Bucking Bull – Critical and Creative Thinking Curriculum Mapping

In the Bucking Bull project, students become amusement park engineers, designing, building and coding a model amusement ride. The build combines a DC motor, motor driver, gears and a crank-rocker linkage to convert continuous rotational motion into a controlled, oscillating bucking motion. The following tables map this project against the Victorian Curriculum F–10 Version 2.0 Critical and Creative Thinking capability, for Levels 3–4, 5–6, 7–8 and 9–10. Each table lists the relevant content descriptions, how they are addressed through the project, and the interrelated strand(s) involved.

Levels 3 and 4

Table 1: Bucking Bull – Critical & Creative Thinking (Level 3–4)

Content Description	Project Application	Interrelated Strands
VC2CC4Q01 – *the construction and use of open and closed questions for different purposes*	Students ask open and closed questions throughout the engineering design process to investigate why their Bucking Bull moves the way it does. For example, "What happens if we use a longer rocker arm?" (open) or "Is the motor spinning in the correct direction?" (closed). These questions guide debugging and design improvements.	• Questions and Possibilities
VC2CC4Q02 – *how pre-established preferences may influence thinking when generating and responding to alternative ideas and possibilities*	Students reflect on whether their preference for a particular bucking rhythm, such as a fast, jerky motion, influences the gear ratio and linkage lengths they choose, and consider how this might narrow the range of mechanism designs they explore.	• Questions and Possibilities
VC2CC4Q03 – *simple strategies for generating new ideas and possibilities, including repurposing or rearranging*	Students generate new possibilities by rearranging the arrangement of their crank-rocker linkage and experimenting with different gear combinations to create different bucking motions for their ride.	• Questions and Possibilities
VC2CC4R01 – *ways to identify, structure and communicate a conclusion justified by a range of reasons*	Students explain why particular gear or linkage choices were made, using evidence gathered from testing. For example, they justify choosing a shorter crank arm because it produced a smoother, more controlled bucking motion.	• Reasoning
VC2CC4R02 – *what is meant by evidence and what is meant by a value and how they are used to support reasoning*	Students use testing evidence, such as measuring how high or how quickly the bull bucks, to support claims about which gear ratio works best, and consider values such as safety when deciding how forceful the motion should be.	• Reasoning

Content Description	Project Application	Interrelated Strands
VC2CC4R03 – *the use of 'if-then' thinking to come to a conclusion when reasoning, and simple errors that can be made when using this thinking*	Students use if-then thinking to control the sequence of their Bucking Bull's motor (for example, "if the motor has turned a certain number of times, then reverse direction"), and identify errors when the bull misbehaves, such as wrongly assuming one successful test means the mechanism will always work the same way.	• Reasoning
VC2CC4R04 – *the basis for different kinds of criteria, such as desired qualities or given rules; and how criteria are used to help make judgements when reasoning*	Students identify criteria for a successful Bucking Bull, such as smooth motion, reliable operation and an entertaining bucking rhythm, and use these criteria to judge their prototype.	• Reasoning
VC2CC4M01 – *an extended range of general learning strategies including connecting to prior learning, self-questioning, self-explanation and peer instruction*	Students connect new knowledge about gears and linkages to prior experience with simple machines and toys, ask themselves questions to check their understanding of how the mechanism works, and explain their design to a peer.	• Metacognition
VC2CC4M02 – *the use of thinking processes to facilitate thinking, including for problem-solving, and verbal and non-verbal strategies for representing thinking processes*	Students develop and test hypotheses about how gear ratio affects the speed and force of the bucking motion, recording their trials in a table to compare outcomes and identify patterns.	• Metacognition
VC2CC4M03 – *how to evaluate a proposed solution using given criteria*	Students use a teacher-provided checklist (for example, "Does the bull buck smoothly?", "Is the mechanism securely assembled?") to evaluate their Bucking Bull prototype and identify areas for improvement.	• Metacognition

Levels 5 and 6

Table 2: Bucking Bull – Critical & Creative Thinking (Level 5–6)

Content Description	Project Application	Interrelated Strands
VC2CC6Q01 – *the construction of questions for identifying and building understanding*	Students construct a range of questions to build their understanding of how gear ratios and linkage geometry affect motion, and construct questions for an expert or online resource about how real amusement rides use similar mechanisms.	• Questions and Possibilities

Content Description	Project Application	Interrelated Strands
of information, possibilities, processes and activities		
VC2CC6Q02 – *the importance of setting aside preconceptions; strategies for setting preconceptions aside when generating and evaluating alternative ideas and possibilities*	Students use given brainstorming rules (deferring judgement, building on others' ideas) when generating alternative linkage and gear designs in small groups, and reflect on how setting aside their initial preferred design allowed more unusual bucking motions to be considered.	• Questions and Possibilities
VC2CC6Q03 – *an extended range of strategies to generate new ideas and possibilities including forming a link between different information sources*	Students research other mechanical rides or toys that use crank-rocker or gear mechanisms to create motion, and form links between these examples to design a distinctive bucking motion for their own ride.	• Questions and Possibilities
VC2CC6R01 – *ways to identify, structure and communicate an argument that uses sub-arguments leading to a main conclusion*	Students construct a design justification with a main conclusion (for example, "Our gear and linkage design produces the most realistic bucking motion") supported by several reasons — an appropriate gear ratio, secure torque transmission and well-tested linkage geometry — each of which is further supported by evidence from testing.	• Reasoning
VC2CC6R02 – *ways to consider competing values and the strength of evidence when reasoning*	Students weigh competing values, such as realism of motion versus mechanical simplicity, and evaluate whose test data — their own or a partner's — provides stronger evidence for a particular gear ratio.	• Reasoning
VC2CC6R03 – *simple reasoning errors including hasty generalisations, false analogies and contradiction, and how reasoning associated with these errors can be improved*	Students examine whether concluding "the linkage is broken" after one failed test is a hasty generalisation, and discuss how running repeated trials improves the reliability of conclusions about their mechanism's performance.	• Reasoning
VC2CC6R04 – *the use of criteria to support analysis and evaluation when reasoning*	Students develop criteria — such as motion smoothness, mechanical reliability and how closely the motion resembles a real bucking bull — to analyse and compare different gear and linkage configurations.	• Reasoning
VC2CC6M01 – *learning strategies suited to general and specific contexts, including different ways of identifying,*	Students use diagrams to organise their understanding of how the motor, gears and linkage work together, and revisit their design across several sessions to consolidate their understanding of torque transmission.	• Metacognition

Content Description	Project Application	Interrelated Strands
expressing and organising key learning, and undertaking spaced practice		
VC2CC6M02 – *thinking processes suited to different contexts and when and how to use them, including for problem-solving*	Students select and apply a structured problem-solving process (define the problem, generate options, test, refine) when troubleshooting why their linkage sometimes jams or moves unevenly.	• Metacognition
VC2CC6M03 – *the use of criteria to identify and compare proposed solutions*	Students each propose a different gear ratio or linkage length for the mechanism, then use agreed criteria to compare solutions and select the most effective approach.	• Metacognition

