Autonomous Robot Car – Critical and Creative Thinking Curriculum Mapping

In the Autonomous Robot Car project, students build and code an Arduino-powered robot capable of driving around and avoiding obstacles autonomously. Student agency varies across the project: mechanical assembly, wiring and the power system are fixed (no agency); movement programming and obstacle-avoidance logic require the same functions and building blocks for every student, but sequencing, thresholds and strategy are up to them (constrained agency); and deciding what to optimise, how, and which features to add for personalisation is entirely open (open agency). 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, noting which agency tier each content description sits within.

Agency key: **No agency** (fixed build/wiring/power) **Constrained agency** (same functions, student-chosen sequencing/thresholds/strategy) **Open agency** (student-chosen optimisations and personalisation features)

Levels 3 and 4

Table 1: Autonomous Robot Car – Critical & Creative Thinking (Level 3–4)

Content Description	Project Application	Interrelated Strands	Agency
VC2CC4Q01 – *the construction and use of open and closed questions for different purposes*	Students ask open and closed questions while following the given build and wiring instructions to build understanding of why each component is connected as specified. For example, "Why does the battery connect to the charging board before the switch?" (open) or "Is the motor wired to the correct driver pins?" (closed). These questions build understanding of the fixed circuit rather than changing it.	• Questions and Possibilities	**No agency**
VC2CC4Q02 – *how pre-established preferences may influence thinking when generating and responding to alternative ideas and possibilities*	Students reflect on whether preferring one movement style, such as always turning left, influences the sequence of forward(), left(), right() and stop() commands they choose when programming their own drive routine, even though everyone uses the same movement functions.	• Questions and Possibilities	**Constrained agency**
VC2CC4Q03 – *simple strategies for generating new ideas and possibilities, including repurposing or rearranging*	Students generate new possibilities within the required movement library by rearranging the order of forward(), left(), right() and stop() commands and adjusting timing to create their own square, figure-eight or obstacle-avoidance sequence.	• Questions and Possibilities	**Constrained agency**
VC2CC4R01 – *ways to identify,*	Students explain why the battery, charging board and switch must be wired in the order	• Reasoning	**No agency**

Content Description	Project Application	Interrelated Strands	Agency
structure and communicate a conclusion justified by a range of reasons	shown in the circuit diagram, using evidence from the diagram and the concept of electrical safety to justify following the given wiring sequence exactly.		
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 how close the robot gets to an obstacle before stopping, to support claims about which distance threshold works best, and consider values such as safety when deciding how cautious their robot's obstacle-avoidance behaviour should be.	• Reasoning	**Constrained agency**
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/else statements to decide when the robot should stop or turn based on the ultrasonic sensor reading (for example, "if distance is less than 10 cm, then stop"), and identify errors when the robot misbehaves, such as wrongly assuming one close reading always means an obstacle is directly ahead.	• Reasoning	**Constrained agency**
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 correctly assembled robot, such as motors spinning in the right direction, secure wiring, and the battery charging safely, and use these criteria — given in the build instructions — to check their robot before powering it on.	• Reasoning	**No agency**
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 batteries, switches and charging circuits to prior knowledge of simple circuits, ask themselves questions to check their understanding of each wiring step, and explain the power system to a peer.	• Metacognition	**No agency**
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 a chosen turning angle affects whether the robot avoids an obstacle, recording their trials in a table to compare outcomes and identify patterns.	• Metacognition	**Constrained agency**

Content Description	Project Application	Interrelated Strands	Agency
VC2CC4M03 – *how to evaluate a proposed solution using given criteria*	Students use a given checklist (for example, "Do both motors spin the correct way?", "Is the battery connected safely?") to evaluate their assembled and wired robot before testing it.	• Metacognition	**No agency**

Levels 5 and 6

Table 2: Autonomous Robot Car – Critical & Creative Thinking (Level 5–6)

