied with their final prototype ideas they need to finalise design idea by produced a Final Design Sketch.</p> <p>EXTENSION – sketch in isometric or use CAD to model their unique mechanism.</p>	<p>Benefits of CAD in the design of new products - Teacher Points for discussion google doc</p> <p>https://www.autodesk.com/education/edu-software/overview</p> <p>www.nutsnboltsdesign.com</p>
	2	<p>Select and use a variety of critical and creative thinking strategies to generate innovative design ideas, for example - DT ST</p> <ul style="list-style-type: none"> - Brainstorming - Sketching - 3D modelling - Experimenting <p>Investigate how force, motion and/or energy are utilised when</p>	<p>Split the class in half - Half work on the Arduino component and the other half work on Prototyping.</p> <p>Introduce Prototyping <u>Exploring ideas through experimentation</u> PRACTICAL ACTIVITY – Engineering Madness Prototypes</p> <p>This activity follows the Make design make method (rough mockup is made, which inspires creative ideas, which are then made).</p> <p>GROUP WORK groups of 3. Ss review engineering concepts. Ss experiment to design and construct a simple mechanism for their pinball machine using materials provided T guides Ss to brainstorm and sketch designs</p>	<ul style="list-style-type: none"> - Cardboard - Pegs - String - Rubber bands - Small weights or objects for testing (marbles) - Tools (scissors, rulers, tape)

		designing engineered systems, for example - (ACTDEK031)	<p>Constraints -</p> <ul style="list-style-type: none"> - At least one type of force - One type of motion <p>Considerations -</p> <ul style="list-style-type: none"> - Try use one or more simple machines <p>Ss to test their mechanisms and observe how force and motion interact.</p> <p>Ss share findings and reflect on utilisation of engineering concepts with table groups</p> <p>After this activity, T collect the mock ups and keep Ss to use</p> <p>EXTENSION - create a CAD file so that an element of the playfield could be manufactured using a 3D printer, or a laser cutter. 3D printers need an STL file. Fusion 360 will all output an STL file. Develop an entire machine in Fusion 360.</p>	
9	1	Develop models, prototypes or products using a range of tools, materials and equipment to test the functionality of design ideas and consider innovative applications of advancing technologies, for example - (ACTDEP037) DT	<p>Introduce backboard design and the incorporation of LED's.</p> <p>All Ss will receive an Arduino powered circuit board that controls up to 8 LEDs. They will incorporate at least one switch into their pinball machine.</p> <p>Code will be provided by T. The pinball library has two basic codes -</p> <ul style="list-style-type: none"> - The first is count up mode, so you can add a light each time you hit the button. - The second is count down mode, where the user loses a life for each time the ball is dropped and the button is hit. <p>Ss are to place LED's on the backboard by drilling 5mm holes.</p> <p>Ss are to design their backboard with the location of their LEDs clearly marked.</p> <p>Differentiation opportunity -</p> <p>Every Ss will incorporate the basic circuit</p> <p>Most Ss will consider the positioning of components</p> <p>Some Ss will modify the code and use additional components</p>	<p>Arduino powered circuit board</p> <p>Programming the Pinball Interface Course</p>

			<p>Ss to follow the Programming the Pinball Interface Course to wire their circuit and code their machine.</p> <p>EXTENSION - create a CAD file so that an element of the playfield could be manufactured using a 3D printer, or a laser cutter. 3D printers need an STL file. Fusion 360 will all output an STL file. Develop an entire machine in Fusion 360.</p>	
	2	<p>Develop models, prototypes or product using a range of tools, materials and equipment to test the functionality of design ideas and consider innovation applications of advancing technologies, for example -</p> <ul style="list-style-type: none"> - developing CAD files to automate manufacturing technologies - programming a microcontroller to collect data or automate a task - computer aided manufacturing. <p>Designs algorithms for digital solutions and implements them in a general purpose programming language</p>	<p><u>ASSESSMENT TASK DUE - PROTOTYPE</u></p> <p>Split the class in half - Half work on the Arduino component and the other half work on Prototyping.</p> <p>Ss are to place LED's on backboard by drilling 5mm holes. The basic code will allow LED's to count down as a switch is pressed.</p> <p>Ss will being to build an electronic circuit into the game. Ss should use Arduino and the resources listed to the right.</p> <p>Differentiation opportunity - Every Ss will incorporate the basic circuit Most Ss will consider the positioning of components Some Ss will modify the code and use additional components</p>	<p>LEDs 5mm switches (made when two pieces of metal come into contact)</p> <p>290 Ohm resistor (first three coloured bands are red, white, brown)</p> <p>9 Volt battery and battery snap</p> <p>Arduino</p> <p>https://www.autodesk.com.au/products/fusion-360/overview?</p>

		TE4-4DP Explains how data is represented in digital systems and transmitted in networks TE4-7DI		
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