Levels 7 and 8

Table 3: Bucking Bull – Critical & Creative Thinking (Level 7–8)

Content Description	Project Application	Interrelated Strands
VC2CC8Q01 – *the construction of a main question and sub-questions for different purposes*	Students define a main investigation question, such as "How can we make our Bucking Bull's motion feel more realistic and exciting?", and break this into sub-questions about gear ratio, linkage geometry and motor timing to guide testing.	• Questions and Possibilities
VC2CC8Q02 – *when and how judgement is suspended to support generating and evaluating alternative ideas and possibilities*	Students engage with a guest engineer or maker to explore how professionals suspend judgement when prototyping unconventional mechanism designs, and practise withholding critique during initial brainstorming of new linkage or gear ideas before evaluating feasibility.	• Questions and Possibilities
VC2CC8Q03 – *strategies for generating new ideas and possibilities including identifying a pattern across multiple information sources*	Students examine several existing mechanical rides, toys or Rube Goldberg-style machines and identify a common pattern in how rotational motion is converted into other kinds of movement, then apply this pattern to their own mechanism design.	• Questions and Possibilities
VC2CC8R01 – *ways to identify, structure and communicate a conclusion and its justification where competing claims, and grounds for claims, are analysed and evaluated*	Students research and weigh competing claims about the best gear geometry for their design — for example, spur versus helical gears — structuring a written or verbal justification that analyses the strength of evidence for each option before reaching a conclusion.	• Reasoning

Content Description	Project Application	Interrelated Strands
VC2CC8R02 – *reasons for competing claims about matters of fact and matters of value, including consideration of evidence and expertise, and ways to analyse and evaluate competing claims*	Students investigate manufacturer specifications for their motor and gears, such as torque ratings (matters of fact), versus peer opinions about which bucking motion "feels" most exciting (matters of value), discussing the role of technical expertise versus user testing when justifying their chosen design.	• Reasoning
VC2CC8R03 – *an extended range of reasoning errors including cause and effect fallacies and arguing from ignorance, and how reasoning associated with these errors can be improved*	Students examine whether their claim that "changing the gear ratio caused the linkage to jam" reflects genuine causation or coincidence, and discuss how testing one variable at a time systematically improves the strength of their conclusions.	• Reasoning
VC2CC8R04 – *when and how criteria are selected to improve clarity and support analysis and evaluation, including of competing claims, when reasoning*	Students develop necessary and sufficient criteria for judging whether their mechanism is "reliable" (for example, it must complete twenty consecutive bucking cycles without jamming) and use these refined criteria to analyse competing design choices within their group.	• Reasoning
VC2CC8M01 – *ways to select, use and reflect on general and context-specific learning strategies*	Students select appropriate strategies, such as building a physical model of the linkage or explaining the gear train to a peer, to consolidate their understanding of torque transmission, and reflect on which strategy was most effective for this technical content.	• Metacognition
VC2CC8M02 – *broad strengths and limitations of thinking processes in different contexts, including problem-solving*	Students compare different approaches to designing their mechanism, such as trial-and-error prototyping versus calculating gear ratios mathematically first, and reflect on the strengths and limitations of each when applying engineering design principles.	• Metacognition
VC2CC8M03 – *the development of criteria for evaluating a range of proposed solutions; ways to evaluate and incorporate new knowledge that could affect the final decision*	Students develop criteria to evaluate multiple proposed gear and linkage combinations, and adjust their final decision in light of new knowledge, such as discovering during testing that a particular gear ratio causes excessive strain on the motor.	• Metacognition

Levels 9 and 10

Table 4: Bucking Bull – Critical & Creative Thinking (Level 9–10)

Content Description	Project Application	Interrelated Strands
VC2CC10Q01 – *the construction and adaptation of questions to suit different contexts*	Students adapt their investigation questions to suit different audiences — technical questions about torque and gear ratios for an engineering forum, user-experience questions for a peer survey about which bucking motion feels most fun — when researching how to refine their Bucking Bull.	• Questions and Possibilities
VC2CC10Q02 – *when and how to critically reflect on suspension of judgement when generating and evaluating alternative ideas and possibilities from different perspectives*	Students critically reflect on how unconscious bias toward familiar mechanisms, such as defaulting to a simple spur gear train, may have limited their exploration of alternative gear geometries like helical or herringbone gears, and discuss strategies to mitigate this bias when generating new design concepts.	• Questions and Possibilities
VC2CC10Q03 – *strategies for generating new ideas and possibilities including identifying links and patterns across multiple information sources and perspectives*	Students gather data from their own trials and from research into how real amusement rides achieve realistic motion, analysing these for shared patterns to inform an evidence-based refinement of their gear ratios and linkage geometry.	• Questions and Possibilities
VC2CC10R01 – *ways to analyse and improve the structure, clarity, consistency and coherence of a conclusion and its justification in different contexts*	Students critically review their design justification report for the Bucking Bull, checking for unclear assumptions, such as about how much torque their motor can realistically deliver, and revising the structure and clarity of their argument before presenting to peers or mentors.	• Reasoning
VC2CC10R02 – *ways to analyse and evaluate claims and grounds for claims for the qualities of accuracy, precision, depth or breadth when reasoning, and ways to identify what qualities are required in different contexts*	Students evaluate whether their testing data on mechanism reliability is sufficiently precise and accurate for a formal design report, and determine whether greater breadth (testing multiple gear ratios) or depth (extensive trials on one configuration) is required to support their conclusions.	• Reasoning
VC2CC10R03 – *complex reasoning errors including false dichotomies and appeal to consensus, their significance and how reasoning*	Students examine whether framing their design choice as "either use a more powerful motor or the mechanism will always jam" is a false dichotomy, and discuss why appealing to popular classmate opinion about the "best" bucking motion is not, by itself, sufficient justification for a final design decision.	• Reasoning

Content Description	Project Application	Interrelated Strands
associated with these errors can be improved		
VC2CC10R04 – *when and how criteria are refined to improve clarity and support analysis and evaluation, including of competing claims, when reasoning*	Students refine their evaluation criteria for the final Bucking Bull mechanism to be specific, measurable and time-bound (for example, "completes fifty bucking cycles with no more than one jam"), and use these refined criteria to resolve competing claims about whose design is most effective.	• Reasoning
VC2CC10M01 – *ways to select, monitor and adapt general and context-specific learning strategies*	Students maintain a design journal to monitor the effectiveness of their learning strategies — for example, calculating gear ratios mathematically versus testing configurations by trial and error — throughout the project, adapting their approach as the mechanical challenges evolve.	• Metacognition
VC2CC10M02 – *the importance of critical analysis of thinking processes in different contexts, including for problem-solving, considering factors such as cognitive biases*	Students critically analyse their own design process when troubleshooting their mechanism, identifying cognitive biases such as confirmation bias (favouring test results that support their preferred gear ratio) and discussing strategies to mitigate this in future testing.	• Metacognition
VC2CC10M03 – *the development and adaptation of criteria for evaluating the viability and sustainability of proposed solutions in different contexts*	Students develop and adapt criteria to assess the viability of their proposed mechanism refinements, considering factors such as motor strain, build complexity and the feasibility of completing changes before the showcase, and justify their final design recommendation.	• Metacognition