Content Description	Project Application	Interrelated Strands	Agency
VC2CC6Q01 – *the construction of questions for identifying and building understanding of information, possibilities, processes and activities*	Students construct a range of questions to build their understanding of how voltage, current and the DC-DC boost converter work together in the given power system, and construct questions for a mentor about why a specific battery and charging board were selected for the design.	• Questions and Possibilities	**No agency**
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 different obstacle-avoidance strategies using the same movement and sensor functions, reflecting on how an initial preference for one strategy — for example, always reversing — may have limited the range of strategies explored.	• Questions and Possibilities	**Constrained agency**
VC2CC6Q03 – *an extended range of strategies to generate new ideas and possibilities including forming a link between different information sources*	Students research other autonomous robots or robotic vacuum cleaners to see how they combine features such as sound or lights, and form links between these examples to decide which personalisation feature — LEDs, a buzzer, or an extra drive mode — to add to their own robot.	• Questions and Possibilities	**Open agency**
VC2CC6R01 – *ways to identify, structure and communicate an argument that uses*	Students construct a justification with a main conclusion (for example, "Our obstacle-avoidance strategy is the most reliable") supported by several reasons — an appropriate distance threshold, well-tested turning logic and	• Reasoning	**Constrained agency**

Content Description	Project Application	Interrelated Strands	Agency
sub-arguments leading to a main conclusion	consistent motor speeds — each of which is further supported by evidence from trials.		
VC2CC6R02 – *ways to consider competing values and the strength of evidence when reasoning*	Students weigh competing values, such as cost versus safety margin, when reading the given circuit diagram for the charging and power system, and evaluate the strength of the manufacturer's safety guidance for handling the 18650 battery when justifying why it must be followed exactly.	• Reasoning	**No agency**
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 ultrasonic sensor is faulty" after one missed detection is a hasty generalisation, and discuss how running repeated trials at different distances improves the reliability of conclusions about their obstacle-avoidance code.	• Reasoning	**Constrained agency**
VC2CC6R04 – *the use of criteria to support analysis and evaluation when reasoning*	Students develop criteria — such as detection distance, turning smoothness and consistency across trials — to analyse and compare different threshold values and turning strategies in their obstacle-avoidance code.	• Reasoning	**Constrained agency**
VC2CC6M01 – *learning strategies suited to general and specific contexts, including different ways of identifying, expressing and organising key learning, and undertaking spaced practice*	Students use diagrams to organise their understanding of how the battery, charging board, switch and boost converter connect, and revisit the wiring across sessions to consolidate their understanding before applying the same power concepts in future projects.	• Metacognition	**No agency**
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 robot sometimes turns the wrong way or fails to detect an obstacle.	• Metacognition	**Constrained agency**
VC2CC6M03 – *the use of criteria to identify and compare proposed solutions*	Students each propose a different feature to add to their robot for the showcase, such as a buzzer, adjustable driving speed or status LEDs, then use agreed criteria — feasibility,	• Metacognition	**Open agency**

Content Description	Project Application	Interrelated Strands	Agency
	impact and time available — to decide which feature to build.		

Levels 7 and 8

Table 3: Autonomous Robot Car – Critical & Creative Thinking (Level 7–8)

Content Description	Project Application	Interrelated Strands	Agency
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 robot avoid obstacles more reliably?", and break this into sub-questions about detection distance, turning angle and reaction timing to guide testing of their obstacle-avoidance code.	• Questions and Possibilities	**Constrained agency**
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 brainstorming unconventional personalisation features, and practise withholding critique during initial brainstorming of new ideas — alternative avoidance strategies, sound effects, extra sensors — before evaluating feasibility for their final showcase.	• Questions and Possibilities	**Open agency**
VC2CC8Q03 – *strategies for generating new ideas and possibilities including identifying a pattern across multiple information sources*	Students examine several existing autonomous robots or robotic vacuum cleaners and identify a common pattern in how they combine sensing, decision-making and feedback (lights or sound) to create a polished user experience, then apply this pattern when deciding on their own personalisation features.	• Questions and Possibilities	**Open agency**
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 why a boost converter and TP4056 charging board are required rather than powering the motors directly from the battery, structuring a justification that analyses the strength of the electrical safety evidence before concluding that the given power system must be followed exactly.	• Reasoning	**No agency**
VC2CC8R02 – *reasons for*	Students investigate manufacturer specifications for the HC-SR04 sensor, such as	• Reasoning	**Constrained agency**