Bucking Bull – Design and Technologies Curriculum Mapping

In the Bucking Bull project, students become amusement park engineers, designing, building and coding a model amusement ride that uses a DC motor, motor driver, gears and a crank-rocker linkage to convert continuous rotational motion into a controlled, oscillating bucking motion. The following tables map this project against the Victorian Curriculum F–10 Version 2.0 Design and Technologies curriculum, for Levels 3–4, 5–6, 7–8 and 9–10. Only content descriptions with a genuine link to the project are included; the Food and fibre production and Food specialisations sub-strands, and content descriptions focused on large-scale industry, cultural or global ethical considerations, have been left out, with a brief note after each table explaining what was excluded and why.

Levels 3 and 4

Table 1: Bucking Bull – Design and Technologies (Level 3–4)

Content Description	Project Application	Strand / Sub-strand
VC2TDE4S01 – *the role of people in design and technologies occupations and factors including sustainability that impact on the design of solutions to meet community needs*	Students consider the role of mechanical engineers who design amusement rides, and discuss sustainability factors such as reusing 3D-printed parts or choosing durable materials for their Bucking Bull's frame and linkage.	• Technologies and Society
VC2TDE4C01 – *describe how forces affect function in a product or system*	Students describe how the force from the spinning motor and gears affects the movement of their Bucking Bull, and explore how changing the linkage arm length changes how forcefully and quickly the bull bucks.	• Technologies Contexts – Engineering principles and systems
VC2TDE4C04 – *describe how the properties of materials affect function in a product or system*	Students describe how the properties of their chosen frame, gear and linkage materials — such as their strength and rigidity — affect how well the mechanism transmits force without bending or breaking.	• Technologies Contexts – Materials and technologies specialisations
VC2TDE4D01 – *explore needs or opportunities for designing and testing materials, components, tools and processes needed to create designed solutions*	Students explore what materials, components and tools they will need to build their Bucking Bull, and test different gear and linkage arrangements to see which produces the best bucking motion.	• Creating Designed Solutions – Investigating and defining
VC2TDE4D02 – *generate and communicate design ideas and decisions*	Students generate and communicate their design ideas for the Bucking Bull using annotated diagrams that label components such as the motor, gears, crank arm and rocker linkage.	• Creating Designed Solutions – Generating and designing

Content Description	Project Application	Strand / Sub-strand
using technical terms and graphical representation techniques, using manual and digital tools		
VC2TDE4D03 – *select and use materials, components, tools and techniques to safely make designed solutions*	Students select and safely use materials, components and tools — such as assembling gears onto shafts and wiring the motor — to build their Bucking Bull, following safe practices when handling moving mechanical parts.	• Creating Designed Solutions – Producing and implementing
VC2TDE4D04 – *use given or predetermined design criteria including sustainability to evaluate design ideas and solutions*	Students use given design criteria, such as smooth motion and reliable operation, to evaluate their Bucking Bull and identify improvements.	• Creating Designed Solutions – Evaluating
VC2TDE4D05 – *sequence steps to individually and collaboratively make designed solutions*	Students sequence the steps needed to build their Bucking Bull, such as assembling the frame, mounting the motor and gears, connecting the linkage, then programming and testing the ride, recording this as a simple plan.	• Creating Designed Solutions – Planning and managing

Not mapped for this project: *VC2TDE4C02 (Food and fibre production) and VC2TDE4C03 (Food specialisations), since neither sub-strand relates to a mechanical engineering build.*

Levels 5 and 6

Table 2: Bucking Bull – Design and Technologies (Level 5–6)

Content Description	Project Application	Strand / Sub-strand
VC2TDE6S01 – *how people in design and technologies occupations consider competing ethical factors including sustainability in the design of products, services and environments*	Students consider competing factors engineers face when designing amusement rides, such as balancing motor power, mechanical durability and the environmental impact of the materials used for the Bucking Bull's frame.	• Technologies and Society
VC2TDE6C01 – *explain how electrical energy can be transformed into movement, sound or light in a product or system*	Students explain how electrical energy from the battery is transformed into the rotational movement of the motor and, through the gear train and crank-rocker linkage, into the bucking motion of the bull.	• Technologies Contexts – Engineering principles and systems

Content Description	Project Application	Strand / Sub-strand
VC2TDE6C04 – *explain how characteristics and properties of materials, systems, components and tools affect their use when producing designed solutions*	Students explain how the characteristics of their chosen motor, gears and linkage material affect how they are used and combined to produce a working Bucking Bull mechanism.	• Technologies Contexts – Materials and technologies specialisations
VC2TDE6D01 – *investigate needs or opportunities for designing, and the materials, components, tools and processes needed to create designed solutions*	Students investigate the materials, components, tools and processes needed to build a reliable Bucking Bull, testing different gear and linkage combinations.	• Creating Designed Solutions – Investigating and defining
VC2TDE6D02 – *generate, iterate and communicate design ideas, decisions and processes using technical terms and graphical representation techniques, using manual and digital tools*	Students generate and iterate design ideas for their Bucking Bull, using labelled drawings and digital tools to communicate how the gear train and linkage will work and how their design has changed through testing.	• Creating Designed Solutions – Generating and designing
VC2TDE6D03 – *select, explain and use suitable materials, components, tools and techniques to safely make designed solutions*	Students select and explain their choice of materials, components and tools, and safely use them to assemble the frame, gear train and linkage for their Bucking Bull.	• Creating Designed Solutions – Producing and implementing
VC2TDE6D04 – *negotiate design criteria that address ethical considerations, including sustainability, to evaluate design ideas, processes and solutions*	Students negotiate design criteria as a class, such as "the motion must not be dangerously forceful" and "materials should be reusable", and use these to evaluate their Bucking Bull.	• Creating Designed Solutions – Evaluating
VC2TDE6D05 – *develop project plans that include consideration of resources to individually and collaboratively make designed solutions*	Students develop a project plan that identifies the resources, time and roles needed to build their Bucking Bull, whether working individually or in a team.	• Creating Designed Solutions – Planning and managing

Not mapped for this project: *VC2TDE6C02 (Food and fibre production) and VC2TDE6C03 (Food specialisations).*

Levels 7 and 8

Table 3: Bucking Bull – Design and Technologies (Level 7–8)

Content Description	Project Application	Strand / Sub-strand
VC2TDE8C01 – *analyse how force, motion and energy are used to manipulate and control engineered systems that are ethical*	Students analyse how force, motion and energy are used to control their Bucking Bull's gear train and linkage, programming a microcontroller to control the motor's speed and direction and testing the durability of their battery over repeated bucking cycles.	• Technologies Contexts – Engineering principles and systems
VC2TDE8C04 – *analyse how characteristics and properties of tools, materials, systems and components can be selected, manipulated and combined to create designed solutions that are ethical*	Students analyse how the properties of their chosen frame material, gears and linkage components can be combined to create a reliable, safe Bucking Bull, considering the durability and safety implications of their component choices.	• Technologies Contexts – Materials and technologies specialisations
VC2TDE8D01 – *explain needs or opportunities for designing, and investigate and select tools, materials, processes and components to create designed solutions*	Students explain the need their Bucking Bull addresses (an engaging, mechanically realistic amusement ride model) and investigate and select appropriate tools, materials, processes and components to meet this need.	• Creating Designed Solutions – Investigating and defining
VC2TDE8D02 – *generate, test, iterate and communicate design ideas, processes and solutions using technical terms and graphical representation techniques and appropriate attributions, using manual and digital tools*	Students generate, test and iterate their Bucking Bull design, using annotated sketches and digital tools to communicate their process and attributing any external gear or linkage designs they referenced.	• Creating Designed Solutions – Generating and designing
VC2TDE8D03 – *select, justify and use suitable tools, materials, processes and components to*	Students select and justify their choice of components — experimenting with different gear ratios, shaft-and-key connections and linkage lengths to understand how the mechanism functions and how to troubleshoot issues — and use safe working practices throughout.	• Creating Designed Solutions – Producing and implementing

Content Description	Project Application	Strand / Sub-strand
safely make designed solutions		
VC2TDE8D04 – *collaboratively develop design criteria that include ethical considerations to evaluate design ideas, processes and solutions*	Students collaboratively develop design criteria for their Bucking Bull, such as motion reliability and safe operating force, and iterate their design based on evaluation — for example, adjusting the gear ratio to reduce strain on the motor.	• Creating Designed Solutions – Evaluating
VC2TDE8D05 – *develop project plans to individually, collaboratively and in teams manage time, cost and production of designed solutions*	Students develop a project plan for building their Bucking Bull that manages time, cost and production steps, adjusting the plan as needed when testing reveals mechanical issues.	• Creating Designed Solutions – Planning and managing

Not mapped for this project: *VC2TDE8S01 and VC2TDE8S02 (Technologies and Society), which focus on broad ethical, cultural and industry-level considerations (such as biomimicry-driven manufacturing or Indigenous cultural and intellectual property) that don't meaningfully connect to a classroom mechanical engineering project; and VC2TDE8C02/C03 (Food and fibre production, Food specialisations).*

Levels 9 and 10

Table 4: Bucking Bull – Design and Technologies (Level 9–10)

Content Description	Project Application	Strand / Sub-strand
VC2TDE10C01 – *analyse and make judgements on how the characteristics and properties of materials are combined with force, motion and energy to control engineered systems that are ethical*	Students analyse and make judgements on how the properties of their chosen materials, combined with the force and motion delivered through the gear train and linkage, control their Bucking Bull's mechanism, and justify their final design choices.	• Technologies Contexts – Engineering principles and systems
VC2TDE10C04 – *analyse and make judgements on how characteristics and properties of materials, systems, components and tools can be combined to create designed solutions that are ethical*	Students analyse and make judgements on how their chosen materials, motor, gears and linkage components are combined to create a safe, reliable Bucking Bull, justifying their final component selections.	• Technologies Contexts – Materials and technologies specialisations
VC2TDE10D01 – *analyse needs or*	Students analyse the need their Bucking Bull addresses, develop a design brief, and investigate,	• Creating Designed Solutions –

Content Description	Project Application	Strand / Sub-strand
opportunities for designing; develop design briefs; and investigate, analyse and select materials, systems, components and tools to create designed solutions	analyse and select appropriate materials, systems, components and tools to meet it.	Investigating and defining
VC2TDE10D02 – *apply innovation and enterprise skills to generate, test, iterate and communicate design ideas, processes and solutions, using technical terms and graphical representation techniques and appropriate attributions, using manual and digital tools*	Students apply innovation skills to generate, test and iterate original design ideas for their Bucking Bull, considering competing variables such as realism of motion, mechanical complexity and build time, and communicate their process with appropriate attributions.	• Creating Designed Solutions – Generating and designing
VC2TDE10D03 – *select, justify, test and use suitable technologies, including processes and skills, and apply safety procedures to safely make designed solutions*	Students select, justify and test suitable materials, components and processes for their Bucking Bull, applying safety procedures throughout production and considering alternatives that maximise mechanical reliability.	• Creating Designed Solutions – Producing and implementing
VC2TDE10D04 – *develop design criteria including sustainability to evaluate design ideas, processes and solutions*	Students develop specific design criteria for their Bucking Bull, such as an acceptable failure rate across many bucking cycles, and make judgements about whether their design meets these criteria after testing.	• Creating Designed Solutions – Evaluating
VC2TDE10D05 – *develop project management plans for intended purposes and audiences to individually and collaboratively and in teams manage projects, taking into consideration time, cost, risk, processes and production of designed solutions*	Students develop a project management plan for building their Bucking Bull that accounts for time, cost, risk and production steps, adjusting the plan as needed and reflecting on their management of the project.	• Creating Designed Solutions – Planning and managing

Not mapped for this project: *VC2TDE10S01 and VC2TDE10S02 (Technologies and Society), which focus on large-scale, global and industry-level ethical considerations (such as Indigenous cultural and intellectual property, biomimicry-driven manufacturing and commercial enterprise trends) that don't meaningfully connect to a classroom mechanical engineering project; and VC2TDE10C02/C03 (Food and fibre production, Food specialisations).*

Bucking Bull – Digital Technologies Curriculum Mapping

In the Bucking Bull project, students become amusement park engineers, designing, building and coding a model amusement ride that uses a DC motor, motor driver, gears and a crank-rocker linkage to convert continuous rotational motion into a controlled, oscillating bucking motion. The following tables map this project against the Victorian Curriculum F–10 Version 2.0 Digital Technologies curriculum, for Levels 3–4, 5–6, 7–8 and 9–10, assuming a simple start button triggers the coded bucking sequence. Unlike the Autonomous Robot Car, this project's code is a largely deterministic, timed motor sequence rather than a sensor-driven decision system, so the Data, Information and Privacy strand (data logging, spreadsheets, binary representation of sensor states) has very little genuine application here — most of what students do sits within Creating Digital Solutions. Content descriptions about networking, cyber security, accounts/passwords and user-interface/experience design have also been left out, since the device is offline and has no screen, with a brief note after each table explaining what was excluded and why. Note also that Arduino/C++ is a text-based, general-purpose programming language: at Levels 3–4 and 5–6, where the curriculum expects a visual programming language, the underlying algorithmic concepts (branching, iteration, input) are genuinely present in this project, but the implementation exceeds what's typically expected at those levels.