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Content Description	Project Application	Interrelated Strands	Agency
competing claims about matters of fact and matters of value, including consideration of evidence and expertise, and ways to analyse and evaluate competing claims	field of view and dead zones (matters of fact), versus peer opinions about which obstacle-avoidance strategy "feels" smartest (matters of value), discussing the role of technical expertise versus user testing when justifying their chosen strategy.		
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 "lowering the turning speed caused the robot to avoid obstacles better" reflects genuine causation or coincidence, and discuss how testing one variable at a time — turning speed, threshold distance — systematically improves the strength of their conclusions.	• Reasoning	**Constrained agency**
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 deciding whether an optimisation, such as a new turning angle or detection threshold, has actually improved their robot's performance, and use these refined criteria to analyse competing tuning choices before finalising their design.	• Reasoning	**Open agency**
VC2CC8M01 – *ways to select, use and reflect on general and context-specific learning strategies*	Students select appropriate strategies, such as tracing the circuit diagram or explaining the power system to a peer, to consolidate their understanding of voltage, current and battery safety, and reflect on which strategy was most effective for this technical content.	• Metacognition	**No agency**
VC2CC8M02 – *broad strengths and limitations of thinking processes in different contexts, including problem-solving*	Students compare different approaches to structuring their obstacle-avoidance code, such as a single long sequence of if/else statements versus reusable functions, and reflect on the strengths and limitations of each when applying computational thinking to their robot.	• Metacognition	**Constrained agency**
VC2CC8M03 – *the development of criteria for evaluating a range of proposed solutions; ways to*	Students develop criteria to evaluate multiple proposed optimisations and personalisation features, and adjust their final decision in light of new knowledge, such as discovering during testing that a chosen turning angle causes the robot to get stuck in corners.	• Metacognition	**Open agency**

Content Description	Project Application	Interrelated Strands	Agency
evaluate and incorporate new knowledge that could affect the final decision			

Levels 9 and 10

Table 4: Autonomous Robot Car – Critical & Creative Thinking (Level 9–10)

Content Description	Project Application	Interrelated Strands	Agency
VC2CC10Q01 – *the construction and adaptation of questions to suit different contexts*	Students adapt their investigation questions to suit different audiences — technical questions about PWM and motor response for an engineering forum, user-experience questions for a peer survey about which personalisation features make the robot feel most "intelligent" — when planning their final showcase features.	• Questions and Possibilities	**Open agency**
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 obstacle-avoidance strategies — for example, always defaulting to reversing and turning — may have limited their exploration of alternative strategies during optimisation, and discuss strategies to mitigate this bias when deciding what to improve.	• Questions and Possibilities	**Open agency**
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 other robots' navigation strategies, analysing these for shared patterns to inform an evidence-based refinement of their obstacle-avoidance thresholds and sequencing.	• Questions and Possibilities	**Constrained agency**
VC2CC10R01 – *ways to analyse and improve the structure, clarity, consistency and coherence of a conclusion and its*	Students critically review their explanation of the robot's fixed power and wiring system for their final showcase, checking for unclear assumptions — for example, about why the boost converter is necessary — and revising the structure and clarity of their explanation before presenting to an audience.	• Reasoning	**No agency**

Content Description	Project Application	Interrelated Strands	Agency
justification in different contexts			
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 obstacle-detection reliability is sufficiently precise and accurate for a formal report, and determine whether greater breadth (testing across many more obstacle placements) or depth (repeated trials at one threshold) is required to support their conclusions about their navigation strategy.	• Reasoning	**Constrained agency**
VC2CC10R03 – *complex reasoning errors including false dichotomies and appeal to consensus, their significance and how reasoning associated with these errors can be improved*	Students examine whether framing their optimisation choice as "either add more sensors or the robot will always get stuck" is a false dichotomy, and discuss why appealing to popular classmate opinion about the "coolest" feature is not, by itself, sufficient justification for a final design decision.	• Reasoning	**Open agency**
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 their optimised and personalised robot to be specific, measurable and time-bound (for example, "successfully avoids obstacles in at least nine out of ten runs on the obstacle course"), using these refined criteria to resolve competing claims about whose tuning choices are most effective.	• Reasoning	**Open agency**
VC2CC10M01 – *ways to select, monitor and adapt general and context-specific learning strategies*	Students maintain an engineering journal to monitor the effectiveness of their learning strategies — for example, tracing circuit diagrams versus building and testing directly — throughout the project, adapting their approach as the electronics, programming and sensing challenges evolve.	• Metacognition	**No agency**
VC2CC10M02 – *the importance of critical analysis of thinking processes in different contexts, including for problem-*	Students critically analyse their own systematic debugging process when troubleshooting their obstacle-avoidance code, identifying cognitive biases such as confirmation bias (favouring test runs that support their preferred threshold value) and discussing strategies to mitigate this in future testing.	• Metacognition	**Constrained agency**

Content Description	Project Application	Interrelated Strands	Agency
solving, considering factors such as cognitive biases			
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 optimisations and personalisation features, considering factors such as battery life impact, reliability trade-offs, and the feasibility of implementing the feature before the showcase, and justify their final design recommendation.	• Metacognition	**Open agency**

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Autonomous Robot Car – Design and Technologies Curriculum Mapping

In the Autonomous Robot Car project, students build and code an Arduino-powered robot capable of driving around and avoiding obstacles autonomously, combining mechanical assembly, a multi-voltage power system, motor control and ultrasonic sensing. 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: Autonomous Robot Car – 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 robotics engineers who design and build mobile robots, and discuss sustainability factors such as reusing 3D-printed parts or choosing rechargeable batteries for their robot car.	• Technologies and Society
VC2TDE4C01 – *describe how forces affect function in a product or system*	Students describe how the force from the spinning wheels affects the movement of their robot car, and explore how changing motor speed changes how fast and in which direction the robot moves.	• 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 chassis material — such as its strength and weight — affect how well the robot car holds its components together and moves.	• 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 robot car, and test different wheel and motor arrangements to see which drives best.	• Creating Designed Solutions – Investigating and defining
VC2TDE4D02 – *generate and communicate design ideas and decisions using technical terms and graphical*	Students generate and communicate their design ideas for the robot car using annotated diagrams that label components such as the chassis, motors, wheels and battery.	• Creating Designed Solutions – Generating and designing

Content Description	Project Application	Strand / Sub-strand
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 mounting motors and wiring the battery — to build their robot car, following safe practices when handling electronic components.	• 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 driving in a straight line and turning reliably, to evaluate their robot car 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 robot car, such as assembling the chassis, mounting the motors, wiring the power system, then programming and testing the robot, 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 robotics build.*

Levels 5 and 6

Table 2: Autonomous Robot Car – 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 mobile robots, such as balancing battery capacity, weight and cost when choosing components for their robot car.	• 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 movement of the wheels in their robot car, deconstructing a simple circuit to see how the motor driver controls this transformation.	• 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 motors, wheels and chassis material affect how they are used and combined to produce a working robot car.	• 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 robot car, testing different wheel and motor 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 robot car, using labelled drawings and digital tools to communicate how the drive system 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 chassis, drive system and power circuit for their robot car.	• 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 robot must drive safely at a controlled speed" and "materials should be reusable", and use these to evaluate their robot car.	• 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 robot car, 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: Autonomous Robot Car – 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 robot car's drive system, programming a microcontroller to control a remote-controlled-style vehicle and testing the durability of their battery over repeated test runs.	• 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 chassis material, motors and wheels can be combined to create a reliable, safe robot car, 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 robot car addresses (an autonomous, obstacle-avoiding vehicle) 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 robot car design, using annotated sketches and digital tools to communicate their process and attributing any external circuit designs or code 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 the motor driver, resistors and the ultrasonic sensor to understand how the circuit 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 robot car, such as obstacle-detection reliability and safe driving speed, and iterate their design based on evaluation — for example, adjusting the detection threshold to reduce false stops.	• 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 robot car that manages time, cost and production steps across its build, drive, sense and engineer phases, adjusting the plan as needed when testing reveals 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 robotics project; and VC2TDE8C02/C03 (Food and fibre production, Food specialisations).*