Levels 3 and 4

Table 1: Bucking Bull – Digital Technologies (Level 3–4)

Content Description	Project Application	Strand / Sub-strand
VC2TDI4S01 – *explore and describe a range of digital systems and their peripherals for a variety of purposes*	Students explore the microcontroller as a digital system and identify the motor driver and DC motor as peripherals connected to it, describing how each expands what the system can control.	• Digital Systems and Security
VC2TDI4C01 – *define simple problems with teacher-provided requirements*	Students define the problem of coding a repeating bucking sequence, using teacher-provided requirements such as "the bull must start bucking when the start button is pressed and repeat the motion smoothly."	• Creating Digital Solutions
VC2TDI4C02 – *follow, describe and represent algorithms involving sequencing, comparison operators (branching) and iteration*	Students describe and represent the algorithm behind their Bucking Bull as a sequence of steps involving a branching decision (checking whether the start button has been pressed) and iteration (repeating the forward-and-reverse motor pattern to keep bucking).	• Creating Digital Solutions
VC2TDI4C04 – *implement simple algorithms as visual programs involving control structures and input*	Students implement their start-and-repeat algorithm in Arduino/C++ code that reads input from the start button and uses control structures to repeat the motor's forward-and-reverse sequence. This is written as text-based code rather than a visual program, going beyond the typical visual-programming expectation at this level while covering the same underlying concepts of input and iteration.	• Creating Digital Solutions

Content Description	Project Application	Strand / Sub-strand
VC2TDI4C05 – *discuss how existing and student-created solutions satisfy the given requirements*	Students discuss whether their Bucking Bull satisfies the given requirements by testing how smoothly and reliably it repeats its bucking motion once started.	• Creating Digital Solutions

Not mapped for this project: *VC2TDI4S02 (transmitting data between digital systems) and VC2TDI4S03 (memorised passwords), since the Bucking Bull is a standalone offline device with no data transmission or account access; and VC2TDI4D01–D05 (Data, Information and Privacy), since the project doesn't involve representing, collecting or sharing data for an audience, or personal accounts.*

Levels 5 and 6

Table 2: Bucking Bull – Digital Technologies (Level 5–6)

Content Description	Project Application	Strand / Sub-strand
VC2TDI6S01 – *investigate the main internal components of common digital systems and their function*	Students investigate the main components of their microcontroller board — the processor, memory and input/output pins — and explain how these work together with the motor driver to control the motor's speed and direction.	• Digital Systems and Security
VC2TDI6D01 – *explain how digital systems represent all data using numbers and explore how data can be represented using binary*	Students demonstrate that the start button's on/off state represents the digits 1 and 0, and explain how this binary representation is how the microcontroller recognises whether the ride has been started.	• Data, Information and Privacy
VC2TDI6C01 – *define problems with teacher-provided or co-developed functional requirements*	Students co-develop functional requirements for their Bucking Bull as a class, such as specifying how many bucking cycles the motion should complete and how quickly it should start after the button is pressed.	• Creating Digital Solutions
VC2TDI6C02 – *design and represent algorithms involving multiple alternatives (branching) and iteration*	Students design an algorithm with multiple alternatives, such as choosing between a gentle and a vigorous bucking pattern depending on a mode switch, and represent this as a diagram before coding it.	• Creating Digital Solutions
VC2TDI6C04 – *implement algorithms as visual programs involving control structures, variables and input*	Students implement their branching algorithm in Arduino/C++ using variables to store the motor speed and direction, and control structures to repeat the bucking sequence. As at Level 3–4, this is implemented as text-based code rather than a visual program.	• Creating Digital Solutions
VC2TDI6C05 – *evaluate existing and*	Students evaluate their Bucking Bull against the class's agreed requirements and discuss its broader	• Creating Digital Solutions

Content Description	Project Application	Strand / Sub-strand
student-created solutions against the requirements and their broader community impact	impact, such as how motor-controlled motion sequences are used in real amusement rides and animatronics.	

Not mapped for this project: *VC2TDI6S02 (networks) and VC2TDI6S03 (passphrases), since the device doesn't connect to a network or use accounts; and VC2TDI6D02–D06, since the project doesn't involve spreadsheets, data visualisation, shared online content or a digital footprint.*

Levels 7 and 8

Table 3: Bucking Bull – Digital Technologies (Level 7–8)

Content Description	Project Application	Strand / Sub-strand
VC2TDI8S01 – *explain how hardware specifications affect performance and select appropriate hardware for particular tasks and workloads*	Students compare the specifications of different microcontroller boards and motor drivers, and select appropriate hardware for their Bucking Bull based on factors such as current-handling capacity and the number of output pins needed to control the motor.	• Digital Systems and Security
VC2TDI8C01 – *define and decompose real-world problems by taking into account functional requirements and constraints*	Students decompose the problem of building a reliable Bucking Bull sequence into smaller parts — detecting the start signal, timing the forward stroke, timing the reverse stroke and repeating the cycle — and define functional requirements and constraints such as cycle timing and motor current limits.	• Creating Digital Solutions
VC2TDI8C02 – *design algorithms involving nested control structures and represent them using flowcharts and pseudocode, and use tracing techniques to test and identify errors*	Students design their bucking-sequence logic using nested control structures, represent this as a flowchart, and trace through their algorithm by hand to identify errors before testing it on the mechanism.	• Creating Digital Solutions
VC2TDI8C04 – *implement, modify and debug programs involving control structures and functions in a general-purpose programming language*	Students implement, modify and debug their Bucking Bull code in Arduino/C++, a general-purpose programming language, writing functions that control the motor's speed and direction to produce a repeating bucking pattern, and debugging timing issues that cause jerky or unreliable motion.	• Creating Digital Solutions
VC2TDI8C05 – *evaluate existing and student-created*	Students evaluate their Bucking Bull against its functional requirements and constraints, and consider possible future impacts of programmable mechanical	• Creating Digital Solutions

Content Description	Project Application	Strand / Sub-strand
solutions against the requirements, constraints and possible future impacts	rides, such as their use in interactive entertainment and animatronics.	

Not mapped for this project: *VC2TDI8S02 (wired/wireless network security) and VC2TDI8S03 (multi-factor authentication, phishing), since the device is offline and doesn't use accounts; and VC2TDI8D01–D06 (Data, Information and Privacy), since the project's coded motor sequence doesn't involve representing text/image/audio data, acquiring and validating data sets, or managing a digital footprint.*

Levels 9 and 10

Table 4: Bucking Bull – Digital Technologies (Level 9–10)

Content Description	Project Application	Strand / Sub-strand
VC2TDI10C01 – *define and decompose real-world problems, taking into account functional and non-functional requirements and by interviewing and surveying stakeholders to identify needs*	Students define and decompose the problem of building an engaging Bucking Bull sequence, specifying functional requirements (must start on command and repeat reliably) and non-functional requirements (such as smoothness and cycle timing), and gather feedback from classmates on which bucking pattern feels most exciting.	• Creating Digital Solutions
VC2TDI10C02 – *design algorithms involving logical operators and represent them as flowcharts and pseudocode, and validate algorithms and programs by comparing their output against a range of test cases*	Students use logical operators such as AND and OR to combine conditions in their sequencing algorithm, such as checking that the start button is pressed and that the motor is not already running, represent this using pseudocode, and validate their program against a range of test cases.	• Creating Digital Solutions
VC2TDI10C04 – *implement, modify and debug modular programs, applying selected algorithms and data structures, including in an object-oriented programming language*	Students structure their Bucking Bull code into modular functions for the forward stroke, the reverse stroke and the overall repeating cycle, and where appropriate define simple classes or structs to model the mechanism's state — noting that fully object-oriented design goes beyond what a typical implementation requires unless the project is extended.	• Creating Digital Solutions
VC2TDI10C05 – *evaluate existing and student-created solutions against the*	Students evaluate their Bucking Bull against its requirements and design criteria, gather feedback on the ride experience, and discuss potential enterprise	• Creating Digital Solutions

Content Description	Project Application	Strand / Sub-strand
requirements and design criteria, user needs, possible future impact and opportunities for enterprise and innovation	opportunities, such as scaling up the mechanism for a real amusement park attraction.	

Not mapped for this project: *VC2TDI10S01 (hardware/software managing access to data in networked systems, including IoT) and VC2TDI10S02 (cyber security threat modelling), since the Bucking Bull is a standalone, offline device with no network connection or data access to secure; and VC2TDI10D01–D07 (Data, Information and Privacy), since the project's coded motor sequence doesn't involve data compression, structured documents, databases, interactive data visualisation, project management tools or a digital footprint.*

Bucking Bull – Science Curriculum Mapping

In the Bucking Bull project, students become amusement park engineers, designing, building and coding a model amusement ride that uses a DC motor, motor driver, gears and a crank-rocker linkage to convert continuous rotational motion into a controlled, oscillating bucking motion. The following tables map this project against the Victorian Curriculum F–10 Version 2.0 Science curriculum, for Levels 3–4, 5–6, 7–8 and 9–10. Only content descriptions with a genuine link to the project are included; content descriptions from strands and sub-strands that don't meaningfully connect to the build (for example, most of Biological sciences, Chemical sciences beyond circuits, and Earth and space sciences) have been left out, with a brief note after each table explaining what was excluded and why.

Levels 3 and 4

Table 1: Bucking Bull – Science (Level 3–4)

Content Description	Project Application	Strand / Sub-strand
VC2S4H01 – *data from observations obtained through scientific inquiry can be used to develop explanations of natural phenomena*	Students collect data from repeated tests of their Bucking Bull, such as timing how long it takes to complete ten bucking cycles at different gear ratios, and use this data to explain why some configurations move faster or more smoothly than others.	• Science as a Human Endeavour – Nature and development of science
VC2S4H02 – *scientific knowledge, skills and data can be used by people to explain how they will meet a need or solve a problem*	Students explain how their understanding of forces and simple mechanisms was used to solve the problem of turning a spinning motor into a bucking motion, in the same way that engineers apply scientific knowledge to design amusement rides.	• Science as a Human Endeavour – Use and influence of science
VC2S4U10 – *forces, including frictional, gravitational, electrostatic and magnetic, can be exerted by one object on another through direct contact or from a distance and affect the motion (speed and direction) of objects*	Students identify the forces acting through their gear train and linkage, including the direct contact forces between gear teeth and the push and pull forces in the crank-rocker arms, and describe how these forces change the bull's motion.	• Science Understanding – Physical sciences
VC2S4I01 – *observations can be used as a basis for posing questions to identify patterns and relationships, and to predict the outcomes of investigations*	Students pose questions based on observing their mechanism, such as "Does a bigger gear always make the bull buck slower?", and use these questions to predict the outcome of changing gear sizes.	• Science Inquiry – Questioning and predicting

Content Description	Project Application	Strand / Sub-strand
VC2S4I02 – *scientific investigations to answer questions or test predictions can be planned and conducted using provided scaffolds, including identifying the attributes of fair tests, and considering the safe use of materials and equipment*	Students use a provided scaffold to plan a fair test of their linkage design, keeping the motor speed the same while changing only the crank arm length, and follow safe practices when handling the motor and moving parts.	• Science Inquiry – Planning and conducting
VC2S4I03 – *observations, including formal measurements, can be made and recorded by following procedures to use familiar scaled instruments and digital tools as appropriate*	Students use a stopwatch and ruler to measure and record how quickly and how far their Bucking Bull moves with different gear and linkage combinations, repeating each measurement to check for consistency.	• Science Inquiry – Planning and conducting
VC2S4I04 – *data and information can be organised and represented to identify patterns and simple relationships by constructing tables, graphs and visual or physical models*	Students construct a table recording the gear ratio used and how quickly the bull bucks, and use this table to identify which combination produces the most exciting motion.	• Science Inquiry – Processing, modelling and analysing
VC2S4I05 – *findings can be compared to those of others, including, as appropriate, whether a test was fair or not, to enable conclusions to be drawn, and may lead to the identification of further questions for investigation*	Students compare their test results with a partner group's results for the same gear ratio, discuss whether either test was unfair (for example, due to different battery charge levels), and pose further questions about what else might affect the mechanism's motion.	• Science Inquiry – Evaluating
VC2S4I06 – *observations, findings and ideas can be communicated for an identified purpose and audience by using scientific vocabulary and digital tools as appropriate*	Students communicate their findings about their Bucking Bull's performance to their class, using scientific vocabulary such as "force" and "motion" and simple diagrams to explain how the gears and linkage work together.	• Science Inquiry – Communicating

Not mapped for this project: *VC2S4U09 (heat energy and temperature change), since the project doesn't meaningfully involve heat transfer; and the Biological, Chemical, and Earth and space sciences content descriptions (VC2S4U01–U08), which cover living things, life cycles, food chains, states of matter, Earth resources, the water cycle and weather/climate — none of which the Bucking Bull's mechanical and electrical build draws on.*

Levels 5 and 6

Table 2: Bucking Bull – Science (Level 5–6)