Levels 9 and 10

Table 4: Autonomous Robot Car – 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 of the drive system, control their robot car's movement, 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 chassis material, motors, wheels and control circuit are combined to create a safe, reliable robot car, justifying their final component selections.	• Technologies Contexts – Materials and technologies specialisations
VC2TDE10D01 – *analyse needs or*	Students analyse the need their robot car addresses, develop a design brief, and investigate, analyse and	• 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	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 robot car, considering competing variables such as reliability, cost 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 robot car, applying safety procedures throughout production and considering alternatives that maximise 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 robot car, such as an acceptable obstacle-collision rate across many trials, 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 robot car that accounts for time, cost, risk and production steps across the term, 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 robotics project; and VC2TDE10C02/C03 (Food and fibre production, Food specialisations).*

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Autonomous Robot Car – Digital Technologies Curriculum Mapping

In the Autonomous Robot Car project, students build and code an Arduino-powered robot capable of driving around and avoiding obstacles autonomously, combining mechanical assembly, a multi-voltage power system, motor control and ultrasonic sensing. 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. Only content descriptions with a genuine link to the project are included; content descriptions about networking, cyber security, accounts/passwords, media/document representation, and user-interface/experience design have largely been left out, since the robot is a standalone offline device with no screen, with a brief note after each table explaining what was excluded and why. Unlike the Rebellious Box, this project's emphasis on systematic testing, threshold tuning and code refactoring means the Data, Information and Privacy strand's spreadsheet/database content descriptions genuinely apply from Level 7–8 onward, where students log and analyse trial data. 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: Autonomous Robot Car – 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 Arduino microcontroller as a digital system and identify the motors, ultrasonic sensor and battery as peripherals connected to it, describing how each expands what the system can sense and do.	• Digital Systems and Security
VC2TDI4C01 – *define simple problems with teacher-provided requirements*	Students define the problem of building a robot that can drive and stop safely, using teacher-provided requirements such as "the robot must stop before touching an obstacle."	• Creating Digital Solutions
VC2TDI4C02 – *follow, describe and represent algorithms involving sequencing, comparison operators (branching) and iteration*	Students describe and represent the algorithm behind their robot car as a sequence of steps involving a branching decision (checking the sensor's distance reading) that leads to the robot either continuing forward or stopping.	• Creating Digital Solutions
VC2TDI4C04 – *implement simple algorithms as visual programs involving control structures and input*	Students implement their drive-and-stop algorithm in Arduino/C++ code that reads input from the ultrasonic sensor and uses a control structure to decide the robot's movement. 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 branching.	• 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 robot car satisfies the given requirements by testing how reliably it stops before reaching an obstacle.	• Creating Digital Solutions

Not mapped for this project: *VC2TDI4S02 (transmitting data between digital systems) and VC2TDI4S03 (memorised passwords), since the robot car is a standalone offline device with no data transmission or account access; VC2TDI4D01–D05 (Data, Information and Privacy), since the project doesn't involve collecting, representing or sharing data for an audience, or personal accounts; and VC2TDI4C03 (designing a user interface), since the robot has no screen or app-style interface for students to design.*

Levels 5 and 6

Table 2: Autonomous Robot Car – 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 Arduino board — the microcontroller, memory and input/output pins — and explain how these work together with the motor driver and sensor to control the robot.	• 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 digital HIGH/LOW signals sent to the motor driver's direction pins represent the digits 1 and 0, and explain how this binary representation is how their Arduino controls each motor's direction.	• Data, Information and Privacy
VC2TDI6C01 – *define problems with teacher-provided or co-developed functional requirements*	Students co-develop functional requirements for their robot car as a class, such as specifying the minimum safe stopping distance and the reliability expected across repeated obstacle encounters.	• Creating Digital Solutions
VC2TDI6C02 – *design and represent algorithms involving multiple alternatives (branching) and iteration*	Students design an algorithm with multiple alternatives, such as checking the sensor reading and choosing between driving straight, turning or stopping depending on the distance detected, 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 sensor reading and control structures to decide the robot's response. As at Level 3–4, this is implemented as text-based code rather than a visual program.	• Creating Digital Solutions

Content Description	Project Application	Strand / Sub-strand
VC2TDI6C05 – *evaluate existing and student-created solutions against the requirements and their broader community impact*	Students evaluate their robot car against the class's agreed requirements and discuss its broader impact, such as how autonomous obstacle-avoidance technology is used in real vehicles and robotics.	• Creating Digital Solutions

Not mapped for this project: *VC2TDI6S02 (networks) and VC2TDI6S03 (passphrases), since the robot doesn't connect to a network or use accounts; VC2TDI6D02–D06, since the project doesn't involve spreadsheets, data visualisation, shared online content or a digital footprint at this level; and VC2TDI6C03 (user interface design), since there's no screen or app interface.*

Levels 7 and 8

Table 3: Autonomous Robot Car – 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, motor drivers and ultrasonic sensors, and select appropriate hardware for their robot car based on factors such as processing speed, number of input/output pins and current-handling capacity.	• Digital Systems and Security
VC2TDI8D02 – *acquire, store, manipulate and validate data from a range of sources using software tools, including spreadsheets and single-table databases*	Students acquire, store and validate test data from their robot car, such as logging detection distance and success/failure outcomes across many trials in a spreadsheet.	• Data, Information and Privacy
VC2TDI8D03 – *analyse and visualise data using a range of software, including spreadsheets and simple database queries, draw conclusions and make predictions by identifying trends*	Students analyse and visualise their trial data using a spreadsheet to identify trends, such as whether increasing the detection threshold consistently reduces collisions, and use these trends to make predictions about the best settings.	• Data, Information and Privacy
VC2TDI8C01 – *define and decompose real-world problems by taking into account functional*	Students decompose the problem of building a reliable autonomous robot into smaller parts — driving, sensing and deciding — and define functional requirements and constraints such as minimum stopping distance and maximum response time.	• Creating Digital Solutions

Content Description	Project Application	Strand / Sub-strand
requirements and constraints		
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 obstacle-avoidance 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 robot.	• 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 robot car code in Arduino/C++, a general-purpose programming language, writing a program that reads distance data from the ultrasonic sensor and changes the robot's behaviour accordingly — directly analogous to a program that reads a soil-moisture sensor and switches on a watering system.	• Creating Digital Solutions
VC2TDI8C05 – *evaluate existing and student-created solutions against the requirements, constraints and possible future impacts*	Students evaluate their robot car against its functional requirements and constraints, and consider possible future impacts of autonomous navigation technology, such as its use in self-driving vehicles.	• Creating Digital Solutions

Not mapped for this project: *VC2TDI8S02 (wired/wireless network security) and VC2TDI8S03 (multi-factor authentication, phishing), since the robot is offline and doesn't use accounts; VC2TDI8D01 (representing text, image and audio data using binary), since the project doesn't involve this kind of media representation; VC2TDI8D04–D06, since the project doesn't involve content creation for an audience or a digital footprint; and VC2TDI8C03 (user interface/experience design), since there's no screen-based interface.*

Levels 9 and 10

Table 4: Autonomous Robot Car – Digital Technologies (Level 9–10)

Content Description	Project Application	Strand / Sub-strand
VC2TDI10D03 – *develop techniques to acquire, store, manipulate and validate data from a range of sources using software tools, including spreadsheets and relational databases*	Students develop techniques to acquire, store and validate their robot car's test data using a spreadsheet or simple database, ensuring readings from repeated obstacle-course trials are accurate and consistent.	• Data, Information and Privacy