Content Description	Project Application	Strand / Sub-strand
VC2S6H02 – *scientific knowledge, skills and data can be used by individuals and communities to identify problems, consider responses and make decisions*	Students use their understanding of circuits and motors to make decisions about how to safely power their Bucking Bull's motor from a battery, in the same way communities use scientific knowledge of electrical safety to make decisions about wiring.	• Science as a Human Endeavour – Use and influence of science
VC2S6U09 – *materials may be electrical insulators or conductors; energy can be transferred and transformed in electrical circuits where the components of a circuit play particular roles in the function of the circuit*	Students identify the necessary components of their Bucking Bull's circuit — a battery, the motor driver and the DC motor — and explain how the circuit transforms electrical energy into the rotational movement needed to drive the mechanism.	• Science Understanding – Physical sciences
VC2S6I01 – *investigable questions and reasoned predictions can be used in guiding investigations to identify patterns and test relationships*	Students pose an investigable question such as "Does a larger gear ratio always produce a stronger bucking motion?" and make a reasoned prediction based on their understanding of gears and motors.	• Science Inquiry – Questioning and predicting
VC2S6I02 – *repeatable scientific investigations to answer questions can be planned and conducted, including, as appropriate, deciding the variables to be changed, measured and controlled in fair tests, considering potential risks, planning for the safe and ethical use of*	Students plan a repeatable investigation into their mechanism's motion, identifying gear ratio as the variable to change, bucking height as the variable to measure, and factors such as motor speed to keep constant, while identifying safety risks associated with moving mechanical parts.	• Science Inquiry – Planning and conducting

Content Description	Project Application	Strand / Sub-strand
equipment and materials		
VC2S6I03 – *equipment can be used to observe, generate, measure and record data with reasonable precision for repeated measurements, using digital tools as appropriate*	Students use a multimeter to record the voltage supplied to the motor and the current it draws under load, using standard units, and record repeated measurements to check for precision.	• Science Inquiry – Planning and conducting
VC2S6I04 – *data and information can be organised and processed to show patterns, trends and relationships by constructing representations including tables, graphs and visual or physical models*	Students construct a diagram of their gear train and linkage using accepted conventions, labelling each component and showing how rotational motion from the motor becomes the bucking motion of the bull.	• Science Inquiry – Processing, modelling and analysing
VC2S6I05 – *methods and findings can be compared with those of others to identify sources of error, to select evidence in support of reasoned explanations and conclusions, and to develop further questions for investigation*	Students compare their mechanism's reliability data with another group's, identifying possible sources of error such as loose gears or an under-powered motor, and use this comparison to refine their conclusions about which design works best.	• Science Inquiry – Evaluating
VC2S6I06 – *scientific ideas, findings, patterns, trends and relationships can be communicated for a specific purpose and audience, using various presentation formats, scientific vocabulary and digital tools as appropriate*	Students construct a short report or poster explaining how their Bucking Bull's motor and gear system work, using appropriate scientific vocabulary such as "conductor", "circuit" and "energy transfer", to share with a younger class audience.	• Science Inquiry – Communicating

Not mapped for this project: *VC2S6U08 (light, shadows, reflection and refraction), since the project has no optical elements; VC2S6H01 (scientific knowledge changing over time through collaboration), which is a weak fit for a single build project; and the Biological, remaining Chemical, and Earth and space sciences content descriptions (VC2S6U01–U07), covering habitats, adaptation, particle models of matter, geological processes and the solar system.*

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Levels 7 and 8

Table 3: Bucking Bull – Science (Level 7–8)

Content Description	Project Application	Strand / Sub-strand
VC2S8U13 – *simple machines, including the lever, inclined plane, wedge, pulley, screw, and wheel and axle, alter the direction and magnitude of forces*	Students identify the gears and crank-rocker linkage in their Bucking Bull as combinations of simple machines — the gears functioning as compound wheel-and-axle systems and the linkage arms as levers — and investigate how each alters the direction and magnitude of the force delivered by the motor.	• Science Understanding – Physical sciences
VC2S8U14 – *balanced and unbalanced forces acting on objects, including gravitational force, may be investigated and represented using force diagrams; changes in an object's motion can be related to its mass and the magnitude and direction of the forces acting on it*	Students draw force diagrams representing the forces acting through their crank-rocker linkage as the motor turns, analysing how the changing direction of these forces produces the bull's oscillating bucking motion, and consider how the bull's mass affects how forcefully it moves.	• Science Understanding – Physical sciences
VC2S8U15 – *energy exists in different forms, including thermal, chemical, gravitational and elastic, and may be classified as kinetic or potential; energy transfers and transformations occur in simple systems and can be analysed in terms of energy efficiency*	Students trace the energy transformations in their Bucking Bull, from the chemical energy stored in the battery to the electrical energy in the circuit to the kinetic energy of the spinning gears and bucking linkage, and discuss where energy is lost as heat and friction during this process.	• Science Understanding – Physical sciences
VC2S8U17 – *electrical circuits transfer energy when current flows and can be designed for diverse purposes using different components; the operation of circuits can be explained using the concepts of voltage and current*	Students explain how voltage and current supplied through their motor driver control the speed and torque of the DC motor, and investigate how the driver acts as a control device managing the power delivered to the mechanism.	• Science Understanding – Physical sciences

Content Description	Project Application	Strand / Sub-strand
VC2S8I01 – *investigable questions, reasoned predictions and hypotheses can be developed in guiding investigations to identify patterns, test relationships and analyse and evaluate scientific models*	Students develop a hypothesis such as "A shorter crank arm will produce a faster but less forceful bucking motion" and design an investigation to test this relationship.	• Science Inquiry – Questioning and predicting
VC2S8I02 – *reproducible investigations to answer questions and test hypotheses can be planned and conducted, including identifying independent, dependent and controlled variables where applicable, stating assumptions, recognising and managing risks*	Students plan a reproducible investigation into linkage performance, identifying crank arm length as the independent variable, bucking height as the dependent variable, and motor speed as a variable to control, while identifying and managing risks associated with moving mechanical parts.	• Science Inquiry – Planning and conducting
VC2S8I03 – *equipment can be selected and used to generate and record data with attention to precision, using digital tools as appropriate*	Students select appropriate equipment, such as a multimeter and a slow-motion video camera, to record voltage, current and bucking motion with precision, recording data in a spreadsheet.	• Science Inquiry – Planning and conducting
VC2S8I04 – *data and information can be organised and processed by selecting and constructing representations including tables, graphs, keys, models and mathematical relationships*	Students construct a graph comparing gear ratio against bucking speed across multiple trials, and use this representation to identify the mathematical relationship between the two variables.	• Science Inquiry – Processing, modelling and analysing
VC2S8I05 – *information and processed data can be analysed to show patterns, trends and relationships, and to identify anomalies*	Students analyse their motion data to identify trends, such as whether increasing the gear ratio consistently increases torque at the cost of speed, and investigate any anomalous results that don't fit the pattern.	• Science Inquiry – Processing, modelling and analysing
VC2S8I06 – *scientific methods, conclusions and claims can be*	Students evaluate their testing method for possible sources of error, such as gear backlash or inconsistent battery charge, and discuss how confident they can be	• Science Inquiry – Evaluating

Content Description	Project Application	Strand / Sub-strand
analysed to identify assumptions, possible sources of error, conflicting evidence and unanswered questions	in their conclusions about which mechanism design is most reliable.	
VC2S8I07 – *evidence-based arguments can be constructed to support conclusions or evaluate claims, including consideration of ethical issues and protocols associated with using or citing secondary data or information*	Students construct an evidence-based argument for their final gear and linkage design, citing their own testing data and referencing manufacturer specifications for their motor and gears.	• Science Inquiry – Evaluating
VC2S8I08 – *communicating ideas, findings and arguments for specific purposes and audiences involves the selection and use of appropriate presentation formats, scientific vocabulary, models and other representations, and may include the use of digital tools*	Students create a presentation explaining the forces, energy transformations and circuit operation of their Bucking Bull for a technical audience, using appropriate scientific vocabulary, diagrams and data.	• Science Inquiry – Communicating

Not mapped for this project: *VC2S8U16 (household energy audits), which doesn't apply to a small battery-powered mechanism; all four Science as a Human Endeavour content descriptions (VC2S8H01–H04), since they focus on the history, philosophy and socio-scientific dimensions of science rather than applied mechanical design; and the Biological, remaining Chemical, and Earth and space sciences content descriptions (VC2S8U01–U12), covering cells, ecosystems, particle theory of matter, plate tectonics and astronomy.*

Levels 9 and 10

Table 4: Bucking Bull – Science (Level 9–10)

Content Description	Project Application	Strand / Sub-strand
VC2S10U14 – *wave and particle models can be used to describe energy transfer (conduction, convection and radiation) through different media; waves (electromagnetic and*	Students use the particle model of electricity to explain how current flows through their motor circuit when the driver switches the motor on, relating this to voltage and the role of conductors in their design.	• Science Understanding – Physical sciences

Content Description	Project Application	Strand / Sub-strand
mechanical) have different properties, features (including amplitude, wavelength, frequency and speed) and applications		
VC2S10U15 – *the Law of Conservation of Energy can be analysed in systems, including Earth systems, by assessing the efficiency of energy inputs, outputs, transfers and transformations*	Students apply the Law of Conservation of Energy to their Bucking Bull, analysing how chemical energy from the battery is transformed into electrical energy, then kinetic energy at the gears and linkage, and assess where efficiency is lost to friction and heat in the gear train.	• Science Understanding – Physical sciences
VC2S10U17 – *Newton's laws of motion can be used to quantitatively analyse the relationship between force, mass and acceleration of objects*	Students use Newton's laws to quantitatively analyse how the torque produced by the motor and gear train relates to the mass of the bull and the acceleration of its bucking motion, calculating the forces involved at different points in the crank-rocker cycle.	• Science Understanding – Physical sciences
VC2S10I01 – *investigable questions, reasoned predictions and hypotheses can be used in guiding investigations to test and develop explanatory models and relationships*	Students develop a hypothesis about the relationship between gear ratio and the torque delivered to the linkage, and design an investigation to test it.	• Science Inquiry – Questioning and predicting
VC2S10I02 – *valid, reproducible investigations to answer questions and test hypotheses can be planned and conducted, including identifying and controlling for possible sources of error and bias in sampling or in making observations; safe, ethical investigations include undertaking risk assessments*	Students plan a valid, reproducible investigation into mechanism reliability, identifying and controlling for possible sources of error such as gear wear over repeated trials, and complete a risk assessment for working with a motor-driven mechanical device.	• Science Inquiry – Planning and conducting
VC2S10I03 – *equipment can be selected and used to*	Students determine an appropriate sample size for their reliability testing (for example, running at least	• Science Inquiry – Planning and conducting

Content Description	Project Application	Strand / Sub-strand
generate and record data sets that show precision, including consideration of sample size and using digital tools as appropriate	fifty bucking cycles) and use a multimeter and slow-motion video to record data with precision.	
VC2S10I04 – *data and information can be organised, processed and summarised by selecting and constructing representations including tables, graphs, descriptive statistics, models, symbols, formulas and mathematical relationships*	Students calculate descriptive statistics, such as the mean and range of their bucking-cycle timing measurements, and represent their energy transformation data using a Sankey diagram.	• Science Inquiry – Processing, modelling and analysing
VC2S10I05 – *information and processed data can be analysed and compared to identify and explain qualitative and quantitative patterns, trends, relationships and anomalies*	Students compare their experimental data on gear efficiency with published specifications for their motor and gears, identifying trends and any anomalies that require further explanation.	• Science Inquiry – Processing, modelling and analysing
VC2S10I06 – *the validity and reproducibility of investigation methods and the validity of conclusions and claims can be evaluated, including by identifying assumptions, conflicting evidence, biases that may influence observations and conclusions, sources of error and areas of uncertainty*	Students evaluate the validity of their investigation into mechanism reliability, identifying assumptions such as consistent motor voltage across trials and discussing areas of uncertainty in their measurements.	• Science Inquiry – Evaluating
VC2S10I07 – *arguments based on a variety of evidence can be constructed to support conclusions or evaluate claims, including*	Students construct an evidence-based argument for their final gear and linkage design, drawing on their own testing data and citing manufacturer datasheets for their motor and gear components.	• Science Inquiry – Evaluating

Content Description	Project Application	Strand / Sub-strand
consideration of any ethical issues and cultural protocols associated with accessing, using or citing secondary data or information		
VC2S10I08 – *communicating and justifying scientific ideas, findings and arguments for diverse audiences involves the selection of appropriate presentation formats, content, scientific vocabulary, conventions, models and other representations, and may include the use of digital tools*	Students prepare a technical report justifying their final mechanism and circuit design, using appropriate scientific vocabulary, formulas and data representations for an audience of peers or industry mentors.	• Science Inquiry – Communicating

Not mapped for this project: *VC2S10U16 (electricity generation via AC turbines or DC photovoltaic cells), which concerns large-scale power generation infrastructure rather than this project's simple battery-and-motor circuit, already covered by the circuit-components descriptors at Levels 5–6 and 7–8; all four Science as a Human Endeavour content descriptions (VC2S10H01–H04), which focus on the contestability, history and societal influence of scientific knowledge rather than applied mechanical design; and the Biological, remaining Chemical, and Earth and space sciences content descriptions (VC2S10U01–U13), covering reproduction, genetics, atomic structure, the periodic table, chemical reactions, the carbon cycle, climate change and astronomy.*