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Content Description	Project Application	Strand / Sub-strand
VC2TDI10D04 – *analyse and visualise data interactively using a range of software, including spreadsheets and relational databases and queries, to draw conclusions and make predictions by identifying trends and outliers*	Students analyse and visualise their test data interactively, identifying trends and outliers across many trials to draw conclusions and make predictions about the most reliable detection threshold and turning strategy.	• Data, Information and Privacy
VC2TDI10D06 – *use simple project management tools to plan and manage individual and collaborative iterative projects, accounting for risks and responsibilities*	Students use a simple project management tool to plan and manage their robot car build across its build, drive, sense and engineer phases, accounting for risks such as component delays or hardware failures.	• Data, Information and Privacy
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 a reliable autonomous robot, specifying functional requirements (must detect and avoid obstacles) and non-functional requirements (such as reliability and response time), and gather feedback from classmates on the obstacle course challenge.	• 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 sensor and timing conditions in their obstacle-avoidance algorithm, represent this using pseudocode, and validate their program by comparing its output against a range of test cases, such as obstacles at different angles and distances.	• Creating Digital Solutions
VC2TDI10C04 – *implement, modify and debug modular programs, applying selected algorithms and data structures, including in an object-oriented programming language*	Students refactor their robot car code into modular functions for driving, sensing and decision-making, applying state-based thinking to manage the robot's behaviour and using constants instead of magic numbers to improve readability — directly reflecting the modular, data-structured approach expected of an object-oriented programming language.	• Creating Digital Solutions

Content Description	Project Application	Strand / Sub-strand
VC2TDI10C05 – *evaluate existing and student-created solutions against the requirements and design criteria, user needs, possible future impact and opportunities for enterprise and innovation*	Students evaluate their robot car against its requirements and design criteria, gather feedback on its performance in the obstacle course challenge, and discuss potential future impact and innovation opportunities, such as extending the robot with additional sensors.	• Creating Digital Solutions

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 robot car is a standalone, offline device with no network connection or data access to secure; VC2TDI10D01 (data compression) and VC2TDI10D02 (representing online documents as content, structure and presentation), since neither applies to this project; VC2TDI10D05 (emerging tools such as AR/VR for interactive content), since the project doesn't create this kind of content; VC2TDI10D07 (Australian Privacy Principles), since no personal data is collected; and VC2TDI10C03 (user interface/experience design), since there's no screen-based interface to prototype.*

EBK ACADEMY

Autonomous Robot Car – Science Curriculum Mapping

In the Autonomous Robot Car project, students build and code an Arduino-powered robot capable of driving around and avoiding obstacles autonomously, combining mechanical assembly, a multi-voltage power system, motor control and ultrasonic sensing. 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: Autonomous Robot Car – 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 obstacle-avoidance trials, such as recording how many times out of ten the robot stops before hitting a box placed at different distances, and use this data to explain why their chosen detection distance does or doesn't work reliably.	• 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 growing understanding of forces and friction was used to solve the problem of getting their robot to turn and stop reliably, in the same way that engineers use knowledge of friction to improve the safety of cars and bicycles on different surfaces.	• 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 on their robot as it drives and turns, including the direct contact force from the spinning wheels pushing against the ground and the friction that helps or hinders movement, and describe how changing motor speed changes the robot's speed and direction.	• 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 robot, such as "Does the robot turn faster if one wheel spins backwards while the other spins forwards?", and use these questions to predict how different combinations of wheel speeds will affect turning.	• 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 robot's obstacle-detection distance, keeping the robot's speed the same while changing only the distance to the obstacle, and follow safe practices when handling the battery and charging equipment.	• 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 tape measure and stopwatch to measure and record how far the robot travels before stopping at different detection thresholds, repeating each measurement several times 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 detection distance used and whether the robot successfully avoided the obstacle, and use this table to identify which distance produces the most reliable result.	• 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 obstacle-avoidance results with a partner group's results for the same threshold distance, discuss whether either test was unfair (for example, due to different battery charge levels or surface types), and pose further questions about what else might affect reliability.	• 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 robot's obstacle-avoidance performance to their class, using scientific vocabulary such as "force" and "motion" and simple diagrams to explain how the wheels turn the robot.	• 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 robot's electrical and mechanical build draws on.*

Levels 5 and 6

Table 2: Autonomous Robot Car – 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 voltage, current and circuit safety to make decisions about how to safely wire their robot's multi-voltage power system, in the same way communities use scientific knowledge of electrical safety when making decisions about power infrastructure.	• 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 robot's power circuit — the battery, charging board, switch, boost converter and motor driver — and explain the specific role each component plays, including how the switch and motor driver control whether electrical energy reaches the motors.	• 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 increasing the motor speed change how accurately the robot can turn a right angle?" and make a reasoned prediction based on their understanding of differential drive.	• 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 obstacle-detection reliability, identifying detection threshold as the variable to change, success rate as the variable to measure, and factors such as battery charge and surface type to keep constant, while identifying electrical safety risks associated with the battery and charging circuit.	• 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 and current in different parts of their robot's circuit, 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 circuit diagram of their robot's power and motor-driver system using accepted conventions, showing the direction of electricity flow from the battery to the motors.	• 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 turning-angle data with another group's, identifying possible sources of error such as uneven wheel grip or inconsistent battery charge, and use this comparison to refine their conclusions about which drive settings work 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 robot's power and motor circuits work, using appropriate scientific vocabulary such as "conductor", "insulator" and "circuit", 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.*

Levels 7 and 8

Table 3: Autonomous Robot Car – 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 wheel-and-axle system connecting their N20 gear motors to the robot's wheels as a simple machine, and investigate how the internal gear reduction changes the torque and speed delivered to the wheels compared with the motor's raw output.	• 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 on their robot as it accelerates, decelerates and turns, analysing how unbalanced forces from the two independently driven wheels change the robot's direction, and consider how the robot's mass affects how quickly it speeds up or stops.	• 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 robot, from the chemical energy stored in the 18650 battery to the electrical energy in the circuit to the kinetic energy of the moving robot, and discuss where energy is lost as heat in the motors and motor driver 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 through the TB6612FNG motor driver control the speed and direction of each motor, and investigate how the HC-SR04 ultrasonic sensor is used as a control device to feed distance information back into the robot's decision-making circuit.	• 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 "Increasing the detection distance will reduce collisions but increase unnecessary stopping" 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 obstacle-avoidance reliability, identifying detection threshold as the independent variable, collision rate as the dependent variable, and robot speed and surface type as variables to control, while identifying and managing electrical safety risks.	• 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 stopwatch, to record voltage, current and stopping distance 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 detection threshold against collision rate across multiple trials, and use this representation to identify the 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 turning and stopping data to identify trends, such as whether increasing motor speed consistently increases stopping distance, 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 inconsistent battery charge, wheel slip or manual timing errors, and discuss how	• Science Inquiry – Evaluating

Content Description	Project Application	Strand / Sub-strand
analysed to identify assumptions, possible sources of error, conflicting evidence and unanswered questions	confident they can be in their conclusions about which settings are 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 obstacle-avoidance settings, citing their own testing data and referencing manufacturer specifications for their ultrasonic sensor and motors.	• 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 robot 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 robot; 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 circuit or 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: Autonomous Robot Car – 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 explain how their robot's ultrasonic sensor uses mechanical sound waves to measure distance, relating the time taken for an echo to return to the speed of sound, and use the particle model of electricity to explain how current flows through the circuit when the motor driver switches a motor on.	• 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 robot, analysing how chemical energy from the battery is transformed into electrical energy and then kinetic energy at the wheels, and assess where efficiency is lost, such as heat generated in the motor driver or friction between the wheels and the ground.	• 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 force produced by the motors relates to the robot's mass and acceleration, in the same way engineers apply Newton's laws to analyse how driverless vehicles brake at the right time to avoid a collision.	• 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 robot speed and the minimum safe stopping distance, 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 obstacle-avoidance reliability, identifying and controlling for possible sources of error such as inconsistent battery voltage or wheel slip, and complete a risk assessment for working with electrical components and a moving robot.	• 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	twenty obstacle-course trials) and use a multimeter and digital timer 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 stopping-distance 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 motor efficiency with published specifications for their motors and motor driver, 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 obstacle-avoidance reliability, identifying assumptions such as consistent battery 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 navigation strategy, drawing on their own testing data and citing manufacturer datasheets for their sensor and motor 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 navigation and power system 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 as AC via turbines or DC via photovoltaic cells), since this describes large-scale power generation infrastructure rather than the robot's simple DC battery-and-boost-converter power management, which is already covered at Level 5–6 (VC2S6U09) and Level 7–8 (VC2S8U17); 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 circuit 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.*